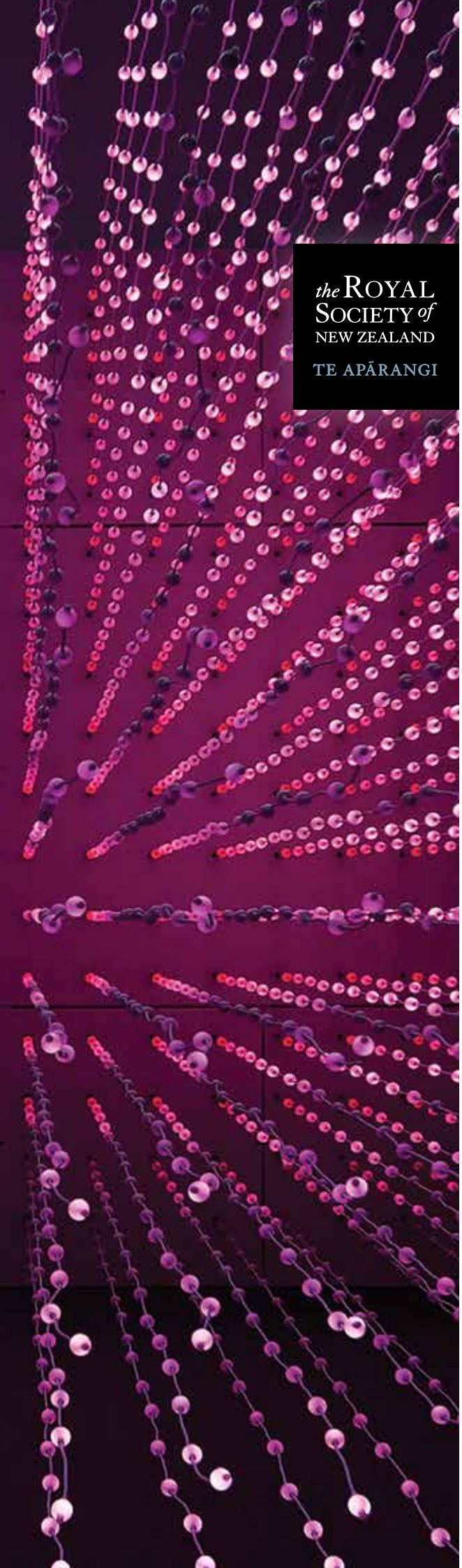
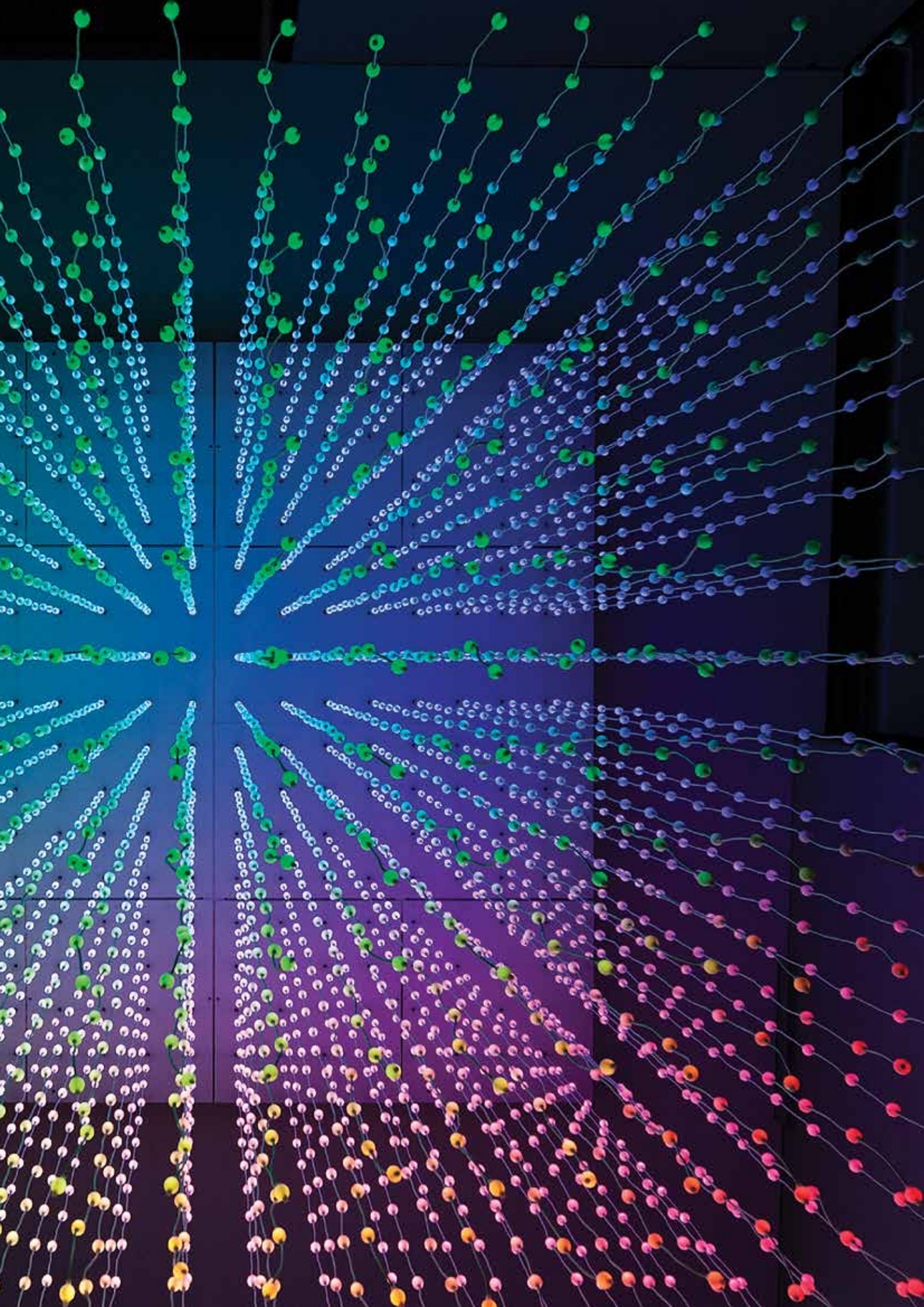


Profiling Excellence

Highlights of 2012



Welcome to Profiling Excellence, which highlights some of the Royal Society of New Zealand's key activities during 2012. We hope you enjoy reading the stories we have chosen to showcase here.

2012 was a year of many achievements and much change. One particular milestone was the completion in August of Te Whare Apārangi – the five-year redevelopment project designed to create a modern office environment for staff and versatile public meeting facilities on our site in Thorndon, Wellington.

During the year we enjoyed strong engagement from our Fellows and wider membership and pursued many initiatives. This publication highlights our involvement in the Transit of Venus Forum, some of our international activities and publication of evidence-based papers aimed at generating informed debate. It also features celebrated researchers, from secondary school students to winners of our prestigious medals.

It has been a privilege to recognise and support emerging and established researchers through contracts including the Marsden Fund, James Cook Research Fellowships and Rutherford Discovery Fellowships.

Thank you to our many supporters and sponsors who continue to make our work possible – Fellows, Companions, Constituent Organisations, Members, sponsors, government and especially our dedicated staff.

Professor Sir David Skegg
KNZM OBE FRSNZ
President

Dr Di McCarthy
ONZM
Chief Executive

Lifting our horizon

The Royal Society of New Zealand was one of the partners in the 2012 Transit of Venus Forum, which took place from 5 to 8 June 2012 in Gisborne and Tolaga Bay.

Hundreds of scientists, iwi representatives, dignitaries and delegates gathered to further the vision of the late Sir Paul Callaghan FRS FRSNZ of making New Zealand "a place where talent wants to live".

Topics discussed included science and prosperity, the emerging Māori economy, using and managing our resources, restoring and enhancing the environment and New Zealand's connection with the rest of the world.

The goals for the forum were to inspire young people to play a role in our future; to provide an opportunity for an evidence-based discussion of New Zealand's current realities; to further links between iwi investors and leaders and the research community; and to consider how our nation, particularly small communities and provincial centres, can develop sustainably.

Viewing the transit

In one of the few sunny areas of New Zealand on 5 June, the Transit of Venus Forum participants viewed the transit in Tolaga Bay with the support and engagement of the local community. Visitors were able to walk along the restored Tolaga Bay Wharf, watched over by HMNZS Rotoiti of the Royal New Zealand Navy.

Where to from here

Following on from the event, the Prime Minister's Chief Science Advisor Sir Peter Gluckman FRS FRSNZ prepared a report, *Science and New Zealand's Future: Reflections from the Transit of Venus Forum,* which highlighted the connectedness, commitment and conversation that the forum had encouraged. The discussions at the forum concluded that New Zealand, like other small countries, will have to strive hard to find its place in the world, and acknowledged the critical role being played by research and innovation. As Sir Peter Gluckman said at the forum: "there is no challenge that we will face over coming decades that does not depend on science".

Image: Participants view the transit of Venus from Tolaga Bay Wharf.

On the airwaves

Arising out of the ideas generated at the forum was **Paradise Regained**, the 2012 Talking Heads series of lectures, produced in partnership with Radio New Zealand.

Sydney Parkinson, artist aboard the Endeavour on James Cook's first voyage to New Zealand, had described the country as "agreeable beyond description, and … might be rendered a kind of second Paradise".

Broadcaster Kim Hill CRSNZ led the series of panel discussions and lectures that discussed ways to realise Sydney Parkinson's vision of New Zealand including conservation, sustainable economic growth and a new enlightenment.

The series can be heard online at: www.royalsociety.org.nz/paradise-regained

The transit as inspiration

The transit of Venus was also the inspiration for the 2012 Manhire Prize for Creative Science Writing, an annual competition organised in association with the International Institute of Modern Letters at Victoria University of Wellington.

"One day in 1769 the future of Aotearoa arrived quite unexpectedly, from the East, and in a form undreamt of." Entrants were asked to reflect on what is on the horizon now.

The winner of the non-fiction section was Dr Renee Liang from Auckland with her entry *Epigenetics: Navigating our Inner Seas,* a personal essay written from her perspective as a new mother.

Brian Langham of Wellington won the fiction section with his story *Fourteen,* in which a father and son go to the Gold Coast during the transit of Venus.

The winning entries and 20 shortlisted entries can be read online at: www.royalsociety.org.nz/2012manhire

A special journal edition

The transit of Venus offered an opportunity for the Journal of the Royal Society of New Zealand to compile a special issue around this theme, guest-edited by the late Sir Paul Callaghan and Dr Rebecca Priestley. The issue presented twelve invited forum articles beginning with a poem from Bill Manhire CNZM FRSNZ. This was followed by articles on a range of subjects including navigation, genealogy, astronomy, New Zealand flora and fauna, human migration and New Zealand history.

In the spotlight

In November the Royal Society of New Zealand presented medals and awards to some of New Zealand's top researchers at the 2012 Research Honours Dinner.

Winning at molecular chess

Distinguished Professor Margaret Brimble CNZM FRSNZ was awarded the Rutherford Medal, New Zealand's top science and technology honour, and $100,000 in award money for her world-leading contributions to the synthesis of bioactive natural products and novel peptides. She is only the second woman to have won the Rutherford Medal in its 21-year history.

Professor Brimble was also awarded the Hector Medal – for excellence in chemistry – and the MacDiarmid Medal – for science of potential human benefit.

Professor Brimble's work encompasses both academic and commercial areas. She is Chair of Organic and Medicinal Chemistry at The University of Auckland and she is also a Principal Investigator in the Maurice Wilkins Centre for Molecular Biodiscovery.

In her academic work, she and her team take complex natural molecules, such as shellfish toxins, and work out how to synthesise them using a mixture of approaches, either mimicking natural synthesis pathways or using modern organic synthesis techniques.

"We have to combine all the approaches together to come up with the best way of tackling the molecule. It's a fast-moving and competitive research area."

She says it may take as little as a month to identify and characterise a new natural molecule, but it can take years to figure out how to make it.

"It's like molecular chess. Sometimes you get really close, but you can't quite complete the synthesis, so you haven't got checkmate. That can often mean going right back to the beginning and coming up with another approach."

Professor Brimble also does commercial work and is Director of Medicinal Chemistry for Neuren Pharmaceuticals.

One recent success story is modifying a naturally occurring peptide found in the brain after traumatic brain injury that helps prevent secondary cell death. She and her team have created 120 similar versions of the natural peptide.

One of these peptides, called NNZ-2566, is more stable and better able to cross the blood-brain barrier than the natural version. The US army has invested US$23 million in this potential drug, which is now undergoing advanced human clinical trials (stage 2b) internationally.

The molecule could be beneficial for a wide range of patients, such as those suffering concussion or head injury from accidents, ballistic head wounds, strokes, and even those who have been exposed to certain toxins.

"When we started working on the project, people said there was no way we could do it with a small team in academia. My PhD supervisor, who was Head of Medicinal Chemistry for Merck's Neuroscience Centre in the UK, was visiting me when we started working on the project and just laughed at the idea that we thought we could create a compound that would make it into clinical trials but we have. It's an amazing story."

Images from left: Hon Steven Joyce presents Rutherford Medal to Distinguished Professor Margaret Brimble; Distinguished Professor Margaret Brimble and Jack Chen in the lab; Professor Russell Gray, Mason Durie Medal winner; Sir Mason Durie presents medal to Professor Russell Gray.

New medal for social science

A new medal for advances in the frontiers of social science, the inaugural Mason Durie Medal, was presented to Professor Russell Gray FRSNZ of the School of Psychology at The University of Auckland.

The new medal honours Professor Sir Mason Durie, who is widely recognised for his research on health outcomes, development of health policy and extensive work with Māori community health providers.

Professor Gray's research interests are diverse but what underlies them is evolutionary theory. He has pioneered the application of evolutionary thinking and methods to the social sciences, applying these methods in a systematic way.

His computational evolutionary methods have helped solve the 200-year-old debate about the origin of Indo-European languages. "We are using the same type of computational methods biologists use to build family trees from DNA to analyse vocabulary and language evolution in European and Asian languages."

The research by Professor Gray and his colleagues supports the controversial hypothesis that Indo-European languages originated in Anatolia, Turkey 8,000 to 9,500 years ago and spread with the expansion of farming.

Professor Gray and colleagues have been using similar methods to study the peopling of the Pacific, revealing that the Pacific was colonised in a series of pulses and pauses starting from Taiwan about 5,200 years ago.

Two further areas of research are New Caledonian crows to study how complex cognitive abilities evolve and looking at changes in marital residence patterns in the Pacific to see if they explain the patterns of genetic data.

2012 Research Honours

The recipient of the **Pou Aronui Award** was Professor Jonathan Mane-Wheoki, Elam School of Fine Arts, The University of Auckland, for his outstanding contribution to the development of the humanities in Aotearoa New Zealand. Professor Mane-Wheoki has exercised insightful leadership in a wide spectrum of academic and public sector organisations, through his commitment to a bi- and multi-cultural concept of the humanities. His life and work demonstrate his deep respect for languages, arts and inherited knowledge as the continuing foundation of societies and cultures.

The **Callaghan Medal** for outstanding contribution to science communication was awarded to Professor Shaun Hendy FRSNZ, Distinguished Scientist at Industrial Research Limited and Deputy Director of the MacDiarmid Institute for Advanced Materials and Nanotechnology. The medal is for his outstanding work in raising public awareness of science and its role in increasing economic prosperity through his column *A Measure of Science* on Sciblogs and his regular broadcasts on Radio New Zealand National. Professor Hendy was elected a Fellow of the Royal Society of New Zealand in November 2012 and is President of the New Zealand Association of Scientists.

The **Sir Charles Hercus Medal** for health sciences was awarded to Professor John Fraser FRSNZ, Dean of the Faculty of Medical and Health Sciences at The University of Auckland, for his pioneering studies on bacterial superantigens which have major implications for understanding and treating human infectious diseases. Professor Fraser is regarded as the world's foremost authority on superantigens and superantigen-like toxins and continues to make significant contributions to the field.

Other medallists

- Pickering Medal to recognise excellence and innovation in the practical application of technology: Professor David Williams FRSNZ, The University of Auckland.
- Thomson Medal for outstanding and inspirational leadership in the management of science: Professor Richard Furneaux FRSNZ, Industrial Research Limited.
- Humanities Aronui Medal for research or innovative work of outstanding merit in the humanities: Professor Alan Musgrave FRSNZ, University of Otago.
- Hutton Medal for excellence in earth sciences: Professor Ewan Fordyce, University of Otago.
- Cooper Medal for the best single account of original research in physics or engineering: Dr Mark Poletti, Industrial Research Limited.
- Jones Medal for lifetime achievements in mathematical sciences: Professor Rob Goldblatt FRSNZ, Victoria University of Wellington.
- Dame Joan Metge Medal for excellence and building relationships in the social science research community: Professor Linda Tuhiwai Smith, University of Waikato and Professor Janet Holmes FRSNZ, Victoria University of Wellington.

Images from left: Emeritus Professor Michael Corballis with Professor Jonathan Mane-Wheoki, Pou Aronui Award winner; Distinguished Professor Richard Faull with Professor Shaun Hendy, Callaghan Medal winner; Sir David Skegg with Professor John Fraser, Sir Charles Hercus Medal winner; 2012 James Cook Research Fellows: Professor John Montgomery; Professor Colin Wilson; Professor Lisa Matisoo-Smith; Professor Robert McLachlan.

Top research fellows

The prestigious James Cook Research Fellowships are awarded to researchers who have achieved national and international recognition, and allow them to focus solely on their research for two years.

Evolution of a cerebellum-like neuronal machine

The cerebellum in the brain plays a major role in the sophistication, elegance and athleticism of movement of humans and other vertebrates. **Professor John Montgomery** FRSNZ from The University of Auckland is looking at how the cerebellum evolved from similar structures found in the hind brain of primitive vertebrate groups, including sharks. Having found the function and mode-of-action of one of these structures, he can now explore the developmental mechanisms underlying the cerebellum's evolution. This will give insights into cerebellar function and provide a potential candidate for technologies that can be applied in robotics.

The life of supervolcanoes

Professor Colin Wilson FRSNZ from Victoria University of Wellington will study how Earth's largest supervolcanoes operate. Professor Wilson's studies will merge fieldwork-based information on the styles, dynamics and timing of huge explosive eruptions with innovative analytical studies of the eruption products and their enclosed minerals. The goal is to understand where and how rapidly molten rock is gathered together below a volcano, then to measure what processes operate during the eruptions, on timescales from many thousands of years down to within minutes of the molten rock being ejected.

The longest journey – from Africa to Aotearoa

University of Otago's **Professor Lisa Matisoo-Smith** is looking into the origins of New Zealanders. Genetic studies indicate that we can all ultimately trace our origins to Africa. About 65,000 years ago modern humans started expanding across the globe. The final landmass settled by humans was Aotearoa New Zealand, just 750 years ago. While Māori were the first to arrive, they were joined by later migrants, primarily from Europe, Asia and the Pacific Islands. A genetic study of the population of New Zealand today will map the many pathways our ancestors took to bring each of us here.

Geometric methods for the simulation of complex systems

Geometric integration is a novel approach to simulate complex systems, such as ice ages, the structure of large molecules, quantum mechanics, nanotechnology and weather forecasting. These systems all have underlying geometric structures that influence the phenomena they generate. When these properties are built into computational methods, the methods become faster, more reliable, and often simpler than traditional approaches. **Professor Robert McLachlan** FRSNZ from Massey University will explore these geometric structures and study the design and performance of such novel computational methods.

Leading-edge research

The Royal Society of New Zealand administers the Marsden Fund, New Zealand's fundamental research fund covering the physical and life sciences, mathematics, engineering, social sciences and humanities.

Evolutionary benefits of sex in difficult places

Scientists from The University of Auckland have provided the first experimental explanation of how sexual reproduction helps species adapt in challenging real-world environments, solving a classic conundrum in evolutionary biology.

"According to classic evolutionary theory, sexual reproduction should actually retard species' ability to adapt to complex environments and in the long run prevent the evolution of new species," explains lead researcher Dr Mat Goddard. "But in the real world, sex is a highly successful strategy that doesn't prevent new species from evolving, so what we see in nature doesn't tally with the theory."

As organisms adapt to environmental challenges they accumulate genetic changes that help them survive. Since sexual reproduction produces offspring with a mix of genes from both parents, in theory, sex between organisms adapting to different environments should be detrimental because helpful genes are diluted.

To test the theory, the researchers developed special yeast that could be switched from asexual to sexual forms. Two groups of yeast grown in different environments were allowed to sexually reproduce, to see whether this slowed the species' simultaneous adaptation to both environments as predicted by the theory.

In fact, sexual reproduction proved advantageous, allowing more rapid adaptation to both environments, even when there was interbreeding between the two groups. The results were consistent with a little-known alternative theory, which states that genes that confer a benefit in one environment are not necessarily detrimental in another and would therefore not disadvantage the offspring of mixed parents.

Criminal minds – the science behind the science

Forensic expertise has made for great entertainment for decades. From the Sherlock Holmes novels to modern television series such as *CSI* or *Criminal Minds*, the idea that reason, logic and the tools of science could bring criminals to justice has been a staple of our popular culture. But what about expertise about the mind? Is forensic psychology as reliable as fingerprinting? How does forensic psychology sit within our justice system, and what is the story of how it got the status it currently has?

Dr Heather Wolffram, from the University of Canterbury, has been awarded a Marsden Fast-Start grant to write the first part of that history, an investigation into how forensic psychology became part of the justice system. Specifically the project asks: how, why and where did forensic psychology emerge as a new field during the late nineteenth and early twentieth centuries? And what impact did forensic psychology have on approaches to crime, criminality and jurisprudence in the period 1850 to 1950?

The goal of the project is a substantially more accurate and nuanced account of the development of forensic psychology than those written by people working in the field at the time. The project will provide a more comprehensive understanding of late nineteenth and early twentieth century conceptions of crime and criminality, and an in-depth exploration of late nineteenth-century research into memory and witness suggestibility.

This project will contribute to a broader and deeper understanding of how the cognitive sciences play a role in deciding questions of legal responsibility and credibility.

Can bees help postoperative recovery?

Following general anaesthesia, people are often confused about the time of day and they experience sleep disruption and fatigue – symptoms similar to those following global travel.

Dr Guy Warman and his team at The University of Auckland, with the support of a Marsden grant, are learning from honeybees about recovering from the effects of general anaesthesia. This work has been published in the highly prestigious journal *Proceedings of the National Academy of Sciences.*

Honeybees show a 'time sense' based on their ability to continuously consult their inbuilt circadian clock, much as we might consult a wristwatch. They use this time sense in many daily activities, for example navigating using the sun as a compass and knowing when to visit flowers at times of maximum nectar production. Usefully, the genetic structure and function of the circadian clockwork of honeybees is remarkably similar to that of mammals – their clocks work in the same ways as ours, making them an excellent model for the effect of anaesthesia on humans.

Tackling the problem of anaesthesia-induced jetlag may significantly speed up the postoperative recovery of a patient. Dr Warman's research suggests two possible avenues for human trials – performing operations at night where the anaesthesia does not impact on the circadian clock, and using light therapy to reset patients' circadian rhythms. The first option is unlikely to receive much favour from doctors and surgeons, but Dr Warman and his team are starting to explore the use of light concurrently with anaesthesia to reduce the jetlag effect in clinical trials.

Image: Honeybees, *photo: Dr James Cheeseman and Ian MacDonald.*

Supporting early-career researchers

We support many postgraduate and postdoctoral researchers, enabling them to further their research careers overseas or return to New Zealand.

Rutherford Foundation Trust

The Royal Society of New Zealand Rutherford Foundation Trust aims to build human capability in science and technology by providing career support for New Zealand's brightest and most promising researchers. This year the Trust has awarded scholarships to nine outstanding emerging researchers, including four international PhD scholarships and five postdoctoral fellowships.

Heart failure and diabetes

One of this year's Rutherford Foundation Trust postdoctoral fellows is Dr Kimberley Mellor. She will return to Auckland from the University of Melbourne to investigate cardiac dysfunction in diabetes.

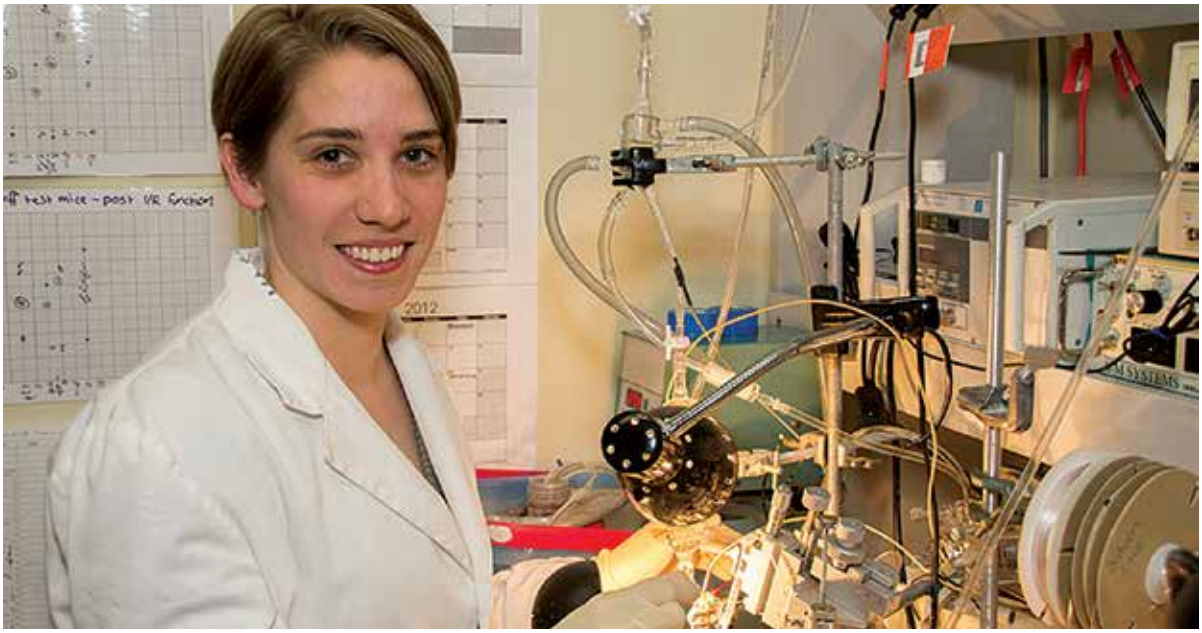
Diabetes is a global epidemic with high mortality and is linked to heart failure. Despite over a decade of investigation, the ultimate cause of cardiac dysfunction in diabetic patients remains elusive.

Dr Mellor proposes that diabetic heart failure reflects a progressive decline in heart pump efficiency due to irreversible modification of the proteins involved in contraction, and an accumulation of large glycogen stores in the heart muscle cells.

At the Auckland Bioengineering Institute she will be able to directly assess efficiency of the heart muscle and investigate the underlying causes of mechanical inefficiency in the diabetic heart. This may lead to new therapeutic approaches.

"It was very exciting to hear that I had been offered the award. The Rutherford Foundation Postdoctoral Fellowship will enable me to return to New Zealand and develop an independent research career in my home country.

"I am very thankful for the opportunities and great mentoring that I have received in my career to date which has enabled me to be competitive for this award."



Rutherford Discovery Fellowships

Rutherford Discovery Fellowships support the development of future research leaders in New Zealand by providing up to $160,000 a year for five years. This year's successful recipients work in a diverse range of research fields, including the genetic basis for autism, researching ancient DNA, the search for Earth-like planets, nanotechnology, ecology and regenerative medicine.

Fixing the body's joints

One of the 2012 recipients of a Rutherford Discovery Fellowship is Dr Timothy Woodfield from the Department of Orthopaedics at the University of Otago, Christchurch.

Dr Woodfield is an expert in biomaterials, tissue engineering and regenerative medicine. He leads a multidisciplinary research group of engineers, biologists and clinicians working at the interface of cell-biology, biomaterials science and orthopaedic surgery.

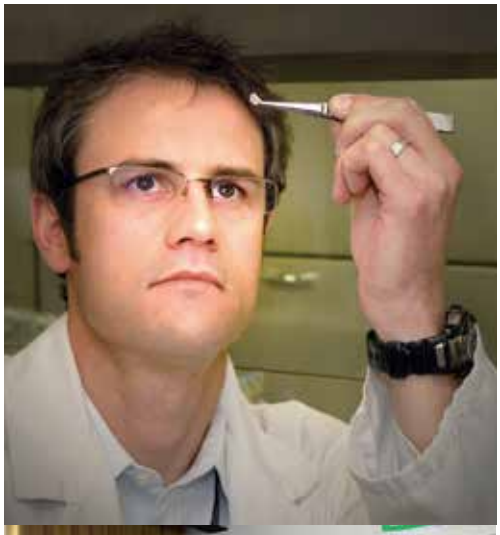
With global population ageing, clinicians are facing an epidemic in degenerative joint diseases, such as osteoarthritis. Total joint replacement with permanent prostheses is often the only option to treat advanced joint disease, yet these are susceptible to long-term wear and loosening. This results in pain and loss of mobility for the patient and costly surgery to replace worn-out implants.

Regenerative medicine is a rapidly advancing field that combines principles of engineering, biology and medicine and aims to repair or regenerate damaged or diseased tissues that fail to heal spontaneously.

The proposed research programme focuses on developing innovative biofabrication platforms integrated with new cell-based treatment concepts to regenerate damaged bone and cartilage tissue. Using these regenerative medicine strategies, this research has the potential to deliver alternative solutions to the previously intractable problems of joint disease.

Rutherford Discovery Fellows' workshop

In November 2012 the Royal Society of New Zealand held the second annual workshop for the Rutherford Discovery Fellows. This event was attended by the Minister of Science and Innovation, Hon Steven Joyce, and several research themes and collaborations have resulted from bringing this group of researchers together.



Images from left: Dr Kimberly Mellor, Rutherford Foundation Fellow; Dr Timothy Woodfield, Rutherford Discovery Fellow; Rutherford Discovery Fellows' workshop attendees (next three photographs): Dr Geoff Willmott, Dr Justin Hodgkiss, Dr Nicholas Shears; Dr Donna Rose Addis, Professor Jennifer Hay, Dr Clemency Montelle; Associate Professor John Reynolds, Dr Ashton Bradley.

Connected worldwide

Sharing ideas and collaborating internationally is important for New Zealand. The Royal Society of New Zealand runs many programmes fostering international connections and exchanges.

Collaborating on river health

Both New Zealand and France experience river algal blooms. The Dumont d'Urville International Travel Grant Programme, which facilitates collaborations between New Zealand and French researchers, is enabling Dr Susie Wood (Cawthron Institute) and Dr Jean Francois Humbert (Institut National de la Recherche Agronomique) to work together on this issue.

Their research focuses on detecting, sampling and managing algal blooms in rivers. The algae responsible for the blooms can produce toxins dangerous to human and animal health. The toxins have caused dog deaths and human poisoning and these are becoming increasingly common in both countries.

Along with other work, the researchers exchanged knowledge on sampling and measurement techniques, and compared conditions which favour blooms in French and New Zealand rivers. These blooms are indicators of the overall health of rivers, so this research and knowledge is important for developing tools for the long-term management of rivers.

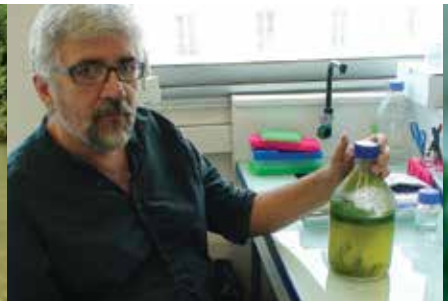
The programme is administered by the Society, the Ministry of Business, Innovation and Employment and the French Embassy, and this year provided funding for collaboration and research visits.

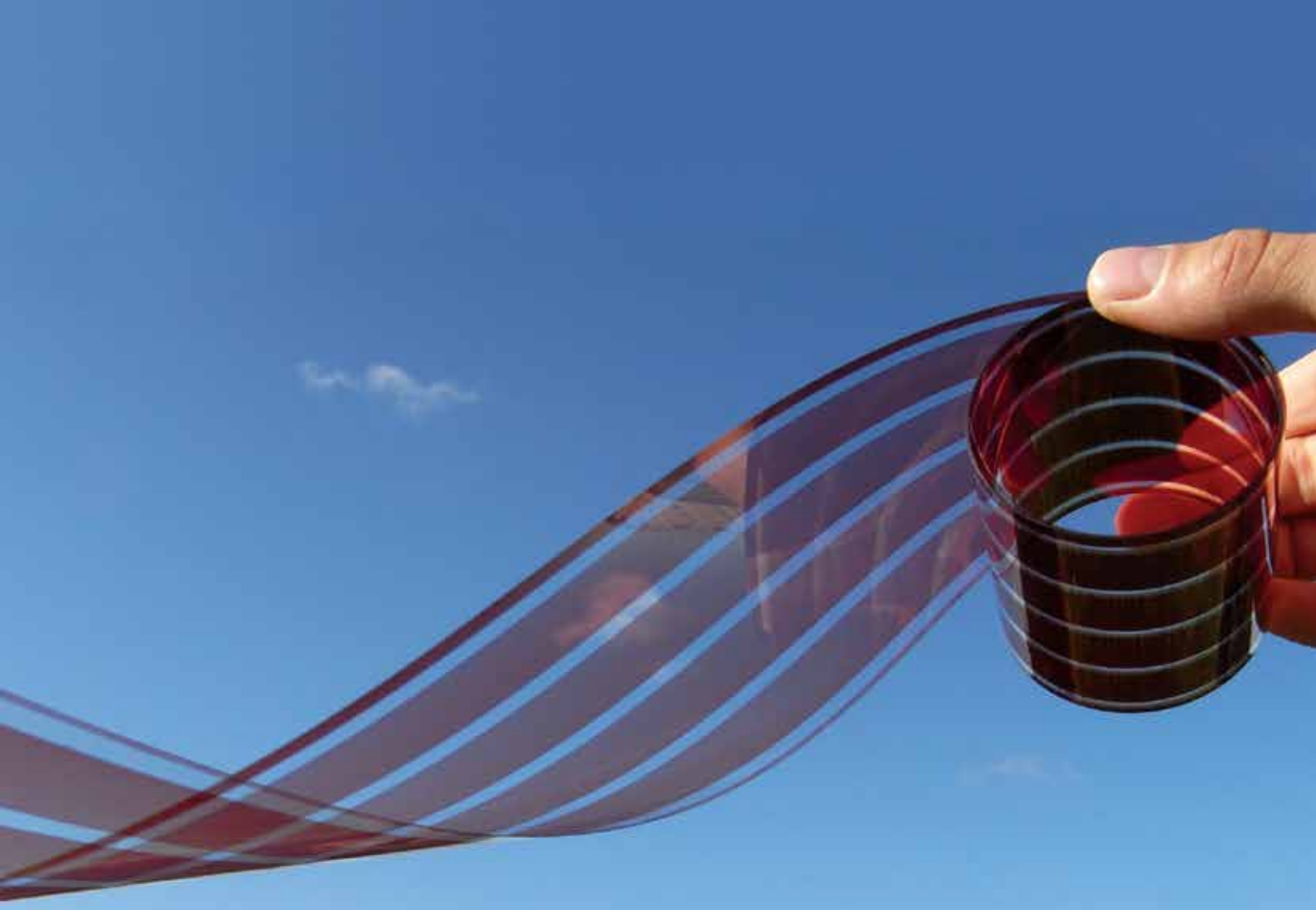
Sharing best practices

Our relationships with international academies in the United Kingdom were enhanced during visits by Sir David Skegg (President) and Dr Di McCarthy (Chief Executive) to the Royal Society (London), Royal Society of Edinburgh and the Royal Irish Academy during 2012. At each of these academies, a common set of interests and issues emerged and discussions covered a range of subjects including: the size, composition and demography of the fellowship; academy and secretariat structures; the need to engage with younger researchers; public and political engagement; processes for providing expert advice; funding and independence; profile and relevance; and codes of ethics.

While in London, they co-hosted a function for Honorary Fellows of the Royal Society of New Zealand, other UK-based New Zealand academics and UK colleagues and officials with the New Zealand High Commissioner at New Zealand House to promote the importance and value of UK-New Zealand research relations.

En route back to New Zealand, Sir David Skegg met with the President of the Singapore National Academy of Science, the first such engagement between the Society and the Singapore academy.





Paper 2.0 – making smart paper from plastic molecules

Imagine watching videos on a paper-thin screen which can be rolled up and put in your pocket or projecting documents from a smart phone onto a flexible screen for easy reading. What if you could cover a whole wall in your lounge with a 'wallpaper' screen, powered by the light coming through the window?

Sir Richard Friend FRS from Cambridge University has pioneered the field of developing organic polymers with electronic properties, utilised in digital displays and solar cells.

He gave a lecture tour in New Zealand in October as the 2012 Royal Society of New Zealand Distinguished Speaker, explaining the unplanned discoveries and breakthroughs that have led to the development of this extraordinary technology and arguing the need for basic research.

He also talked about the commercialisation of his team's ideas as part of the high-technology cluster which has built up around Cambridge University, where he is the Cavendish Professor of Physics, a position originally occupied by Ernest Lord Rutherford.

Images from left: Evaluating the Loue River, France: Dr Jean-Francois Humbert, Mark Heath, Dr Catherine Quiblier; Dr Jean-Francios Humbert with a flask containing cyanobacteria; Sir Richard Friend, 2012 Royal Society of New Zealand Distinguished Speaker; Printed plastic solar film.

Outstanding secondary school science

Nurturing curiosity and creativity in young people and encouraging them to continue their studies in science and technology is a key role of the Royal Society of New Zealand.

Science road trip

Twenty of New Zealand's top secondary school science students were selected to take part in the annual Genesis Energy Realise the Dream programme, during which they travelled south from Auckland to Wellington.

Along the way they were hosted by science and technology organisations in the North Island, including Leigh Marine Centre, the Liggins Institute, DairyNZ, Massey University (Wellington), Genesis Energy and NIWA.

The students were selected for their excellent science and technology projects that covered a range of topics, including a robotic window cleaner, shortsightedness, cyber bullying, an online school enrolment system, mastitis, a Rubik's Cube solver, tracking elusive geckos, bee genetics and Varroa mite, and probiotics.

The purpose of the programme was to excite these young scientists about the opportunities a career in science in New Zealand could offer and to reward them for their excellent projects.

The week concluded with an award ceremony hosted by the Governor General at Government House where a number of travel awards and scholarships for the participants were announced.

2,000 cows, 8,000 teats, 32,000 tests

Nicolette Adamson, from Morrinsville College, earned a Gold CREST award for her exhaustive study looking at the progression of teat damage to infection in dairy cows.

The aim of Nicolette's study was to investigate the relationship between skin thickening around the teat – called teat-end hyperkeratosis (TEH) – and infection, a condition called mastitis, which is estimated to cost New Zealand dairy farmers $180 million dollars a year. She also investigated the bacteria involved in teat infections.

Nicolette found that skin thickening was associated with an increased risk of infection in the teat, as has been found overseas; however, she also found that some skin thickening can improve without treatment, something that was not known before.

CREST co-ordinator Jessie McKenzie from the Royal Society of New Zealand says Gold CREST awards are for advanced projects that take six school terms to complete and allow students to develop entrepreneurial, goal-setting and problem-solving skills and perseverance.

"Nicolette has completed an outstanding study that is of great interest not only to the local farmers and vets that she worked with, but also to the wider dairy industry."

Nicolette was selected to take part in the Genesis Energy Realise the Dream programme where she won the DairyNZ Outstanding Award and received a $3,000 cash scholarship, three days sightseeing in Sydney and an Antarctic sightseeing fly-over.

Images from left: Genesis Energy Realise the Dream awards presentation at Government House; Nicolette Adamson, Gold CREST award and DairyNZ Outstanding Award, *photo: Piako Post;* Rt Hon John Key with Hannah Ng, 2012 Prime Minister's Future Scientist Prize and Genesis Energy Realise the Dream Supreme Award; Hannah Ng.

Student discovers that blurry peripheral vision may worsen shortsightedness

Hannah Ng, from St Cuthbert's College, won the Genesis Energy Realise the Dream Supreme Award and the 2012 Prime Minister's Future Scientist Prize for her study on shortsightedness that has provided university researchers with a novel theory that may provide solutions to a global eye problem.

Hannah spent four years researching childhood myopia, or shortsightedness, which is a focusing error of the eye that causes blurry vision.

Myopia affects up to 40 percent of Caucasians and 90 percent of some Asian populations. Hannah's interest in myopia was sparked when many of her peers started to wear glasses after eye checks at school.

Hannah used chick models, making tiny sets of multifocal lenses similar to mini goggles, which were placed over the eye of chicks to investigate different effects on their vision. She discovered that blurring of peripheral vision could increase the rate of shortsightedness. She says that optometrists usually do not take into account peripheral vision when prescribing glasses and the constant blurring induced may exacerbate myopia levels.

"I've learned the joys of being persistent, innovative and open to new ideas and that looking for different ways to solve a problem will help find an answer," says Hannah.

Hannah was a scholarship recipient of the Liggins Institute scientist mentorship programme and also worked alongside researchers, including Principal Investigator John Phillips, at The University of Auckland's Myopia Laboratory.

Dr Phillips says Hannah's research project had the same complexity as those being conducted by university researchers and that it may change the way spectacles and contact lenses are designed to help reduce the rate at which myopia progresses in childhood. Optometry researchers and students will extend Hannah's study.

As the grand winner of Genesis Energy Realise the Dream, Hannah received a $7,000 cash scholarship and an all-expenses paid trip to attend the European Union Young Scientist Competition in Prague in September 2013. As the winner of the 2012 Prime Minister's Future Scientist Prize, Hannah received $50,000.

Evidence-based advice

Using the expertise of our Fellows and Members, we produce information papers on emerging issues where policy will benefit from being informed by research.

A paradigm shift needed in science learning

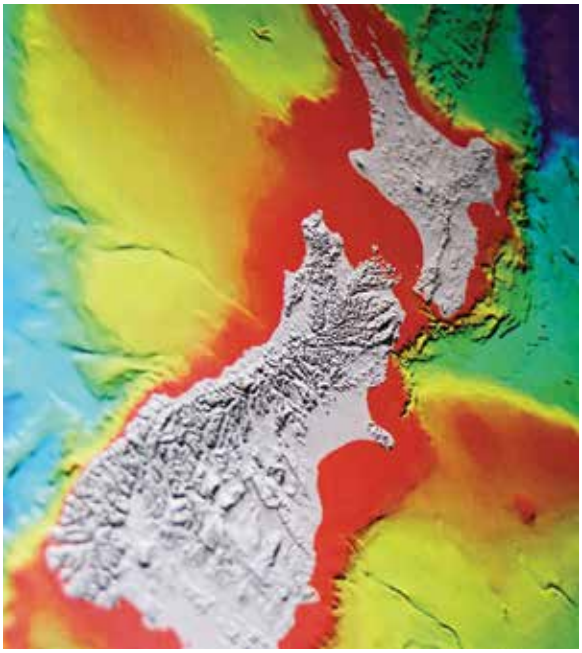
The Royal Society of New Zealand's 2012 paper *The Future of Science Education in New Zealand* suggests that if New Zealand is to develop a smart economy and society, we are going to need a paradigm shift in our approach to science learning. This paper responds to the challenges raised by the Prime Minister's Chief Science Advisor, Professor Sir Peter Gluckman, in his 2011 paper *Looking Ahead: Science Education for the Twenty-first Century.*

The Future of Science Education in New Zealand highlights that a knowledge and innovation-oriented country needs professional scientists, engineers, technologists and mathematicians who can think and work in today's organisations. It is not simply a matter of producing more people who have been 'filled up' with existing knowledge. We need people with a different orientation to knowledge, who can apply the knowledge they have to innovate. An innovation-oriented country also requires an engaged and scientifically literate public and that, too, is a function of science education.

A clear message is that students need to stay in science longer than Year 11, when over half of New Zealand students presently drop science. To achieve this, new programmes need to be developed that develop scientific literacy for such students, while still allowing those who need a pre-professional course to delve into specialist subject areas and build their knowledge by working on complex practical problems. The paper can be read at: www.royalsociety.org.nz/science-education

Reviewing peer review

The Royal Society of New Zealand worked with the Prime Minister's Chief Science Advisor to inform his paper on peer review, publishing an information paper *Evidence from Ten Years of Research Contract Management*, which summarised our evaluations from administering the Marsden Fund, the Rutherford Discovery Fellowships and other research funding. This paper aims to address questions of efficiency and effectiveness in funding decisions, fairness and bias in a small research community, and the balance between funding specific ideas and supporting the careers of promising researchers. The report can be read at: www.royalsociety.org.nz/evidence



Images: Undersea New Zealand; Breaking wave, *photo: Peter Marriott, NIWA.*

New Zealand – a continent under the sea

Did you know that 96 percent of New Zealand is under water? New Zealand's ocean territory is vast. Its EEZ (Exclusive Economic Zone) stretches across an area twenty times greater than its dry land. Scientific surveying allowed the country to expand its claim further in 2008, giving it rights to additional seabed minerals and resources.

But with this growth has come widespread recognition that there are gaps in the environmental laws that cover this ocean territory.

The growing awareness of New Zealand's vast maritime realm was a driver for expert advice this year, with the Royal Society of New Zealand presenting an Emerging Issues paper on marine resources and making submissions to Parliament on the Exclusive Economic Zone Bill. The paper reviewed the state of knowledge about our resources, covering fisheries, oil and conventional gas, gas hydrates, seabed minerals, and tidal flow and wave energy technologies.

Key themes in this paper were the uncertainty about these resources and the equal uncertainty about the ecosystem services that our oceans provide. The Society's submission to Parliament on the Bill highlighted concerns about the standard of knowledge required to implement the proposed environmental management approaches, the need for long-term baseline data about ecosystems and monitoring that can attribute the cause of observed changes in ecosystems to human activity or natural variation.

Read paper at: www.royalsociety.org.nz/marine

A place for knowledge and excellence

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Lighting installation 'Volume 4,096' by digital arts group Squidsoup and Massey University's College of Creative Arts in foyer of Te Whare Apārangi, Royal Society of New Zealand, *photos: Shaun Waugh.*