# BE PREPARM $\mathbf{T}(\mathbf{)}$ CHANG THE WORLI

Research Report 2010/2011



Produced by Research & Innovation and Communications & External Relations, University of Canterbury

Design by Communications & External Relations, University of Canterbury

CD produced by Amstore

Publication printed by Kalamazoo Wyatt & Wilson

April 2012 ISSN 1176-8193

Cover image: University of Canterbury zoology PhD student Sara Kross.



Through research one is able to venture beyond the horizons into unchartered waters, unidentified fields, unseen domains, and unexplored knowledge/s to piece together the unfamiliar in the creation of new patterns; new ways of knowing; as is suggested in the Māori word for research, "rangahau". It is through research that we can tap into our potentials and ascend to new heights; like "te piki kōtuku" (the ascending heron).

**The bird that partakes of the miro berry reigns in the forest.** The bird that partakes of the power of knowledge has access to the world.

**Nōna te Ao**. Mixed media (ink, watercolour) by Mere Skerrett, Waitaha, Kāti Mamoe, Ngāi Tahu, Ngāti Pikiao and Ngāti Mahuta (Senior Lecturer, School of Māori, Social and Cultural Studies in Education).



#### Sara Kross, zoology PhD student

The New York-born student studied for her master's degree at St Andrews in Scotland after completing her undergraduate degree at Cornell University. When she arrived in Blenheim, New Zealand, she was intrigued by Falcons for Grapes, a Marlborough-based programme which translocates falcon chicks from their nests in the mountains into the vineyard dominated valleys and is aimed at helping to increase falcon numbers while also providing a sustainable answer to pest birds. Supported by funding from the University of Canterbury, Pernod Ricard, Canon New Zealand and the Brian Mason Scientific and Technical Trust, Kross' research looks at whether the falcon conservation project is working. She uses carefully developed remote videography - or nest cameras - in the nests of wild and vineyard falcons to compare a variety of factors including feeding rates, prey species, parental attentiveness, parental behaviour, chick behaviour and predation.

#### Research & Innovation Connecting UC's research with the world

Research & Innovation is the first point of contact for external organisations who are interested in: discussions on how UC resources might help your organisation; assistance in accessing UC expertise and facilities, including the areas of science, engineering, education, business and economics, arts, and law; consulting services and contract research; opportunities to use or commercialise UC's intellectual property; assistance in identifying business or investment opportunities. R&I includes NZi3, the national ICT Innovation Institute. NZi3 is an entrepreneurially focused, applied research institute for strategic ICT research.

Phone: +64 3 3642688 Email: enquiries@research.canterbury.ac.nz www.research.canterbury.ac.nz www.nzi3.com

#### UC SPARK A showcase of UC research

UC SPARK (system for people and research knowledge) is a searchable website which showcases UC's research. You can search SPARK for information about individual researchers, the projects they are working on, the research groups they belong to, the specialist equipment that they use, and their affiliations. SPARK provides a comprehensive view of research at UC.

www.canterbury.ac.nz/spark



# Contents

- 4 Research 2010 & 2011
- 6 At the cutting edge
- 8 Law and disasters trying to do it better
- 10 Quakes trigger a wave of research
- 12 Dutton honoured as outstanding scholar
- 13 A healthy approach to education
- 14 Fellowships open a world of discoveries
- 16 Ruffling feathers
- 18 Searching for the sources of seismicity
- 20 Living in the red zone
- 22 Delving into the nuances of social media
- 24 The burka ban
- 25 Stress taking toll on frontline workers
- 26 Antarctic lake opens window on early life on Earth
- 28 Understanding the youth of today
- 30 Putting real-life economic theories to the test

- 32 Molecular mysteries unravelled
- 33 Building on UC's research strengths
- 34 Preserving earthquake memories
- 36 Cancer epidemiology enhances health sciences
- 38 Court cases to sing about
- 40 Quantifying liquefaction
- 42 Making the boardroom green
- 43 Revolutionising medical imaging
- 44 Challenging the traditional concept of learning
- 46 A smart approach to water management
- 48 Power computing
- 50 Schools can benefit from better parental involvement
- 51 New software renders city in pre-quake glory
- 52 Treasures brought to light
- 54 Unpicking communication
- 56 Bioimprints provide valuable research platform

- 58 Chemical linked to development disorders
- 60 Celebrating innovation
- 62 Modern technology built upon ancient knowledge
- 64 Understanding human-animal relationships in a disaster
- 66 Helping late talkers
- 68 Facilitating Māori research
- 70 Proteins promote partnerships
- 72 College of Arts
- 73 College of Business and Economics
- 74 College of Education
- 75 College of Engineering
- 76 College of Science
- 77 School of Law
- 78 Research Institutes and Centres
- 80 UC Statement of Strategic Intent
- 81 Research Outputs 2010/2011 CD



# Research 2010 & 2011

This report provides an overview of the wide range of research activities undertaken by staff and postgraduate students at the University of Canterbury in our five Colleges (Arts, Business and Economics, Education, Engineering and Science) and the School of Law. It is a celebration of human inquisitiveness and curiosity — the willingness to ask and be asked questions, often very hard ones, and the determination to answer them. Research and scholarship is the core business of the University of Canterbury and links strongly to our other core business, teaching and learning in a research-informed context. Research at the University of Canterbury ranges from what may be described as pure, fundamental or "blue skies" to that which is termed applied because it fulfils an identified need within our society or is a response to specific "end-user" requirements.

A dilemma for research-led universities, such as ours, and governments, which are their prime funders, is around the correct balance between pure and applied research. Unsurprisingly, the New Zealand Government is calling for an increased emphasis on research of direct economic value to the country. Elsewhere in this report I have outlined the University of Canterbury's positive responses to that call and its increasingly direct relevance to the economic prosperity of the region and the nation as a whole. However, universities take a longer term and broader view of what is, or may become, relevant or useful to society. It is hard to predict the future. We do therefore undertake much research which can be labelled pure or fundamental because that is a measure of a research-led university of international calibre. It's a question of balance and researchers themselves hold differing views on what that balance should be. Whatever your view, I hope you enjoy reading this sample of the research, both pure and applied, done at the University of Canterbury.

The current report on the University of Canterbury's research activities covers two years – 2010 and 2011. Normal practice is annual reporting but the earthquake of 22 February 2011 and ongoing seismic activity redefined many of our priorities and thus prevented completion of the report on our 2010 year. The bonus is this bumper issue!

It is very pleasing to report that total research funding from all external sources reached a record \$55.4 million, up from \$49.8 million in the

The total number of quality assured research outputs was 4071 in 2010, the first year this figure has surpassed 4000. There is no doubt that the imperatives of the Performance-Based Research Fund system are at least partly responsible for this increase. However, total research outputs in 2011 were lower at 3534 (but still exceeded the 3150 total of 2009). The tectonic events that began in September 2010 have had an impact on research activities at the University of Canterbury as teaching-related activities became our overwhelming priority in our recovery response. Most staff were displaced from their offices, laboratories and work spaces, and their research materials and facilities for significant periods of time. Some lost research results and equipment. Many staff have experienced severe impacts in their personal circumstances and for many this is a continuing factor in their lives.

Research postgraduate students, those pursuing masters thesis work and PhDs, represent the

research engine of the University. These students were adversely impacted by the earthquakes in much the same way as their academic supervisors and, for some, the completion of their research and submission and examination of their theses were delayed. In 2010, the numbers of completed PhD and masters theses were 110 and 207 respectively. In 2011, these figures were 106 and 197.

Despite the negative impact of the earthquake activity on research at the University, a positive effect has emerged. The earthquake and postearthquake circumstances of Christchurch and its community have generated a significant quantum of new research activity amongst our staff and postgraduate students. To date (March 2012) more than 170 new earthquake-related research projects have been initiated. Some, particularly those related to the immediate response phase, have already been completed. These research projects and programmes span all disciplines across the University. Many of these projects are in direct response to the needs of the Canterbury community and at the behest of those organisations responsible for managing the recovery of the region. Several are outlined in this report.

Each year we recognise excellence in research by the award of the University of Canterbury Research Medal. In 2010 the recipient was Professor of Philosophy Denis Dutton, an intellectual leader of world renown who founded the influential Arts and Letters Daily website

and whose challenging and controversial book The Art Instinct was published in 2009. Sadly, Dutton died in late 2010 shortly after receiving the University medal. The 2011 recipient of the Research Medal was Professor Douglas Bridges of our Department of Mathematics and Statistics. Bridges has published copiously within mathematics and is recognised as a world leader in the branch known as constructive mathematics.

Our leading researchers and their achievements continue to be recognised at the national level. In 2010, Fellowship of the Royal Society of New Zealand, our national academy, was conferred on Professor Geoff Chase of the Department of Mechanical Engineering. In 2011, Professor Richard Blaikie of the Department of Electrical and Computer Engineering and Professor Jack Copeland of the School of Humanities were awarded fellowships. In addition, a prestigious James Cook Research Fellowship was awarded in 2011 to Professor Rick Millane of the Department of Electrical and Computer Engineering.

I congratulate our researchers for their endeavours over the last two years. Theirs is a remarkable success story given the challenges that the region has endured, and ample verification that they are prepared to change the world as the world itself changes around them.

**Steve Weaver** Assistant Vice-Chancellor. Research



Steve Weaver

# At the cutting edge

Hooked on mathematics since reading a book on elementary calculus as a schoolboy in Edinburgh, University of Canterbury mathematician Professor Douglas Bridges' enthusiasm for his subject has seen him become one of the leading authorities in his field.

Bridges, who has held the title of Professor of Pure Mathematics at the University since 1999, is recognised worldwide for his work in constructive mathematics, in which the focus is on finding algorithms for constructing mathematical objects.

"In standard mathematics a typical proof of the existence of an object goes like this: assume the object does not exist, derive a contradiction, and conclude that the object exists after all. The trouble with this type of proof is that it doesn't give any clue about finding the object. In contrast, an existence proof in constructive mathematics must provide the information that enables the mathematician to find - or, usually, to compute/construct the object in question. Thus every constructive proof embodies an algorithm that could be implemented on a computer. Moreover, the existence proof also shows that the algorithm is correct - in computing parlance, 'meets its specifications'."

Although he has a particular interest in constructive functional analysis, Bridges says he does not work in any individual branch of mathematics, tending instead to look at constructivity over a wide range of areas. These have included algebra; apartness and uniform spaces; topology and analysis in metric, normed and locally convex spaces; constructive methods in the foundation of physics and economic theory; and mathematical logic. He is currently working in a relatively new area of mathematics, constructive reverse mathematics, one aspect of which involves finding the principles that are necessary and sufficient for constructive proofs of individual results.

The work he is most proud of, however, has been the development of the axiomatic theory of apartness spaces, which he started working on in 2000 with former University of Canterbury mathematician Dr Luminiţa Simona Vîţă. This theory, which has subsequently been investigated by mathematicians in Japan, Sweden, Germany and the United States, resulted in his latest book, *Apartness and Uniformity: A Constructive Development* (Springer, 2011), written with Vîţă. It is the first book to deal with the apartness approach to the mathematical discipline of constructive topology.

"This theory is absolutely our baby and I think it is the most significant thing I've done in the last 10 years," says Bridges.

"We're particularly proud of the whole thing because the theory was initiated and developed by us, rather than being based on someone else's work. What we developed is an approach to topology that provides a fairly general framework for large parts of mathematical activity. It is based on five axioms that encapsulate the notion of objects being apart, and it encompasses both point-set topology and the theory of uniform spaces."

Apartness and Uniformity is the latest in a prolific output of published work. Bridges has written more than 170 research papers as well as eight books. Two of these monographs — *Constructive Analysis* (1985, with Errett Bishop), and Varieties of Constructive Mathematics (1987, with Fred Richman) — are regarded as indispensable references for those working in the field of constructive analysis. A third, *Techniques of Constructive Analysis* (Springer, 2006), written with Vîţă, is the only book to highlight the developments in constructive analysis over the preceding 20 years.

Bridges' work has seen him dubbed the successor to American mathematician Errett Bishop, the father of constructive analysis. It was Bishop's 1967 book, *Foundations of Constructive Analysis*, which got Bridges into constructive mathematics when he was a graduate student at the University of Newcastle-upon-Tyne.

"I was studying operator algebra theory when I came across Bishop's book, and when I read it, I was gripped by it. I've been interested in constructive mathematics ever since — but I wouldn't call myself Bishop's successor, more an acolyte who, together with others in various countries, has been keeping Bishop's ideas alive."

A graduate of Edinburgh, Newcastle and Oxford universities in the United Kingdom, Bridges has received numerous accolades both nationally and internationally. He was appointed a Fellow of the Royal Society of New Zealand in 2000 and, four years later, was elected a Corresponding Fellow of the Royal Society of Edinburgh, one of only 61 such fellows worldwide. In 2006 an international conference was held in Bavaria in his honour and further tribute was paid through a special edition of the Journal of Universal Computer Science. However, perhaps the strongest international endorsement of Bridges' work came in 2000 when he was awarded a higher doctorate, a Doctor of Science, from the University of Oxford.

The latest accolade came in 2011, when he was awarded the University of Canterbury Research Medal during the December graduation ceremonies. The medal is awarded annually and is one of the University's highest honours, recognising academic staff who have made an outstanding contribution to academic and scholarly research.

In support of Bridges' nomination for the medal, one of the referees, fellow mathematician Professor Michael Rathjen from Leeds University in the United Kingdom, said that the medal would be "a very well-deserved tribute to this outstanding mathematician and most eminent authority in the world of constructive mathematics".

By Stacey Doornenbal

"This theory is absolutely our baby and I think it is the most significant thing I've done in the last 10 years." "Since we started we realise how wide this thing is and how worldwide the whole disaster recovery industry is. So there are plenty of international leads we can pursue." Law and disasters – trying to do it better

Surveying members of the legal profession who experienced Canterbury's earthquakes is seen by law professors Jeremy Finn and Elizabeth Toomey as just the start of what is an exciting and significant undertaking. They aim to produce a best practice model for earthquake recovery and expect to recommend changes to both legal practice and substantive law based on their findings. "Can we design a better law?" asks Finn. "It's a very big project." With assistance from Professor Lucy Johnston (New Zealand Institute of Language, Brain and Behaviour), Finn and Toomey have put together a detailed online questionnaire that canvasses approximately a thousand lawyers in practice in Canterbury since the earthquakes began in September 2010. They are looking for both the lawyers' own experiences and those of their clients that can be disclosed within the limits of confidentiality.

The survey is to assess the impact of the earthquakes on the New Zealand legal system as part of a wider project that will also consider legal issues raised by floods and other natural disasters, and to suggest legal or professional practice changes which may better address the risks of such consequences. Funding for this stage of the project was received from both the New Zealand Law Foundation and the Centre of Commercial and Corporate Law Incorporated.

Follow-up interviews need to be conducted with businesses and social organisations including judges, trade unions, community lawyers, beneficiaries, Ngai Tahu, the Pacifika community, migrants, budget advisory groups, the Citizens Advice Bureau, the Institute of Value and Grey Power. They hope to capture experiences "as broadly as possible," says Finn, to assess what was and wasn't easily resolved. Looking at an "enormous spectrum across a huge range of areas" enables them to look at a possible change in the law that will have a positive outcome all round.

Their focus is on the experiences of rural, city and suburban lawyers, including those that have moved away, and these lead into the legal stories of the general public. Each story "leads to another," says Toomey. The end result will embrace socio-legal parameters, putting law into the "people context". Toomey's own story even appears on YouTube — captured lecturing students in Advanced Land Law during the February 2011 earthquake.

The researchers hope to broaden their work to other kinds of natural disasters and have applied for a Marsden grant to do so.

"Are we in fact imposing the same allocation of risk of disaster for different disasters, or does each one have its own regime, which no one has looked at before?" asks Finn. "Do the same rules apply for tsunamis, or for volcanic eruptions or whirlwinds?"

This bigger picture project involves looking at many issues to try to get a global understanding, and then picking it apart to come up with harmonious solutions to assess future risk and tailor remedies.

In addition to electronic data the study includes collaboration with a research assistant, seven Canterbury law colleagues and two city-based practitioners. A senior law lecturer from Otago University is also involved, as is a staff member from UC's Department of Accounting and Information Services. Members of the group supervised five summer scholarships in 2011/12 covering aspects of disaster law and experiences, with some of this valuable work to be published. Further interaction is with the University of Canterbury CEISMIC Project which involves building a comprehensive digital archive of video, audio, documents and images relating to the Canterbury earthquakes, including a collection of "Quake Stories" from the public. Toomey sits on the CEISMIC committee. Two PhD students are also starting work soon on earthquake-related projects.

While all the data has not been analysed, anecdotal feedback allows them to suggest the major legal problems are likely to be: CERA and the buy back deals, commercial leases, insurances, employment, lack of IT backup, and family law cases particularly involving one parent wanting to move a child out of Christchurch.

The detail of the work is important.

"Not many people do shipping law," says Finn, "but if the docks in Lyttelton are out that may raise some quite interesting shipping law even though not many lawyers handle the issue."

The bigger issues demonstrate how complex the legal problems are.

"What does 'uninhabitable' in a residential tenancy situation mean?", asks Toomey.

Finn and Toomey are hoping to minimise the consequences of natural disasters with laws allowing more predictable results.

"Moving it on, basically, so someone who is in the same situation in ten years time has got a best practice model from which to work," says Toomey.

Finn says a key point is that "we previously thought of earthquakes as a one-off, not a long-lived event".

Toomey expresses the worth and moral obligation this research has internationally. She has attended comparative conferences recently both at the Law Institute of Victoria in Melbourne and at the Australian Network of Japanese Law Conference in Sydney.

"Since we started we realise how wide this thing is and how worldwide the whole disaster recovery industry is. So there are plenty of international leads we can pursue."

Both professors will visit the USA to learn from the Californian experience of earthquakes and analyse the consequences of Hurricane Katrina. Progress workshops are planned and plenty of interim articles. A book will be published in two years which Finn promises will have "considerable impact".

By Amy McDaid

### Quakes trigger a wave of research

Jessica Petersen took up the role of Canterbury Earthquake Research Facilitator at UC Research & Innovation in July 2011. Since then, she has seen the number of earthquake-related projects at UC increase from an initial 40 to more than 170 and predicts this number will reach 200 before the middle of 2012.

"The UC research response following the earthquakes was profound," says Petersen. "It began with a number of quick-fire rapid response projects commissioned by Government with specific requirements for getting the city back up and running. This comprised comprehensive assessments of damage to existing infrastructure, the performance of materials comprising that infrastructure and changes to the soils, land and waterways resulting from the earthquakes.

"Researchers from both engineering and geological sciences made themselves immediately and unreservedly available in response to the city's needs and local authorities are now basing many of their decisions on that early research. Many important publications, guidelines and revisions to building and design codes have been generated as a result.

"A crucial part of my role has been to connect researchers with end users and vice versa. I have built up strong connections within CERA [Canterbury Earthquake Recovery Authority], Environment Canterbury [ECan], the Christchurch City Council and the councils of Waimakariri and Selwyn districts," says Petersen. "I am point of contact for these authorities if they need research, and can put them in touch with the appropriate UC personnel. Alternatively, I may see an application for our research within one of these groups and will contact them directly to make them aware of the resource. "My previous experience with disaster and recovery through civil defence organisations has made me very aware from a government perspective of the information needs of government agencies. I can also gauge when those needs will arise during response or recovery, and the forms in which the information will be required. Most important is the need to keep everyone informed, on both sides of the equation."

Since the initial thrust of research, a large number of projects have either been established or were redesigned following the earthquakes. This second category applied to projects that had already recorded baseline data before the earthquakes and are now in a position to draw definite conclusions about their effects through direct comparisons.

Two environmental projects are based around recovery dynamics in the Avon-Heathcote Estuary. One project is investigating the effects of sediment upheaval, raw sewerage inputs and changes to sediment geochemistry. Another is determining the effects of the disturbances on the estuarine ecosystem and its intertidal communities.

On and around the Port Hills, there are a number of engineering geology projects underway which concentrate on understanding the rock and cliff collapses that have occurred there. Other geologists are engaged in seismic and tectonic surveys and analyses of the entire region. The engineering departments completed a vast data collection and analyses of earthquake effects on infrastructure including water and waste systems, bridges and other utilities and lifelines. Within buildings they are researching a range of elements including construction materials used and their performance through to structure design, foundations and non-structural elements. Findings from this work will eventually feed into revised building and design codes to minimise the effects of major earthquakes on New Zealanders in the future.

Innovative new construction technologies that have evolved within UC's Department of Civil and Natural Resources Engineering are being put forward as engineering solutions that will allow the construction of large timber buildings from precision pre-fabricated structural elements to incorporate earthquake resilience into the commercial and industrial buildings of the future.

"Because people were so affected by the quakes, researchers within the social sciences are working hard to capture some of these effects within the community — from demographic movements within the red zone to the simple coping mechanisms of different groups," says Petersen.

"Our people are working very closely with CERA around community wellbeing and have helped devise a set of indicators of community health and welfare that will be employed for the next 15 years as the region moves towards full recovery." There is also significant work being done on the impacts of the earthquakes on business and tourism and the challenges that education faces as a result of ongoing disruptions. Staff in the history programme are particularly active in ensuring that the seismic events and their effects on the community are recorded for posterity. A number of projects are devoted to architectural heritage, while others are repositories for people's stories and experiences.

"Funding for the research has come from a number of sources," says Petersen. "Much of the early work was commissioned by CERA, ECan and other authorities. The Natural Hazards Research Platform is funding a range of projects, with funding also coming from academic funds such as the Marsden Fund and some overseas funds if their criteria can be met. UC has also been able to offer six PhD scholarships related to the earthquakes. But there is not one single source of funding, and many of the researchers are undertaking the work with no extra funding."

It is important to Petersen that when she completes her contract in the middle of 2012 that the foundations have been put in place for UC's research in this area to develop and continue to inform and contribute to the future rebuilding of Canterbury.

"These are historic times and the research generated at UC following the Canterbury earthquakes will be an enduring legacy for decades to come."



#### Dutton honoured as outstanding scholar

Internationally renowned philosophy professor Denis Dutton died in December 2010 just two weeks after receiving one of UC's highest recognition — the University's Research Medal.

Deputy Vice-Chancellor Professor Ian Town described Dutton as "an outstanding scholar, popular teacher and generous colleague".

"His research and scholarship was of the highest international standard and he was awarded the University's Research Medal to recognise his enormous contributions to his discipline."

Dutton's prolific and celebrated contributions to the field of the philosophy of art placed him at the forefront of academic excellence. A referee for Dutton's nomination for UC's Research Medal, Professor Steven Pinker of Harvard University, said Dutton was "a true intellectual leader, an astonishingly productive and daring scholar and one of the most influential academics in the world".

Dutton's magnum opus, *The Art Instinct: Beauty, Pleasure and Human Evolution* (Oxford University Press and Bloomsbury Press, 2009), accomplished the rare feat of becoming a hugely respected academic study that also achieved commercial success. Described by Dutton as "a study of art as a product of evolution", the book focused on Darwinian applications in aesthetics. It has so far been translated into five languages and has become a landmark in its field.

As well as developing philosophical theories, Dutton sought to encourage recognition of the work of others. In 1976, while working at the University of Michigan, he founded the journal, *Philosophy and Literature*, as an outlet for new ideas in a developing field. The journal was taken over in 1983 by Johns Hopkins University Press, where it remains one of their flagship journals. It has received the coveted "A" rating in the European Union's international rating of scholarly journals with Dutton continuing as editor for a further thirty-five years.

In October 1998, Dutton created Arts & Letters Daily, a website with carefully selected links to essays, articles and book reviews on an extremely broad range of topics. *The New York Times* described the website as one of the first sites "to exploit the Internet as a vehicle for meaningful intellectual exchange". When the site was barely three months old, the *Guardian/ Observer* named Arts & Letters Daily the best website in the world. The site, now owned by the Chronicle of Higher Education in Washington, receives 3.7 million page views a month.

In 2004, *Time* magazine named Dutton as one of "the most influential media personalities" worldwide for the acclaimed Arts & Letters Daily website, recognising him as one of the first people to recognise the power of the Web to facilitate intellectual discourse.

Born in California in 1944, Dutton received his PhD in philosophy from the University of California Santa Barbara in 1975. He joined the staff at the University of Canterbury in 1984 and was appointed Professor of Philosophy in 2009. Just two weeks prior to his death, Dutton briefly left hospital to receive the 2010 University of "His research and scholarship was of the highest international standard and he was recently awarded the University's Research Medal to recognise his enormous contributions to his discipline."

Canterbury Research Medal at a graduation ceremony in the Christchurch Town Hall.

Dutton took the opportunity to say a few words following the presentation and thanked the University for the opportunities it had afforded him "by the research environment it has so carefully cultivated over the years" and his colleagues for their "rugged, incisive, yet cheerful criticism" of his work.

By Jeanette Colman

#### A healthy approach to education

Creating a healthy, supportive environment within school communities could be the key to addressing barriers to learning and improving educational outcomes.

One strategy that is being mooted internationally as a way to achieve this goal is the Health Promoting Schools (HPS) approach and two UC College of Education researchers have been investigating the use of this method in New Zealand's schools.

Penni Cushman and Tracy Clelland (Sciences and Physical Education) said HPS is internationally recognised for its effectiveness in addressing a range of health issues that adversely impact on student learning. These issues range from mental health and food-related concerns to hygiene, physical fitness levels and sleep deprivation.

"Healthy students are more likely to be engaged in the school environment, which means they learn better," Cushman said.

"By creating a learning environment that promotes physical, mental, social and spiritual wellbeing schools will be contributing to the development of healthy, well-rounded people, giving them skills they will carry with them for life."

HPS is an international movement that emerged in the 1990s and is based on the principles of the Ottawa Charter for Health Promotion, an international agreement signed at the First International Conference on Health Promotion organised by the World Health Organisation in 1986. The aim of HPS is to address barriers to learning by promoting the creation of positive and supportive school environments that address the physical, mental, social and spiritual needs of students. The strategy hinges on the involvement of all members of the school community — students, teachers, parents, community organisations and health agencies — working together to protect and promote student health and wellbeing.

While not mandatory in New Zealand, Cushman and Clelland said schools have been encouraged to engage in HPS practices. To gauge the current use and knowledge of HPS in New Zealand's schools, the pair recently carried out a nationwide survey of 1000 primary and secondary schools from across urban and rural areas and representing a mixture of deciles. The survey asked schools to identify the health issues they believed influenced learning and explored the strategies schools used to address these issues.

"What we found was that almost every school identified health issues as being barriers to learning," Clelland said.

"The top health concerns were to do with food issues, where schools identified poor nutritional choices and a lack of food as of concern. Mental health issues such as stress, anxiety, depression, and emotional issues around self worth, bullying and stereotyping were also at the top as well as lack of sleep, physical activity and low fitness."

The researchers said while a lot of the schools surveyed had put in place one or two initiatives

from the HPS framework to tackle these issues, few were using the three components of the integrated approach.

"Which means their programmes are not going to be as effective as they could be," Cushman said.

"For example, if a school is teaching health education but the school canteen isn't providing healthy food options and parents don't know what the healthy options are then the health education programme has little chance of being successful."

Cushman and Clelland said the survey also revealed a general lack of understanding of the HPS approach among educators.

"There is not a lot of professional development at a national level to help schools get on board but our research shows that there is a definite need for it," Clelland said.

The survey findings had so far resulted in the publication of four papers, as well as conference presentations in New Zealand and overseas. Cushman and Clelland said the survey had also opened up a lot of other research areas they were keen to investigate.

The New Zealand Ministry of Health is in the process of developing a national strategic framework to support and increase the effectiveness of HPS in schools and Cushman and Clelland hope their work will support the process.

"Our findings have also helped inform our own practice so our teacher education students have



Tracy Clelland (left) and Penni Cushman

some of the latest, up-to-date research to learn from," Cushman added.

"Hopefully they will leave their studies with more understanding of HPS and how it can help create healthy learning environments."

By Stacey Doornenbal



# Fellowships open a world of discoveries

University of Canterbury academics are benefiting from a newly established fellowship programme designed to support early to mid-career researchers.

Five UC researchers have been awarded Rutherford Discovery Fellowships since the programme was launched in late 2010. Administered by the Royal Society of New Zealand, the fellowships provide financial support of up to \$200,000 per year over a fiveyear period, with funding going towards both the researcher's salary and programme of work.

The multi-million dollar research boost is furthering a variety of research projects at the University ranging from episodic word memory to the development of a system to control rockets.

Three UC academics received fellowships in the inaugural round — Professor Jason Tylianakis and Dr Paul Gardner (Biological Sciences), and Professor Jennifer Hay (Languages, Cultures and Linguistics) — with Dr Christopher Hann (Electrical and Computer Engineering) and Dr Anthony Poole (Biological Sciences) taking up fellowships on 1 December 2011.

Tylianakis is using the fellowship to assist his research programme investigating the interplay of species traits and resource constraints during the assembly and disassembly of ecological networks in changing environments.

Global environmental changes threaten biodiversity, but their effects on the networks of interactions connecting all living organisms are largely unknown so Tylianakis is studying these network structures in detail and relating this to the function of ecosystems.

Working in collaboration with scientists in Argentina, Tylianakis' research shows that it is possible to predict which relationships between plant species and pollinators, such as particular bee species, are most under threat.

"Those plant and bee species that depend most strongly on each other will be the most likely to suffer from environmental changes, and this accelerates the extinction of both plant and pollinator species," said Tylianakis.

The research, published in the March 2012 issue of *Science*, also showed how the network of insects involved in pollination is disrupted not randomly but in a consistent way, which is why they can now predict which relationships are the most at risk.

Hay, who is Director of the New Zealand Institute for Language, Brain and Behaviour based at UC, is conducting research into episodic word memory.

Individuals know many hundreds of thousands of words. Recent results indicate that what we know about each word is shaped in a dynamic ongoing way with our own experience with that word. Hay's research programme explores this episodic word memory — asking what the range of environments (social, physical and contextual) in which we encounter a word does to the way we hear, use and pronounce that word.

"For example, words vary in their distribution across different dialects and social groups," said Hay. "Someone exposed to both American and New Zealand English dialects will have likely heard words like 'filibuster' predominantly from the former, and 'parliament' predominantly from the latter. In New Zealand a speaker will have heard the word 'frightened' more from older speakers than younger speakers, and the word 'husband' more from females than males."

In a central strand of her work, Hay is interested in whether the fact that the distributions of some words are dominated by certain speaker groups have any consequences for the representation and processing of these words. To answer this question, she is conducting psycholinguistic experiments and working with large archives of recorded speech.

One interesting set of questions arising from the work relates to how the dialect to which a speaker is most exposed affects and constrains their language use, and how listeners are nonetheless able to adjust to speakers with different dialects. Hay, together with collaborators in Australia and the UK, was recently awarded an A\$501,000 Australian Research Grant on this topic. "This grant will allow us to investigate Australian, New Zealand and UK listeners' adaptation to each other's accents, in order to shed light on how we are able to achieve stable word recognition via flexible adjustment to pronunciation differences."

Gardner will put the new funding to use on a research programme looking at bioinformatic approaches to functionally characterise RNAs.

Together with proteins, fats, sugars and DNA, RNA is a member of the selected group of molecules that play a major role in life's chemical machinery. Recent scientific advances have shown that RNAs are important for turning genes on and off in response to different signals.

Gardner is using UC's Blue Fern supercomputer facility to perform computational analyses of RNAs to find out more about their diverse functions.

Gardner said his personal research goal was "the complete functional classification of all functional RNAs".

"We are just beginning to appreciate the number of central roles that RNA mediated processes play in biology."

Hann will use the fellowship to progress his work in the development of a system to control rockets.

His work involves building a mathematical model of the rocket as it is travelling through space, including directly identifying random wind loads to allow prediction and stabilisation of the rocket. This approach will avoid the need for costly trial and error runs currently used to tune the control systems and significantly reduce the long turnaround time required to launch and accurately position a payload.

"We are just beginning to appreciate the number of central

roles that RNA mediated processes play in biology."

Hann has completed four successful rocket launches for testing parachute recovery and has completed the avionics. "I have developed a 6DOF rocket model with fin actuation and have validated it on one rocket flight and several wind tunnel tests. A gimbal frame has been constructed and we will do extensive control system testing for pitch, yaw and roll in the vertical wind tunnel followed by subsonic rocket flights in the near future. In addition, we have developed a supersonic rocket, which is capable of speeds up to Mach 2 and is expected to reach an altitude of 8km."

In addition to writing a provisional US patent on real-time control concept for rocket flight, Hann and a PhD student are working with Trimble Navigation Ltd to apply similar mathematical algorithms developed on the rockets to Caterpillar machines.

Hann said the fellowship was "a fantastic opportunity to pursue exciting research in New Zealand".

"The Royal Society has had a great history of funding scientific projects and I feel honoured to be part of that." Poole, a senior lecturer in genetics, is using a combination of computational and experimental approaches to investigate the evolution of biological complexity. He aims to shed light on the mechanisms by which complex molecular and cellular systems evolve.

Poole said when looking at the inside workings of a cell it was easy to think that the enormous complexity we saw reflected a well-honed and well-adapted machine.

"But complex is not necessarily better sometimes a simple streamlined system is more efficient than a needlessly complex one. What I am hoping to do is to test the conditions under which biological complexity evolves and to understand how it persists. We want to work out the genetic conditions that are conducive to the emergence of such complexity. I'm excited by the prospect of building a team of talented students and postdocs to work with me on these problems."

Poole said that as a scientist, UC was a "really exciting place to work", with new research labs and a talented cohort of local and international students being attracted to the school.

"I'm very pleased to have the opportunity to contribute to a strong research culture at Canterbury and to be working alongside students as they develop into great young scientists."

By Jeanette Colman



### **Ruffling feathers**

The human-like qualities of chickens, including their ability to communicate, form friendships, feel pain, joy, grief and even boredom, are examined in a new book by University of Canterbury academic Associate Professor Annie Potts (Humanities).

*Chicken* has been a two-year project for Potts who says she wanted to write a book showing the intelligent side of an animal that has become largely disparaged in recent history.

"I was concerned that people didn't really have any knowledge about chickens as living creatures. I felt that they are seen as unthinking and unfeeling blobs of meat. Most people don't have anything to do with them until they end up on their plates," she says.

"I wanted to show behind the chicken jokes. I was interested in their history and how it came to be that they are now so undervalued. Chickens have traditionally been revered in past cultures but something has changed and now they are disparaged and ridiculed. Over the past 100 years they have gone from being respected creatures to the most manipulated beings on the planet. I argue that it's because of industrialisation and changes to the ways they are farmed that we have lost our connection to them." *Chicken* analyses the harsh reality of modern, mass chicken farming and how that has developed over the past 100 years.

"There are 50 billion chickens killed for meat worldwide each year and 90 million chickens annually in New Zealand alone," she says.

The UK-published book cites the latest scientific research from the United Kingdom, United States and Australia, revealing how chickens are more intelligent, expressive and individualistic than they are credited for.

"I explore their cognitive, emotional and social abilities and how they form families and communicate. People don't often think about chickens as being able to talk but avian ethologists have discovered they have at least 30 different calls, each meaning something different. Previously it was believed that only human language demonstrated syntax and semantics; now we know chickens are also capable of representational thinking and associative learning.

"Chickens can also grieve when they lose a fellow chicken they are particularly close to. They will go and sit in the dark for a few days and stop eating. Interestingly, they are also capable of altruism, and of acting deceptively."

Potts, who grew up with a flock of chickens in her backyard, also examines the natural history and evolution of chickens and the birds' changing cultural role in art, cinema, literature, mythology and even therapy.

"The ancient Romans used chickens for fortune telling to predict the outcome of battles," she says. "In the past they were revered as creators of the universe in mythology while roosters were seen as solar divinities.

"In the book I give an example of a bantam rooster called Mr Joy who imparted 'chicken therapy' when taken around nursing homes to cheer up the patients. He developed quite a following and was very loved and admired.

"I hope that by reading the book people will gain a new perspective on, and appreciation for these birds."

 Chicken by Annie Potts, published by Reaktion Books Ltd, 2012, RRP US\$19.95, paperback, 216pp, ISBN 978-1-86189-856-6.

#### By Renee Jones

"There are 50 billion chickens killed for meat worldwide each year and 90 million chickens annually in New Zealand alone."

### Searching for the sources of seismicity

For the past 25 years, UC's Department of Geological Sciences has systematically studied and built up a record of the earthquake hazard of the Canterbury region. No one could have foreseen how critical this would become in understanding the extraordinary sequence of Canterbury earthquakes that have occurred since September 2010.

Professor Jarg Pettinga, current Head of Geological Sciences, along with now retired colleague Jocelyn Campbell, were the driving force behind the longitudinal study which has since proved so valuable and pivotal in the investigations that have followed the Canterbury earthquakes. Their Active Tectonics and Earthquake Hazard Research Programme had already established a sound understanding of the regional geological context. This was crucial in quickly recognising why these earthquakes were occurring and the relationship between the September 2010 Darfield earthquake, the February 2011 Port Hills earthquake and the subsequent events that have occurred to the east of the city.

Following the February 2011 earthquake, Pettinga was commissioned by the Natural Hazards Platform, along with GNS Science, to lead a collaborative seismic reflection survey to search for faults beneath Christchurch and the region south-west of the city. Dr Michael Finnemore, a UC graduate and Director of Southern Geophysical Ltd, supported field survey logistics. Professor Don Lawton, Director of the University of Calgary's Consortium for Research in Elastic Wave Exploration Seismology (CREWES) and support staff joined the team, making available the specialised equipment required to undertake the survey.

"Before these events, we had already identified quite a number of active faults in the Canterbury region," Pettinga says. "Both in the foothills of the Southern Alps and in the north-west and western part of the Canterbury Plains, we have been aware for more than a decade now that there are active faults close to Christchurch. So we knew they were there, but we didn't have great detail.

"With our extensive database we have supported the probability modelling led by GNS Science over the last decade. This resulted in the inclusion of a potential magnitude 7 earthquake source on hidden faults beneath the Canterbury Plains. So in effect, we had correctly identified the probability of such an event, but not pinned down a specific location. Although we didn't know about the Greendale fault in particular, we certainly had enough understanding to appreciate that there were active faults beneath the plains that occasionally would rupture and generate large earthquakes.

"The events of September 2010 and February 2011 highlighted the urgent need for a more comprehensive knowledge of the subsurface geological profile beneath Christchurch and surrounding region," says Pettinga, "but such a survey requires expensive equipment not available in New Zealand. It was the collaboration with the University of Calgary team that provided this essential component."

CREWES brought with them from Canada a heavy tractor-like buggy that transmits sound signals into the ground which are then reflected back off geological strata ranging to depths of greater than two kilometres. The reflected signals are then recorded by a six kilometre array of geophone sensors and the data processed. The end result provides images that build up a detailed picture of the geometry and disposition of geological layers, including evidence of any faults which are displacing strata in the subsurface.

The seismic reflection survey focused on the central and eastern parts of the city and on the aftershock-rich zone between the Greendale fault and the Port Hills fault. Around 50 km of line surveys were completed during the months of April and May 2011, and Pettinga and his team are currently working through this data and writing up reports.

To the question of whether or not these two critical faults will join up, Pettinga says it "is highly unlikely because both faults are inherited from a much earlier geological period around 60-80 million years ago".

"They were formed under different geological conditions during a period when the Canterbury crust was being stretched and extended, the exact opposite of the situation today. In extensional settings, faults tend to be of relatively short length with many small segments that are not necessarily directly connected to each other. In this context, if one fault segment ruptures and generates an earthquake due to a build-up of plate tectonic stresses, individual fault segments will tend to rupture sequentially over a period of time as there are no direct links between them. This is why the earthquake sequence has been so complex, rather than a single through-going fault extending from the Greendale structure right through out to the eastern city. We've had this sequence that's been transferred progressively onto a number of fault branches progressively further to the east."

The information generated from the Seismic Reflection Survey will provide the location and some insights into the activity of faults beneath the city and its environs to assist authorities with the revision of building codes and land-use planning for the region. Pettinga has been involved in a number of workshops and committees to support decisions around these issues, and also to do with the forecasting of earthquakes through his role as UC's representative on the Natural Hazards Platform.

"These seismic events have added enormous knowledge to the ongoing Active Tectonics and Earthquake Hazards Research Programme and the team is even more highly motivated now to add to that," Pettinga says.

"South-west of the city and at the end of the Greendale fault where the ground surface rupture finished in September 2010, evidence has been found of that fault extending closer to the city by several kilometres. Evidence from the seismic survey corroborates this, confirming that the fault appears to terminate just on the city side of the state highway, but there is no evidence that the fault continues closer to the city."

Pettinga and colleagues from Geological Sciences and Civil and Natural Resources Engineering have postgraduate research students working on other aspects of the earthquake sequence on the Port Hills and on liquefaction studies in Christchurch and Kaiapoi. A newly arrived Rutherford Foundation Postdoctoral Fellow, Dr Ben Mackey, is undertaking a landform study to document previous large earthquakes that impacted on Banks Peninsula. Paleo-channels of the braided river systems forming the Canterbury Plains shown on vertical aerial photographs from the 1940s are being used to search for evidence of pre-historic ground ruptures but, to date, none has been found.

"A wealth of new knowledge has been achieved over recent months and the seismic reflection survey has definitely added new understanding and insights to that which already existed prior to the earthquake sequence," says Pettinga, "but as is always the case, many new questions arise and also need to be researched, so we are actively engaged in trying to answer those as well as contributing in any way we can to the rebuild of our city and community."

By Jann O'Keefe





## Living in the red zone

University of Canterbury geologist Dr Mark Quigley is digging deep into the depths of the Canterbury Plains to try to shed light on possible future earthquake activity in the region.

#### A senior lecturer in tectonics and geomorphology, Quigley's research focuses on two main areas: earthquake behaviour, such as fault rupture processes and the impact that has for future hazards; and the geomorphic evolution of continental landscapes.

Quigley (Geological Sciences) is currently channelling his expertise into analysing the past behaviour of the Greendale Fault near Darfield, the site of the 7.1 magnitude quake on 4 September.

"It isn't an easy thing to study because the record of past earthquakes is not obvious on the surface, so we have to dig deep to understand any previous activity," he says.

"We are using all sorts of techniques including ground penetrating radar, seismic reflection surveys and detailed mapping to try and understand the earthquake history of the Greendale Fault and the other faults that ruptured last year. That also involves trenching the faults to see if we can find evidence of past displacements in the materials. We are trying to produce maps of the sub-surface and try and image buried stream channels that may have broken apart in past quakes," he says. Quigley says his aim is to understand not only the history of active faults around the country, but also to discover the maximum magnitude potential of the faults. He is also involved in research into the much-talked-about Alpine Fault and the Hope Fault in Marlborough.

"We are trying to understand patterns of tectonic uplift in the Kaikoura region and to the west. The Hope Fault starts off the coast of Kaikoura and joins up with the Alpine Fault. It is a large earthquake and potential tsunami source so understanding its earthquake history is very important. We are trying to understand its past patterns of ruptures and I have a student working up there on that using airborne laser scanning imagery."

But Quigley, whose research has taken him to Australia, East Timor and Mexico, has also been working a lot closer to home. The geologist lost his Avonside home in the 22 February quake and has turned his red-zoned backyard into a laboratory for research.

"I have been focusing just on my property as a small scale project that needs to fit into a regional context but it's important to understand things on a small scale," he says.

"I am correlating the amount of distributions of sand that comes out as liquefaction to the intensity and duration of seismic shaking at that site. It's kind of the interface between seismology and geology. We are learning about the seismology from the dense seismic network in that area. "We are trenching into the sand to understand where the material is coming from and what this is going to look like in the geological record 1000 years from now. Will we be able to come back to these sites where there have been several earthquakes above the critical shaking threshold for liquefaction and know what happened or would we just see a pile of sand and not know what to make of it?"

Quigley's research in East Timor, funded by a Royal Society NZ Fast-Start Marsden Grant, uses fossil corals to develop sub-annual records of climate change over millions of years and examines how the tectonic uplift of Timor may have played a role in global climate change.

Despite his ongoing research, Quigley has been consistently in the media spotlight since the 4 September and 22 February events, commenting on the earthquakes and giving 45 public lectures. But his dedication has paid off. Not only was he awarded the 2011 New Zealand Association of Scientists Science Communicators award for 2011 for his communication work following the quakes, but he also received the 2011 Prime Minister's Science Media Communication Prize and with it \$50,000 and a further \$50,000 allocated for developing his science media communication skills

"To win those awards and to receive acknowledgement from my peers is hugely important to me and I am very grateful," he says. Quigley adds that the Prime Minister's award will enable him to write a book this year. "What I want to do is provide the whole scientific context for the earthquakes in a user-friendly, easy-to-read format for the public. I want to take an immensely complicated subject and pull it apart to its bare essentials so that people can understand the science," he says.

"I want to weave into that my own personal experience of what it was like living in the red zone and to go through what we did. It's a personal account and a story about science. It's a unique position to be in as an earthquake scientist to have my home destroyed by an earthquake and to have a natural laboratory just metres away in my backyard."

Quigley says that he is enormously proud of the research that has been accomplished despite the hardships of the past year.

"We have accomplished incredible things. We led the world in the earthquake science response to the Darfield earthquake despite the challenge of living locally. It's been difficult for a lot of us but I would hope that the book I write could provide a learning resource and also help people get through such an ordeal when it happens again in New Zealand," he says.

"The more we understand something the less afraid of it we become and it helps to know what we are up against. It hasn't been easy but it has been an opportunity to do some amazing science, educate the public and hopefully make a difference. As a scientist you don't often get the chance to a make that sort of impact in your career."

By Renee Jones

## Delving into the nuances of social media

Facebook. Defined by urbandictionary.com as "a stalker's dream come true", the voyeuristic behaviour of some of the social networking site's users has come under scrutiny by UC "consumer psychologist" Dr Ekant Veer. Veer, a senior lecturer in marketing and winner of the 2011 College of Business and Economics' Early Career Researcher of the Year Award, recently conducted a study exploring how Facebook facilitates the breaking of social norms, using the example of how the site eases the tension between our desire to stare and the social taboo that frowns upon it in Western society.

In his study with a small group of avid Facebook users, published in *Research in Consumer Behavior Vol* 13 (Emerald Group Publishing Limited, 2011), Veer discovered users' motivations for staring into the lives of their "friends" were driven by not just a desire to collect novel and interesting information, but also because their friends' posts repulsed them, and their friends' misfortune released feelings of *schadenfreude* and selfaffirmation.

Veer's research interests in social marketing and transformative consumer research tend to centre on "serious" issues such as eating disorders and anti-smoking, so he originally looked at Facebook for research fodder as a bit of "light-hearted fun" but soon discovered a much darker side to the phenomenally popular pastime.

He finds the *schadenfreude* aspect the most fascinating and says literature reviews reveal that not much research has been done on *schadenfreude* in modern society aside from "surface level stuff related to sporting teams".

Veer says the Internet is "the modern-day freak show". He argues that the travelling freak show carnivals of the late 19<sup>th</sup>/early 20<sup>th</sup> century with such "exhibits" as the bearded lady and Siamese twins that would draw crowds willing to pay, stare and laugh at other people's misery are no longer socially acceptable, so the 21<sup>st</sup> century has delivered replacement channels in the form of reality TV shows like *Jackass* and *Tosh.O* and online sites such as YouTube, Failblog and Facebook.

He says future research needs to look at whether *schadenfreude* staring is triggered by Facebook activity or if it is simply a change in consumer culture that accepts and demands more of this type of entertainment.

"And my research raises the question: Is tomorrow's online generation simply not that interested in the feelings of others due to the mediated nature of online activity?

"I'm 31 so I've had 26 years of being socialised in an offline environment but for the generation growing up today and tomorrow it is endemic to their culture so how is the online environment affecting their social skills?"

Veer, who has 700-plus Facebook friends and admits to a slight addiction to the media (a week at a conference in Beijing without Internet access felt like "an online detox"), says delving into Facebook's more nuanced appeals with his research "hat" on has opened his eyes to what's going on but not turned him off it.

"A lot of people I know rage against it but for me I just accept that when I post something on Facebook — even if I have great privacy settings — I have to appreciate that someone will find out who I didn't intend."

Veer says it's all about appreciating that "we're not so private now, learning to accept it and have fun with it".

Despite learning more about the darker, seedier side to the site's use, Veer says Facebook has a lot of positives to offer its users hence its huge appeal with more than 800 million active users around the world.

He says his family got into it as a great way of keeping in touch with friends and family overseas.

"Also, colleagues overseas get to know me better through Facebook so that when we meet at a conference we can shake hands and talk about everything because we are like close friends, while if you just took our interactions at prior conferences we would vaguely remember each others' names and that would be about it. Because we interact on a daily basis online we are building a much stronger social network and that is hugely beneficial to me as a researcher here in New Zealand.

"We are becoming a globalised culture but we can have a small village feel still with Facebook."

Applying what he has learned from his initial Facebook study to the world of marketing, Veer says there are key lessons for the business community.

"One of the main things is you have to keep engaged. You can't update your Facebook page every six months and think that's okay. You can't have a competition to join Facebook and then not do anything for two months. If you want to do this it has to be a regular thing.

"And it's not just about information. A lot of Facebook business pages use this as an information portal but you see the really successful ones are not just saying 'here's what we're doing and here's the latest news' but also 'here's who we are, what we have in development, what we're planning' and they share and invite the sort of interactions that friends have and give a human side to their page. "I mean, you don't just see your friend and say 'Hey I've just had a baby'. You say 'we're thinking of having a baby', 'we're pregnant', 'we're six months on' you know and then they can get involved and engaged. But if all you've heard from someone is 'I've had a baby' you're going to feel you've missed out on a whole lot of the process and won't feel close at all. "I'm reluctant to use the analogy of pregnancy

but businesses do need to gestate a little bit for every news announcement."

Veer also says it is important businesses and organisations try to engage their audience and get them "liking" and commenting on posts.

"Facebook is not a panacea for every business. It depends on how much effort you can put into it. And it is important to note it isn't a way of making money but a way of building relationship and brand."

Having just dipped his toes into Facebook for research purposes, Veer sees plenty of scope to dive in to a huge potential pool of topics.

"I'm looking more at the way that social media is changing our offline relationships, looking specifically at how our offline relationships and our online relationships are very divergent. Are you a different person when you are on Facebook than when you are offline? Or when you've had a bad day offline do you try and compensate by getting support from your online world?"

Veer says he would also like to explore more of the nuanced interactions that are deemed acceptable online but offline would be quite the reverse, such as assuming someone else's identity on Facebook to post as them ("fraping") or the notion of "defriending".

By Maria De Cort

Dr Ekant Veer

## The burka ban



When a controversial French law became a topic of interest over coffee, UC senior law lecturer Geoffrey Leane's curiosity was piqued. The result was an internationally published article, a two hour lecture to law students in France, and inclusion in his teaching at the University of Canterbury as an example of when a Bill of Rights can fail. The problem? In April 2010 the French passed a law banning women from wearing the full body burka in public. Leane labels this "outrageous". "How far do you go? Surely it's a hallmark of a liberal democracy to be tolerant of others."

The French law carries a fine of €150 for female violators and larger penalties for men found to be pressuring women to wear the garment.

"When I heard about it, I realised it was a question at the limits of liberal political theory, the freedom of an individual's right to express their religious belief," said Leane, who reasons that despite our preconceptions about the burka, we have no right to inhibit the wearing of a garment if an individual should freely choose to do so.

"This happens to be material I teach in my Bill of Rights and Jurisprudence classes. So I did more research and found this law at odds with France as a liberal democratic state. Why was that? Can it be justified?"

On study leave in the second half of 2011, Leane was in France and through the Law School of the

"Stripping women of the right to wear an item of spiritual significance will have a psychological price-tag. The burka is a 'public' face for many women, do they now need to hide?"

University of Toulouse was invited to speak on the topic in November at the University of Albi. His lecture coincided with the publication of his research in the international journal *Human Rights Quarterly* (2011, 22: 1032-1061). Both were well received, although Leane was surprised at the conservative response from the French law students. "Half of them were happy with the law." He has since found this result mirrored with his University of Canterbury law students.

"To understand our Bill of Rights, you must understand how liberal political theory forms it," said Leane. "This French compromise is extremely important, it's a wonderful opportunity to observe a contemporary breach of rights." His research has a "payback in teaching" and helps students here to focus on "our own weak protection of rights".

This is a topic very much in vogue. Similar legislation to the French burka ban is being rolled out through the Netherlands, Belgium and Spain. Two women have been fined in Brussels for wearing the niqab and these prosecutions are being contested. Potentially the French ban may end up before the European Court of Human Rights.

New Zealand came under scrutiny in 2011 when in two separate incidents bus drivers refused entry to Moslem women wearing a veil. Leane said our own protection of rights was much weaker than the French "when you consider how little difficulty the New Zealand government would have in changing our own Bill of Rights".

"Stripping women of the right to wear an item of spiritual significance will have a psychological price-tag," said Leane. "The burka is a 'public' face for many women, do they now need to hide?"

Leane will continue to question the justification for this ban. The absurdity of the ban was brought home to Leane on a flight to Paris when a woman sitting next to him suggested that "there are laws against wearing too little, this is a law against wearing too much".

By Amy McDaid

#### Stress taking toll on frontline workers

Human service workers in Christchurch have been under a lot of pressure over the past year following the Canterbury earthquakes, University of Canterbury social work and human services lecturer Associate Professor Kate van Heugten has found, but there are steps organisations can take to help.

Van Heugten, who interviewed frontline workers and managers from human service organisations after October 2011, said she noticed several trends. She found that prolonged stress was taking a toll on those in charge of helping others, but also that they were often reluctant to tell others they were having trouble.

"They're coping pretty well, but they are really tired. They're not necessarily publicly advertising that because they really are people who are concerned about their client groups or service users, so they don't want to say 'we're really tired' because they want to help."

The causes of the stress varied, with improvised facilities and reduced resources putting workers in difficult situations. Other causes were not being able to talk about their own problems and the feeling of not being able to offer as much help as was needed.

"What upsets service workers most is when they don't feel they have the resources available to help their service users. Working long hours is hard, working with really distressing situations is hard, but what really gets people down is when they feel they can't do as good a job as they would like to for the people that they serve. That's why they're in that line of work. It's not for the pay." Many human service organisations had taken steps to support their employees, though some methods were proving more effective than others. Some organisations had their out-of-town management visit Christchurch to better understand the situation and so avoid making unreasonable demands. Van Heugten said that it was important that management was seen to be making an effort to support staff.

"Of course, it's been hard for some, but if they've visibly and actively made efforts for staff to be able to talk about the impact on them and support them at home as well as at work, that's built loyalty amongst their workers."

Talking about experiences was found to be an important part of dealing with stressful situations, as workers responding to the immediate and longer term aftermath of the disaster often experienced stress in the form of "shared trauma", where they had to repeatedly put their own problems to the side in order to help other people deal with theirs.

"Some organisations have encouraged people to talk about the earthquake more than others, not forced debriefing but giving people opportunities to talk about it. Some organisations have at least been perceived as clamping down on that. People find that stressful — they prefer to be able to communicate."



One positive trend that came up in the interviews was that the first earthquake in September 2010 actually ended up being helpful because it gave staff at many organisations something akin to a dry run before the more severe earthquake in February 2011.

"A number of people talked about how it helped them prepare for the February one. [Without it] in some ways they wouldn't have been quite as well prepared," van Heugten said. "The causes of the stress varied, with improvised facilities and reduced resources putting workers in difficult situations."

By Martin Moore

# Antarctic lake opens window on early life on Earth

By Stacey Doornenbal

Unique microbial structures found only in a remote lake in Antarctica are giving a University of Canterbury researcher a glimpse into the organisation of early life on Earth.

"As far as we know there are no other ecosystems like this in the world and by studying it we could have a better understanding of what life perhaps used to be like on Earth billions of years ago."

Limnologist Dr Ian Hawes, Professor of Antarctic Limnology at Gateway Antarctica and the Waterways Centre for Freshwater Management, was recently part of an international research expedition to study other-worldly landscapes discovered in 2008 in Lake Untersee in the Oueen Maud Land area of Antarctica.

Lake Untersee, the largest and deepest freshwater lake in East Antarctica, was extremely unusual, Hawes said. Its crystal clear waters were permanently covered in about three metres of ice so there was no contact with the atmosphere; there were no streams flowing into the lake so it got all its water and gasses, including carbon dioxide needed for photosynthesis, from melting ice. The lake's water, which contained high levels of dissolved methane, was extremely alkaline.

These unusual features, Hawes said, had led to the creation of a unique environment as microbial ecosystems in the lake adapted to their unusual surroundings over millions of years.

Working with scientists from the Winogradsky Institute of Microbiology, part of the Russian Academy of Sciences, and planetary scientists from NASA, the SETI Institute and the University of California, Hawes' role on the expedition was to study bacterial cone-like structures, a form of stromatolite, that cover the bottom of the lake.

"These structures rise up to half a metre from the lake bottom, are covered in a thin layer of intensely purple Cyanobacteria (blue-green algae) and are made up of layer upon layer of organo-sedimentary material. These structures seem to be unique in the modern world, yet closely mirror formations that were common in shallow waters around the globe around two billion years ago," he said.

"Understanding the functioning of these modern structures can offer insights into how the earliest communities on Earth were organised. Cyanobacteria are the oldest lineage of photosynthetic organisms on Earth, having evolved two to three billion years ago when the Earth was a very different place. They are thought to have introduced high concentrations of oxygen into the atmosphere and, for hundreds of millions of years in the Precambrian, they probably dominated the planet.

"The first evidence of the emergence of these organisms are fossils known as stromatolites, to which some of the Lake Untersee structures bear a striking resemblance. The Untersee structures in particular resemble a type of stromatolite known as a 'complex cone', and these are so far the only known modern example of such stromatolites. There is still controversy over the extent to which this and related kinds of stromatolite are evidence of biology or could be formed by sedimentation alone. The evidence from Lake Untersee comes down on the side of a biological involvement." He said the astrobiologists were particularly interested in what the lake could tell them about what life could have been like on Mars.

"Mars is extremely cold now but it used to be a lot warmer and there is a body of opinion that, for a long time, it could have supported Earth-like organisms. Knowing what to look for as incontrovertible evidence of past life is a real challenge, and the communities in Lake Untersee provide more insights into what fossilisable structures are unmistakable evidence of life."

Hawes first got a glimpse of Lake Untersee and its unusual inhabitants in 2008 when he travelled to Antarctica with the same group of researchers. Unable then to study the lake fully, the team was able to return recently to study its environment more closely.

"We were a varied team and my job was to measure the photosynthetic activity of the bacteria and to look at the ecology of the lake and how the mounds were formed. In terms of growth, the structures formed very slowly growing at a fraction of a millimetre a year over thousands of years. Slow growth is mainly due to the absence of carbon dioxide in the water, which severely limits photosynthesis but the very small amount of sediment reaching the lake means that even slow growth can outpace sedimentation."



Professor Ian Hawes

Hawes said the cone-like shape of the structures was also due to the convection currents caused by the melting ice, which also distributed the bacteria, creating chains of mounds along the lake floor.

"Diving beneath the ice of Lake Untersee is an eerie experience. Everything is blue, it's superquiet, the water is crystal clear and spread out before you and, way into the distance, are countless numbers of these extraordinary cones. It's easy to imagine that you have dived into a different world."

Hawes said the task now was to examine samples collected from the lake as there were a lot more questions the team wanted to answer.

"As far as we know there are no other ecosystems like this in the world and by studying it we could have a better understanding of what life perhaps used to be like on Earth billions of years ago."

## Understanding the youth of today

Dr Bronwyn Hayward's research in political and social sciences is youthfocused, globally connected and locally relevant. Her field of enquiry centres on understanding the way that values of democracy and the social, economic and environmental conditions required to support citizens can be renewed for each generation.

"Every generation faces unique challenges; however globally, those born at the turn of this millennium face an almost perfect storm of unprecedented youth unemployment, dangerous environmental change, a strained model of economics driving unsustainable growth, growing social inequality and weakening democracies as communities everywhere struggle to hold decision makers to account," said the senior lecturer in UC's School of Social and Political Sciences.

"In Christchurch we have a constant reminder of the importance of the task before us. The future of our young people requires us to rethink the social, economic and environmental supports our children will need if they are to flourish into the future."

Hayward's current work is published in a forthcoming book, *Children, Citizenship and* 

Environment: Nurturing a Democratic Imagination in a Changing World (Earthscan/Routledge, 2012).

The research for the book began in Christchurch and led to work with research teams in the UK, Norway and the United Nations in Paris. Havward initiated the Christchurch study in 2006. Over the following four years she worked with seven graduate students: Jessica Buck, Wakaiti Dalton, Holly Donald, Nicholas Kirk, Amanda Thomas, Celia Sheerin, and Aramiro Te Rakena. The students each graduated with distinction and were funded by New Zealand Electoral Commission scholarships, a College of Arts grant and UC summer scholarships. The project examined Christchurch children's attitudes to citizenship, with the graduate researchers returned to their home primary schools to interview 160 children aged 8-12, mostly in Christchurch, about their views on their community and local democracy.

"We were looking at what gives children a sense of 'political agency', that is, their ability to imagine their future and the confidence and skills to act with others to achieve their goals. The results were very rich and startled us. Children's sense of politics and justice, their experience of their environment and community, and the hardships and joy they reported gave us a deeper insight into what supports children's ability to act as citizens in liberal democracies." Hayward said seed funding from UC was vital to kicking off the project, however, as the depth of the research findings became apparent, she took special leave to the UK accepting two, concurrent visiting fellowships to develop the emerging ideas. The first was with the UK's Environment/Economics Commissioner Tim Jackson's research group RESOLVE, an ESRCfunded centre for Research on Sustainable Lifestyles, Values and the Environment based at the University of Surrey and the second, at the Tyndall Centre for Climate Change based at the University of East Anglia.

With Jackson, Hayward joined the steering committee of a United Nations Environment Programme global survey where Hayward led the UK and New Zealand contribution to an international research study involving 8000 young participants from 21 countries using online qualitative surveying undertaken in 13 languages.

"Our research questioned 18-35 year olds about their quality of life and their lifestyle with a view to predicting social, consumer and energy trends."

"The project proved to be an insightful source of data because we collected information directly from participants via social media rather than relying on data filtered by government reports."

The success of that global survey resulted in Hayward and Jackson being invited to lead the

planning for a new longitudinal global survey of young citizens aged 12 to 25 years in 21 countries. The research is for the United Nations Environment Programme's new sustainable consumption unit with the UK Sustainable Lifestyles Research group in consultation with a number of agencies including the OECD and International Social Science Research Council.

"The study aims to provide global qualitative research that will be useful for drawing international comparisons and tracking trends in children's lifestyles."

Hayward's work at the Tyndall Centre focused on rethinking the "social contract" or the relationship between governments and generations of citizens in a changing climate. That work culminated in a research partnership with Professor Karen O'Brien and Dr Elin Selboe at the University of Oslo in Norway, funded by the Norklima Norwegian science research council. The team plan to study young people's lives and attitudes in Norway over the next three years to understand what enables Norwegian children to flourish in a changing climate.

"2011's devastating Oslo shootings will prompt a careful reconsideration of how we use the research resources to support the recovery of a cohort of Norwegians devastated by the loss of so many young leaders."

Hayward notes that disaster also intervened in the Christchurch children's study in the form

"2011's devastating Oslo shootings will prompt a careful reconsideration of how we use the research resources to support the recovery of a cohort of Norwegians devastated by the loss of so many young leaders."

of the Canterbury earthquakes in ways that underscore some of the universal conditions that all children need to flourish as citizens in changing environmental conditions.

"Our earthquake experiences have provided a point of connection for other communities. Reflecting on my research in the UK, particularly after the austerity measures were introduced there, for example, I have been startled at the parallels between the impacts of economic restructuring on young lives and earthquakes — both have the potential to have some similar, devastating effects. It is how we respond to prioritise children that will make a difference to outcomes. We have to tackle issues affecting youth at all levels, globally and locally."

A passionate advocate for youth, Hayward hopes that her research and her involvement in crossdisciplinary teams can make a difference to the futures of young people. Since returning to New Zealand Hayward accepted an appointment as trustee of the Foundation for Democracy and Sustainable Development in London, working with government agencies and charities to develop a voice for future generations at the United Nations. She has also been appointed to the management committee of the Child Poverty Action Group in Auckland.

By Jacquie Walters



# Putting real-life economic theories to the test

allo

The New Zealand Experimental Economics Laboratory (NZEEL) based at the University of Canterbury under the directorship of Dr Maroš Servátka (Economics and Finance) has the potential to benefit businesses and individuals alike.

To test economic theories and potential market institutions, NZEEL performs controlled laboratory experiments to identify how people behave in different economic situations.

"Economics is about behaviour," Servátka said. "How do economic agents like firms and consumers behave and make decisions?

"Experimental economics is the application of experimental methods to study economic questions.

"In the laboratory we are able to accurately observe human decision-making, eliminate potential confounds present in naturally occurring activities and even observe unobservables, like for example fraud or cost of effort. Our participants are paid based on the decisions they make. This helps to create the incentives they would have in everyday-life scenarios.

"In our experiments everything depends on how real people respond to economic incentives. At the beginning of each experiment we give them instructions about the decision-making scenario and available choices and explain what the monetary consequences of their decisions are. Based on their own preferences, people choose options they prefer. Then we calculate their earnings and pay them in cash as they leave the laboratory.

"Having a world-class lab here at Canterbury gives us a huge advantage. It's a modern lab that enables us to test sophisticated theories which, based on a set of assumptions, predict certain decisions. Following an experiment we are able to answer whether people really behave the way that the theory predicts," he said. This methodology also enabled NZEEL to provide evidence and support for how policies might unfold in the field. One could run economic experiments to assess various open policy issues, ranging from whether labour market trial periods are an effective way of screening employees or whether an unemployment insurance bonus increases the search intensity for jobs.

The team believed its work had a multitude of potential benefits yet to be accessed in New Zealand.

"When you look at big companies in the States, like eBay, Google, or Yahoo!, they have their own research department that conducts economic experiments relevant to their business strategies. New Zealand doesn't have these economies of scale so that's why NZEEL could be so important here. We can run projects that the whole of New Zealand society can benefit from," Servátka said.

"We are affiliated with large experimental research centres throughout the world and have amazing visitors, top experimental economists who come every year to visit NZEEL and work on our collaborative projects."

Servátka specialises in experimental and behavioural economics and is interested in how fairness considerations and psychological factors, such as guilt, pride or reciprocity, govern decisions of economic agents during negotiations or in labour markets.

Servátka is currently working on a research programme examining whether informal agreements fostered trust and co-operation in the absence of formal contracts. In this programme Servátka and his co-authors, Martin Dufwenberg from University of Arizona and Radovan Vadovič from Autonomous Technological Institute of Mexico, propose a new theory of negotiations in partnerships, which will be tested using laboratory and field experiments.

"Partnerships occur under a variety of circumstances. Sometimes they are reinforced by formal agreements or contracts that induce co-operation through the right set of economic incentives. But more often agreements are informal, sealed only by a handshake, which requires the parties to trust in their mutual honesty. In this project we're studying how the incentives in the ensuing relationship shape the agreement between honest players on what actions to take.

"Our solution builds on the past 20 years of behavioural research. It specifies that parties to a negotiation split monetary gains-fromtrade equally as long as this is individually rational for each of them. Unequal divisions, or compensated deals, are justified only if one of the parties is facing too much temptation to renege and would be unlikely to honour the deal in the future."

Servátka's other projects include a couple of behavioural studies of firm boundaries (with Hodaka Morita from the University of New South Wales), a real-effort experiment with Canadian economists Bram Cadsby and Fei Song using MBA students as participants to study gender competitiveness, a series of experiments exploring the effects of status quo in economic decision-making (with an NZEEL affiliate James Cox, from Georgia State University, and Vadovič), and a labour market experiment testing the effects of exogenous revenue shocks on longterm relationships between firms and their workers.

"The research environment at UC is exceptional and I have greatly benefited from it."

Servátka joined the staff at Canterbury in 2007. After completing a PhD in economics at the University of Arizona in the United States, he took up a position at the University of Mannheim in Germany before coming to UC.

In 2008 he was awarded a fellowship to spend a semester at the George Stigler Center at the University of Chicago Booth School of Business, and in 2009 he served as guest editor of a special issue of the journal *New Zealand Economic Papers* (43 (2)), which focused on experimental economics.

His research has been published in European Economic Review, Experimental Economics, Journal of Economic Education, Journal of Economic Psychology, Journal of Socio-Economics, Games, Economics Bulletin, and Perspectives on Economic Education Research, among others. He also has five working papers which are currently undergoing a review process in highly ranked economics journals and another eight papers in progress.

Servátka was named the UC College of Business and Economics' Early Career Researcher of the Year in 2010 and was awarded the Early Career Research Excellence Award at the 2011 Modelling and Simulation Society of Australia and New Zealand biennial conference held in Perth in December 2011.

By Jane Lucas

#### Molecular mysteries unravelled

An engineer in the field of structural biology is looking to apply new data analysis tools to unravel the complex structures of individual biological macromolecules such as proteins and viruses.

In September 2012 Professor Rick Millane (Electrical and Computer Engineering) will take up a two-year James Cook Research Fellowship to study ways of decoding data from new x-ray free-electron laser technologies which will enable biologists to better understand the structure and function of biological molecules. It is a relatively new field of science — Millane will be working with scientists and engineers at the University o f California Berkeley and Arizona State University in the US, and the University of Hamburg in Germany — but a field expected to produce longawaited insight into the workings of these tiny particles.

Biological molecules are made up of long polymolecular chains that fold themselves up into complex three-dimensional shapes. Identifying this shape helps determine how the molecule functions biologically and the location of active sites where it interacts with other molecules to perform certain biological processes.

For the past sixty years x-ray crystallography, in which an x-ray beam is fired through an artificially grown crystal made up of millions of molecules lined up in a regular pattern, has been used to plot the unique shapes of molecules. A detector picks up the pattern of the scattered x-rays (called a diffraction pattern) which is then analysed using a computer to provide the threedimensional shape.

While the process is becoming more efficient, it does have its drawbacks.

"Sometimes it doesn't work, particularly for large molecules," says Millane. "Sometimes it can be difficult to get enough information to determine the shape of the molecule, requiring additional experimental work. Sometimes the crystals are not good enough and so they don't diffract sufficiently well, and sometimes it's just not possible to make a crystal. So there are many protein molecules out there whose structures haven't been determined — membrane proteins in particular, which are actually very important."

The new x-ray free electron lasers rely on short pulses, lasting just hundreds of femtoseconds (or quadrillionths of a second), of extremely intense x-rays to give atomic-level resolution snapshots on an ultrafast timescale.

"Because the intense diffraction is much stronger you can use much smaller crystals nanocrystals, less than about a thousandth of a millimetre in size. These are easier to produce than bigger crystals and can form spontaneously."

The result is tens of thousands of weak diffraction patterns giving huge amounts of digital data, which is where Millane's expertise comes in.

"It is somewhat unusual for engineers to be working in the biology arena — it is a different skill set — but we do a lot of data processing and tend to think in a more mathematical way, and the combination of complementary skills can lead to a more creative outcome."

A better understanding of the thousands of proteins in the body is sought by biologists, physicians and drug companies.

"If you're designing drugs, you need to know how a particular protein functions and the only way to do that is to work out what its precise chain folding is. For example, finding out where the active sites are in a virus, and the arrangement of the amino acids in the sites, may help you design a drug that can block replication of the virus. That's the end goal."

By Sally Blundell

#### Building on UC's research strengths

Driving the research environment at the University of Canterbury to reflect its core strengths is just one of the many priorities Assistant Vice-Chancellor Research (AVCR) Professor Steve Weaver wants to achieve.

Weaver, who took over the role of driving the strategic research direction and performance of the University in 2010, has worked on campus for 34 years, originally making his mark in geological sciences where he was head of department for ten years.

Weaver's own research during that time focused on the geological evolution of the Southern Pacific Rim and environmental applications of geo-chemistry. Now, as AVCR, he is committed to guiding the whole research portfolio to emphasise the University's established and emerging strengths and to indicate clearly the benefit of UC research to New Zealand.

"We need to develop further our existing very good research strengths in engineering, the sciences, communication disorders and health together with education and linguistics," he said.

"In saying that, across the university there are other areas of research expertise that are nationally and internationally recognised."

Weaver said another key focus was to intensify and drive strategically collaborative research partnerships with the Crown Research Institutes (CRIS).

"We have made very good progress in the last 12 months, particularly with relationships with Industrial Research Ltd, Environmental Science & Research, SCION, the National Institute of Water and Atmospheric Research and Geological & Nuclear Sciences via the Natural Hazards Research Platform," he said.

"We are working with those external organisations much more closely, often involving postgraduate students in joint research programmes. We have always worked with the CRIs but now we are achieving a step change in the degree of cooperation as New Zealand research moves away from the competitive model of previous years."

Weaver said the transformation of UC's research efforts via the innovation pipeline is a priority for the University to demonstrate tangible returns to the society that supports its endeavours.

"I see the University of Canterbury as playing a significant leading role in the New Zealand research and innovation eco-system," he said.

"We are working in partnership with industry far more effectively than ever before. NZi3, the Wireless Research Centre, Electric Power Engineering Centre and the Biomolecular Interaction Centre have all helped us make good progress in this area."

But the University's research role during the rebuild of Christchurch, following the sequence of 2010-2011 earthquakes, would be particularity important, Weaver said.

"I think a very significant portion of our research effort now and for the next few years will be directed towards and will benefit the recovery and growing resilience of the Canterbury region," he said.



Assistant Vice-Chancellor, Research, Professor Steve Weaver

"The response of our researchers at the University has been very impressive. We now have more than 170 earthquake-related research projects across all disciplines. A lot of people would expect just geology and engineering to be involved but we have had our education people out there in schools, sociologists and psychologists out there, just about every discipline has got involved which is superb, and the CEISMIC project is a major contribution in the digital humanities and beyond," he said.

"That response is an immediate confirmation of the relevance the University of Canterbury has to the community that it serves."

By Renee Jones

# Preserving earthquake memories

Long after the ground finally stops shaking, the story of how the people of Canterbury endured in the face of some of the most significant natural events in New Zealand's history will remain thanks to a major new digital archive initiative based at the University of Canterbury.
CEISMIC — the Canterbury Earthquakes Digital Archive — is an initiative of UC's School of Humanities to preserve the stories, images and media concerned with the devastating Canterbury earthquakes of 2010 and 2011. The project's website, www.ceismic.org.nz, which was launched in October 2011, was the first step in a process of preserving this material and facilitating the study of the impacts and effects of the disasters and the region's recovery process.

It is envisaged that when completed the website will be the portal to a world-class, federated archive of earthquake stories, images and media. Users will be able to search across New Zealand's digital heritage collections for earthquakerelated content and find places where they can contribute their own material.

The CEISMIC consortium, led by the University of Canterbury, includes the National Library, the Ministry for Culture and Heritage, Christchurch City Libraries, Canterbury Earthquake Recovery Authority (CERA), Te Papa, Archives New Zealand, Canterbury Museum, NZ On Screen and the Ngãi Tahu Research Centre.

Heading the project is UC academic Associate Professor Paul Millar, who co-ordinates the University's Department of English, Cinema and Digital Humanities, within the School of Humanities. He and Project Manager Dr James Smithies have modelled the CEISMIC project on the 11 September Digital Archive at George Mason University in the United States, which is not only a major research resource for those studying the terrorist attacks but also a significant teaching tool and public outreach facility.

Millar says that the creators of the 11 September Digital Archive learned that collecting such material is time-critical. "Already Canterbury's stories are being lost as people try to move on, perhaps deleting their earthquake-related emails, texts, phone messages, images and movies in the process. We must begin now and we must be prepared to operate for decades to come. When all the empirical data around the earthquakes has been collected and the city's infrastructure restored, the effects will still be felt among families and communities. These events have torn apart towns and suburbs and irrevocably changed our society. For a long time our cultural landscapes are going to seem as strange to us as our deconstructed cityscapes.

"We aren't unique in our experiences. We know that many communities will experience disasters of this magnitude or greater in the future but we may be a little unique in being such a geographically defined, relatively homogenous, first-world community with high technology uptake. We have the means to fully document our experiences; we have a world-class university uniquely placed to study these experiences; and through the CEISMIC digital archive we will have the ability to share what we learn with communities in similar situations around the world in the hope they may benefit from our knowledge."

The focus of the CEISMIC website is on community participation and commemoration, but the site will also provide an essential resource for local and international researchers and students, says Millar.

UC is not only leading the CEISMIC consortium, but has started building an important new asset for New Zealand's national cultural heritage infrastructure behind the scenes. "Quakestudies", which will go live in May 2012, will promote and facilitate research into disaster impact and recovery, complementing the Ministry for Culture and Heritage's website, www.quakestories.govt.nz.

"We're building for the long term," says Millar. "Quakestudies can hold millions of digital objects. It will be like an Olympic swimming pool — really well designed, but largely empty to begin with. Our researchers and students will spend years filling it. In the coming decades you'll be able to plunge in and find it full of material carefully preserved for future generations and other communities that experience disasters.

"It is fitting, given everything they've endured, that UC students will drive the CEISMIC project. Selected students will work as interns and research assistants to create and curate earthquake content. We're also establishing New Zealand's first digital humanities teaching programme around CEISMIC, and we'll be offering humanities-focused courses in web design, software development, project management, writing for the web and critical analysis of online content.

"We've even equipped our own mobile recording studio — 'The Quake Box'— in a donated container which will be staffed by students and deployed at places where people can record their earthquake stories."

To initiate CEISMIC-related research projects the University has established a \$100,000 contestable research fund to support a range of research projects from any discipline.

Millar says among the 13 projects to have received support in the first funding round are studies on making coastal cities more disaster resilient, the nature of public earthquake commemorations, memorialising Christchurch in photos, the effects of the earthquakes on accounting practices, and experience of the disaster by the elderly. The CEISMIC project is also supporting a group seeking to preserve Christchurch history through a range of local heritage digitisation initiatives.

"The CEISMIC website and Quakestudies are being built for the future as well as the present," says Millar. "These projects will take time and they will cost money. What we intend to do won't be properly achieved without public buy-in and substantial material support. The University of Canterbury, recognising the importance and urgency of the task, committed significant startup funding at a time of real scarcity. But with potentially millions of digital objects to curate and ingest, we'll be looking in every direction for assistance."

Major supporters already on board include the Canterbury Community Trust, which donated \$55,000 towards the recording studio and to support earthquake research; and the project's two founding partners: multinational change management company Sysdoc Group, and Christchurch newspaper *The Press*, which will offer long-term support.

"The University of Canterbury and the CEISMIC consortium can play a unique role in turning the tragedy and suffering to the benefit of others," says Millar. "We didn't ask for this disaster, but now that it has happened, the onus is on us to take something positive out of it.

"I'd like to think that a century or two from now, a researcher will still be able to access the CEISMIC digital archive and find in it answers to questions people have only just realised they need answers to."

By Stacey Doornenbal



# Cancer epidemiology enhances health sciences

In the short time Professor Ann Richardson has been resident Cancer Epidemiologist in UC's Health Sciences Centre, she has initiated six collaborative projects with far-reaching potential for public health in New Zealand. Richardson's position was established as a partnership between the Wayne Francis Charitable Trust and UC. She has worked in cancer epidemiology for more than 20 years, firstly at Otago University in Dunedin, then at Oxford University in the UK, and finally in Public Health at the Christchurch campus of Otago University. Arriving at UC in June 2011, she brought an entirely new area to UC Health Sciences and a long-standing interest in breast cancer epidemiology and screening.

Richardson also has an eminent collaborator, Adjunct Professor John Potter, who receives support from the Canterbury Medical Research Foundation, of whom she says "we are extremely lucky to have the involvement of this internationally renowned cancer epidemiologist. He has a long history of discovery at the Fred Hutchinson Cancer Research Centre in the US and strong affiliations with a number of very large international cancer cohort studies."

The two share a common interest in a potential association of viruses with breast cancer and together are involved in proposals for three different projects to test this hypothesis. One of these projects, with Health Sciences colleagues Arindam Basu and Pat Coope, is in collaboration with the NZ Blood Service to investigate a possible link between cytomegalovirus and breast cancer.

A similar project will involve stored blood from a maternity cohort in a Finnish serum bank which is collected during pregnancy to test for congenital infections. Each sample is filed under a Finnish ID number the donors hold for life so that if breast cancer is later diagnosed, these earlier samples can be tested for the presence of cytomegalovirus and Epstein-Barr virus (EBV). The proposal for this project was invited by the Finnish serum bank itself and is about to be submitted. "The reason we test for both viruses," says Richardson, "is that they are both Herpesviruses, and similarly transmitted — so if we detect a link with one virus and not the other, it strengthens the finding because it indicates that the association may be causal and not due to bias. In previous research, we have found an association between breast cancer and cytomegalovirus, but not EBV."

A third proposal, in collaboration with colleagues at the Christchurch Medical School, will approach the same hypothesis in a different way by testing whether there is evidence of viral genetic material in breast tissue and will entail accessing samples from the Christchurch Cancer Society Tissue Bank. The researchers are currently seeking funding sources for this project.

Rice consumption in eastern cultures is the subject of another study, also in collaboration with Potter and international colleagues. This will look at whether rice consumption could be a protective factor for colorectal cancer. In countries like Hong Kong and Japan, international patterns of the incidence of colorectal cancer show a rise from one of the lowest incidence rates to one of the highest in the world within a few decades.

"This is too fast for a genetic cause," says Richardson. "It has to be environmental. One possibility is to do with food and some researchers have looked at the adoption of a Western style diet in those countries as a possible cause. But we are speculating that it may be due not to the introduction of a harmful factor, but to the loss of a protective one.

"We know that rice consumption in Japan has roughly halved within the same time and there is also some biological evidence to suggest that rice may be protective against carcinogenesis. Countries where rice consumption has not fallen have not seen the same rise in incidence of colorectal cancer."

Potter has links with huge cohort studies around the world and has contacted colleagues with this hypothesis. Interest is high and the Nurses Health Study, a large US cohort study, has agreed to analyse their data to test this hypothesis.

"We have also applied for a Marsden Grant, led by John Potter, to investigate international patterns of breast cancer which show a five fold difference in incidence across the world. New Zealand is one of the high risk countries and many researchers think the five fold difference can be explained by reproductive factors in females such as number of children, breast feeding or the age of women when they bear their children, but we are not convinced.

"Although female breast cancer is one hundred times more common than male breast cancer, we have looked at comparing the incidence in these countries of breast cancer in men. Findings indicate a strong relationship between male breast cancer and female breast cancer incidence in the same countries. The differences between countries cannot be due solely to female reproductive factors if the same incidence pattern is occurring in males, and we want to investigate this further," Richardson says.

"Finally, we are planning a research project in partnership with the Cancer Society and the Canterbury District Health Board [CDHB]. The intention is translational research, or creating strong links between research and practice."

This project involves others from the UC Health Sciences Centre including Kate Reid, Palliative Care Convenor, and Associate Professor Pauline Barnett, who has expertise in analysing qualitative data. Together, this team consulted with the Cancer Society and the CDHB for areas that particularly needed researching. Support services for people with head and neck cancer in Canterbury was identified as an area of need.

The question is whether the services currently being delivered are adequate and whether they will remain so as the New Zealand population continues to age and to grow. As the risk of head and neck cancer increases with age, the number of people with head and neck cancers is therefore expected to also increase in the future. A detailed guidance document for support services for people with this cancer has recently been released in the UK that recognises the major difficulties these people experience after treatment.

Richardson is very aware of the problems faced by this population.

"Their difficulties can centre around speech, swallowing, eating and changes in appearance that can be extremely hard to adjust to. The support services they require come from multiple sources. At different times they will need surgeons, oncologists and nurse practitioners. They might also need psychologists, speech therapists, oral and maxillofacial surgeons, and dentists as well as Māori health providers, the Cancer Society, and the whole range of primary care support.

"Delivering these services from a multidisciplinary team in a well coordinated way is an extremely complex logistical problem, so we want to begin by mapping the services that are currently available and we plan to interview patients and care providers to gauge what their requirements might be. We will then collate our information and make recommendations. This is exciting work, very applied, and the team is keen to begin," says Richardson.

By Jann O'Keefe

# Court cases to sing about

"My criteria for choosing a case is that it must be one or more of interesting, amusing, bizarre, important; that it must be suitable for light verse and thus must not be nasty, boring or tragic."

Some of the more bizarre, interesting yet groundbreaking court cases in British and American legal history will feature in a unique songbook being put together by a University of Canterbury law academic.

While claiming to have not much of a musical background apart from the occasional "tootle" on a clarinet, Professor Stephen Todd (Law) has written the lyrics for 26 songs, set to music by Gilbert and Sullivan, about some of the more curious court cases that have made legal history in the United Kingdom and the United States.

He is putting them together as an illustrated songbook, *Leading Cases in Song*, with an accompanying CD. Former UC staff member John Pattinson worked on the musical arrangements, putting the words and music together on computer files.

"My criteria for choosing a case is that it must be one or more of interesting, amusing, bizarre, important; that it must be suitable for light verse and thus must not be nasty, boring or tragic," he said. "I set the various songs to music from the Gilbert and Sullivan operas. Sir Arthur Sullivan's music certainly is cheerful and appealing. I know the operas quite well, so I chose those songs which seemed to me to fit the kind of song I was writing."

Among the songs included in the book are those Todd put together for three short operas that have all been performed at UC as part of the School of Law's annual Law Revue. Todd said that it was during the 1991 revue that the "germ of the idea" for a songbook first arose.

"Staff contributions were invited and I suggested staff sing a song or songs about interesting cases that the students would know about from their lectures. Our first attempt was pretty amateurish, but we have got much better over the years."

As well as acting out cases, he took off singers and groups — such as Metallica, Prodigy, and Abba — and rewrote their songs with a legal theme. He recently branched out into opera with his first, featuring six songs, being about the 1930s decision of the House of Lords in Donoghue v Stevenson. Songs from this opera will be included in his book. "This is a very famous case and every lawyer knows about it. Mrs Donoghue went with a friend to Wellmeadow Café in Paisley in Glasgow. Her friend bought her a glass of ginger beer, in an opaque bottle. Mrs D eagerly drank some of the ginger beer, but when she poured some more into her glass she found the remains of a decomposed snail," Todd said.

"Mrs D alleged she was made ill from drinking the ginger beer containing the bits of snail. She couldn't sue the café owner for breach of contract as she didn't buy the beer, so she sued Stevenson, the manufacturer, in the tort of negligence and succeeded. So, Donoghue v Stevenson is the foundational case on the responsibilities of manufacturers towards the ultimate consumers of their products."

This opera debuted in the 2009 Law Revue and was published in the *New Law Journal*. After it was published Todd said his daughter, Lucy, suggested he put together a songbook. It may also be performed again at a major conference in Scotland celebrating the 80<sup>th</sup> anniversary of the decision.

Todd's most recent opera was about the trials of model Naomi Campbell, who successfully

sued the *Daily Mirror* for an invasion of privacy for publishing the true information that she belonged to Narcotics Anonymous after she claimed she did not take drugs; and about Max Mosley who successfully sued the *News of the World* for invasion of privacy after it published stories about him undergoing disciplinary sessions with prostitutes. This opera was performed in the 2011 Law Revue.

"I have also written about 10 more individual songs, based on various cases decided in England and the US. They did not involve a lot of research as I knew about most of them beforehand. However, I did come across one or two obscure cases that I like. In one example, a lady took her dog to the defendant animal hospital where it unfortunately died. The owner arranged for an elaborate funeral, but during it she discovered on opening the casket that it contained the remains of a dead cat. The hospital was held liable for her shock and upset."

Todd said once he had sourced illustrations and produced the CD he planned to approach a publisher with his work.

By Stacey Doornenbal

# Quantifying liquefaction

Since September 2010, no earthquake phenomenon is more familiar to Christchurch residents than liquefaction. And no one knows the extent and significance of the Christchurch liquefaction deposits better than Professor Misko Cubrinovski (Civil and Natural Resources Engineering).

A world-renowned geotechnical earthquake engineer, Cubrinovski marshalled an extraordinary collaborative data-collecting effort following the Christchurch earthquakes. Earthquake engineers around the world agree that the result is likely to be the best liquefaction dataset in history.

Cubrinovski admits this was only possible because the quakes were so well recorded on 15 strong motion stations throughout the city and because the reconnaissance and field investigations conducted by the team were "unprecedented in quality and number".

The September 2010 earthquake caught Cubrinovski at an earthquake engineering conference in Macedonia. Because of the significance of the liquefaction event, many of his international colleagues were keen to assist. He organised them to arrive in Christchurch shortly after his own return, where they immediately faced the challenge of best approach — whether to cover every aspect, or focus on a select few. Using the expertise of his international colleagues and an army of students from many sources, the team was eventually able to cover everything. Their investigation sought to determine which particular soils were susceptible to liquefaction, and under what type and severity of earthquake would they liquefy. Records were taken of the ground deformations resulting from liquefaction — from lateral movement to ground cracking and settlement — and evidence was gathered of the impacts these deformations had on different structures, on high-rise buildings, houses, bridges, stopbanks and lifelines.

Of initial surveys with his overseas colleagues, Cubrinovski says their first effort concentrated on trying to understand what the geotechnical impacts of the event were. "This took us just over a week gathering evidence of the types of deformation and their impacts on different structures. We summarised our findings in a 77-page journal article<sup>1</sup> co-authored by the USA experts who were part of the team.

"We realised during this first effort just how much more work there was to do, and so enlisted UC PhD and ME students and a group of Summer Scholarship students from UC and Auckland University. Using EQC funding for liquefaction field investigations, this group systematically gathered different types of data and evidence until work was interrupted by the earthquake of 22 February 2011.

"Suddenly, everything had to be repeated," says Cubrinovski, "and we were all so exhausted, but yet again we could count on great support, because the overseas experts from Japan and the USA returned to help us again. Colleagues from the University of California Berkeley, Cornell University and Virginia Tech in the USA also brought grants back with them to continue the work and, of course, the students went back into the field again too. The drive to understand what was going on was intense."

Soil behaviour during earthquakes is extremely complex and the impact of soil on structures is even more complicated because of the interaction between the two in severe events. Many means are used to predict such interactions in the laboratory including soil testing and scaled down physical models of structures. These are placed in a box within a ground model and shaken using different earthquake motions to acquire a range of responses which allows for variability of ground movements. A variety of analyses are also used, from simplified – which are important from a practical standpoint, to advanced numerical analyses – which attempt to realistically simulate what is actually happening in the field.

"In addition, field investigations identify *in situ* soil conditions which are added to the liquefaction evaluation equation. Canterbury and Christchurch have a unique groundwater regime with so much water coming from the alps and moving through and beneath the city. This has a pronounced effect on the soils and creates some very unique environments," says Cubrinovski.

"The liquefaction observed in the 2010-2011 earthquakes and its impacts on engineering structures embody the combined effects of all complex and site-specific factors. This is why we have to capture the evidence in great detail and scrutinise it thoroughly in order to better understand our natural and built environments and how they interact during strong earthquakes."

One of the practical outcomes from the research is a map of liquefaction resistance for urban areas of Christchurch. It was a product of a short-term recovery project supporting the Christchurch City Council (CCC) in its efforts to recover the city water supply and waste water systems. Two factors – ground shaking intensity and liquefaction severity – were combined to produce a resistance index map that indicates the strength of the soils in relative terms. The map reflects soil resistance to liquefaction through zones 1 to 4, with the soils in zone 4 being four times more resistant than those in zone 1. Cubrinovski also quantified the deformation expected in each zone and this map is now used by the CCC as an invaluable tool prior to infrastructure design work and repair. The accompanying comprehensive report also correlates the performance of the water supply and waste water systems with liquefaction severity, and shows how different pipe materials performed during the earthquakes.

When Cubrinovski arrived in New Zealand almost seven years ago, there were no codes on geotechnical earthquake engineering. With colleagues, he immediately formed a working group to address this and is major author of the first NZ Geotechnical Guidelines on Liquefaction which were released just two months before the September 2010 earthquake. The wealth of experience and ensuing dataset that has been gathered from the Christchurch seismic events will allow a major update and upgrade of this code based on New Zealand specific data, "Now is the time to get the message across that we must build resilience into our society through good engineering. If we do this in Christchurch, other New Zealand cities will follow."

and further contribute to the development of international codes on liquefaction.

Cubrinovski and his team have amassed crucial information in terms of building resilience into any future city infrastructure. He is keenly aware that "times like these bring a wealth of interest and funding to earthquake engineering research — everyone is paying attention at the moment, and the community is listening".

"Now is the time to get the message across that we must build resilience into our society through good engineering. If we do this in Christchurch, other New Zealand cities will follow. If we do not — the next earthquake will have the same devastating results. We have the information we need and the methodologies are available to us, we now just need to make the right choices."

### By Jann O'Keefe

1 Cubrinovski, M., Green, R.A., Allen, J., Ashford, S., Bowman, E., Bradley, B., Cox, B., Hutchinson, T., Kavazanjian, E., Orense, R., Pender, M., Quigley, M. and Wotherspoon, L. (2010) Geotechnical reconnaissance of the 2010 Darfield (Canterbury) earthquake. Bulletin of the New Zealand Society for Earthquake Engineering 43(4): 243-320.



### Making the boardroom green



Professor Chris van Staden

### Companies keen to improve their environmental performance should take a look at the characteristics of their board of directors.

Research by University of Canterbury academic Professor Chris van Staden (Accounting and Information Systems), working with Professor Charl de Villiers (University of Waikato) and Associate Professor Vic Naiker (University of Auckland), has found that corporate boards play an important role in promoting strong environmental performance.

In November 2011 the research findings were published in the *Journal of Management* (37(6): 1636-1663) in a paper titled "The effect of board characteristics on firm environmental performance". Van Staden said although it was too soon to know what influence the paper would have, early indications were promising.

"We are the first to investigate the link between corporate governance and environmental performance," van Staden said.

"I expect interest from other researchers. More research is needed in this area."

Using information from two highly regarded databases, van Staden said the researchers found that the governance structure of a company is linked to the impact it has on the environment. For example, companies that had greater board independence and a lower concentration of directors appointed after the CEO performed better environmentally.

"Directors appointed by the CEO are more likely to be influenced by him or her, compromising the independence of the board."

The research also found that companies that have larger boards, CEOs of other companies sitting on the board and directors with legal expertise had better environmental performance.

"A bigger board will give a better performance because, collectively, it will have more knowledge and richness of expertise and diversity. A larger board will also be more independent, particularly if it's not involved in the management of the company or if members are not financially involved in the company, while CEOs of other companies bring a wealth of knowledge and expertise to the board," he said.

"Lawyers have an understanding of the risks involved if a company's activities contravene regulations. Not everyone understands these regulations, so having a lawyer or someone with legal expertise on board is an advantage."

Van Staden said the natural environment had become an important avenue for companies to gain competitive advantage.

"Consumers are becoming more and more aware of environmental issues and want products that are environmentally friendly and have not been produced in a way that pollutes. This means the market opportunities for companies that take the environmental impact of their activities into consideration can be substantial and the risks of not doing so can be huge," he said.

"If companies want to change their environmental performance, they have to change their governance."

Van Staden is also investigating environmental disclosure versus environmental performance – looking at the impact of environmental performance on reporting. Are companies misleading stakeholders about their environmental impact, compared to what they actually achieve?

Van Staden said he was excited to be doing more research within the field.

"Understanding how company environmental performance (long term and short term) influence where companies choose to disclose voluntary environmental information has practical implications for investors, regulators and other stakeholders interested in company environmental performance. Our findings imply that information users and researchers should consider voluntary disclosures in both annual reports and on websites, because the two media are used differently."

By Marcia Johnson

### Revolutionising medical imaging

A Ministry of Science and Innovation (MSI)funded research project based at the University of Canterbury to build spectral colour CT scanners suitable for use on humans is expected to revolutionise medical imaging globally.

The MARS (Medipix All Resolution System) collaborative project led at UC by Professor Phil Butler (Physics and Astronomy) and at the University of Otago by Dr Anthony Butler involves a multi-disciplinary team from engineering, mathematics, physics and HIT Lab NZ at the University of Canterbury and specialists from the University of Otago Christchurch.

"We have been working on this for six years and have enrolled 13 PhDs so far, in addition to producing spin out company MARS Bioimaging Ltd," said Professor Butler.

"Once the project develops to the stage where we are building equipment for use on humans the possibilities for deployment of the technology around the world are staggering."

While existing x-ray technology measures the total amount of x-rays that pass through an object a spectral colour CT scanner will allow diagnosticians to determine what they are looking at in a completely new way.

"We'll be able to do things like looking in the walls of human blood vessels and determine what is fat and we'll be able to see a complex molecule attached to blood platelets," said Dr Butler, who also splits his time as a UC researcher.

"This will be useful information for applications such as diagnosing heart disease or damage from stroke. Basically this will unlock a whole range of information that's always been there but it hasn't been easy for us to get at it. One way of explaining it is to say that the world had always been in colour but we weren't recording it that way."

The project was given a very positive mid-project endorsement from MSI at the end of 2011 and has funding for a further three years with the next stage being to develop the technology from its current use in a small animal scanner, which is about the size of a large barbecue, to being ready for loading into a human scanner.

"We believe that this will become standard medical technology in the next 5 to 15 years and that it will make diagnosis easier all around the world," said Dr Butler.

"We will be able to get better characterisation of disease, including a better understanding of how it is behaving and better monitoring of that behaviour. It's not so much a matter of gaining more detail but gaining a better quality of molecular and physiological information."

Two heart disease researchers from Virginia Tech in the USA, and one researcher from the Mayo Clinic, were brought to Christchurch in 2011 to collaborate on the project. In the first term of 2012 two researchers from the German cancer research centre in Heidelberg have been brought to Christchurch.

The collaborative approach that is at the heart of the research project has been crucial, said Professor Butler, and was particularly evident post-earthquake when the University of Otago Christchurch was unable to use its premises in the central city.

"The team worked hard together to get our research back on track and we were delighted to get to the end of 2011 and receive such a positive endorsement from MSI," said Professor Butler.

Excitement is building internationally as the potential of the locally-built technology becomes clear.

"Research labs know that there is a new tool coming for them and they are learning what they will be able to do with it," said Dr Butler. "This really is 'the next big thing' in the medical imaging world."

**By Jacquie Walters** 



Professor Phil Butler



# Challenging the traditional concept of learning

New research published by academics at the UC College of Education has investigated the implications of the 2007 revised New Zealand Curriculum for how teachers, educators and student teachers understand what it means to know and to learn in the  $21^{st}$  century.

The Teaching and Learning Research Initiative (TRLI) funded research project, titled "Shifting conceptualisations of knowledge and learning in the integration of the New Zealand Curriculum in teacher education", was led by Dr Kathleen Quinlivan (Educational Studies and Human Development) and Dr Jane Abbiss (Māori, Social and Cultural Studies), along with former UC colleague Dr Vanessa de Oliveira Andreotti, now based at the University of Oulu, Finland. Also involved in the project as practitioner researchers were Dr Jae Major, Alison Ayrton, Juliet Fry, Helen Moore, Kerri Fitzgerald, Judi Bruce, Amosa Fa'afoi, Wayne Freeth and Neville Myers. The project aimed to understand how to best support educators to explore and critically engage with 21<sup>st</sup> century ideals of knowledge and learning, and how they affected pedagogical practices. Preparing students as 21<sup>st</sup> century learners is an underpinning concept of the 2007 New Zealand Curriculum.

"What we attempted to do with this project was to make a case for valuing ways of knowing which, traditionally, have not been given particularly high status," said Quinlivan. "Instead of thinking about knowledge and learning in terms of narrow conceptualisations of 'back to basics' literacy approaches we critically engage with and re-vision the knowledges considered most worth knowing. For example, in two case studies we explored the potential of embodied ways of knowing through dance and the visual arts, and considered the extent to which they enabled young people to live and to learn in contemporary times."

The project also endeavoured to position educators, both teacher educators and teachers in schools, as active and critical curriculum constructors, rather than technocrats.

The project included eight case studies produced by the practitioner researchers. Each practitioner researcher, including both pre-service and inservice teacher educators, explored projects within their area of professional interest and practice. The educators' explored knowledge and learning within a diverse range of contexts, including engaging with cultural difference, leadership and teaching ESOL.

"One of the case-studies involved a teacher educator whose project explored what it means for teachers to be 'knowers'. An issue in teacher education is that there is often the expectation that teachers have to take on this mantle of becoming an authoritative 'expert knower', yet that orientation is not always helpful in encouraging students to engage with what it means to live and learn in uncertain contemporary times. The project explored the possibilities and challenges of reframing teachers' identities as knowers. It can be really destabilising for a teacher, to call into question such a taken-for-granted role," said Quinlivan. The methodology used by Quinlivan and Abbiss to analyse the data across the case studies was itself unique. A dual meta-ethnography was carried out from interpretivist and poststructuralist viewpoints. This offered two interpretations of the data, which included the eight reported case studies, pre- and postinterviews with practitioner researchers and pre- and post-questionnaires completed by student teachers and teachers in schools who were participants in the case study projects. The interpretivist analysis focused on the practitioner researchers' narratives of the issues raised in shifting conceptualisations of knowledge and learning. The post-structural analysis focused on ways in which both the overall project and the case studies operated as sites of resignification of the knowledges considered most worth knowing, and critically engaged with the politics of knowledge production.

"Doing a dual-analysis of the data was quite an innovative aspect of the project," said Quinlivan. "Most research looks at the data through one theoretical lens, but we were interested in exploring the potential of complementary theoretical understandings. We analysed the data from two different perspectives; the findings had two different theoretical spins on them. Undertaking a dual analysis meant that the results were so much richer and more nuanced."

The research has been submitted to TRLI and will soon be published on its website. For more information visit www.tlri.org.nz.

By Nick Maitland

# A smart approach to water management

Aquifer levels are falling, saltwater is encroaching on underground water systems, nitrate and phosphorus runoff is on the rise and sediment build-up and land development are increasing the risk of flooding. All in all, says UC senior lecturer in management science Dr John Raffensperger, our systems for coping with water risk are "a bit of a mess."

"Living sustainably means living under constraints. We have to learn to live with the available water and, to do that, we need to manage it better."

Raffensperger and other members of the University of Canterbury's Water Markets Research Group (WMRG) have devised a way to do just that, using ecological science, mathematical modelling and smart market trading to find the highest value commercial use for available water while also protecting the environment.

"The idea is to think collaboratively, to be more aware of what is happening over the fence. The current system is litigious but if you have a smart market people are incentivised to get along — they have to be fair."

A smart market is an auction in which a resource is traded by a pool of users within a set of physical constraints. In trading groundwater, for example, an auction manager would use a hydrological optimisation computer model to allocate water on the basis of users' bids, sustainable river flows and real time monitoring, so allowing permit owners with unused water capacity to find a buyer, and those needing more water capacity to find a seller.

It is, says WMRG member Associate Professor Mark Milke (Civil and Natural Resources Engineering), "a completely new way of managing the environment".

"Councils have a fairly sophisticated understanding of their water source to manage current allocation but even that is pretty much 'first come first served'. If you want some water you go to the council and say this is how much I want and this is what I want it for and they check to see if it will put them over some limit and if it's not then they say that's fine."

As people rush to stake their claim the country's resources are being pushed to their limit.

"One mindset is if water falls on my land it's mine," says WMRG researcher Professor Grant Read (Management). "If it flows past my back yard it's mine. If I can suck it out of the ground irrespective of where it comes from — it's mine. So whoever sucks hardest gets the most. That is a race to the bottom. If you go to some parts of the world you find whole villages dead because people put down deeper wells to suck the water out, leaving traditional wells dry so people have had to abandon the place. Then you come to a beautifully irrigated field owned by some farmer wealthy enough to afford a modern pump."

In putting a price on a unit of water at a particular place and at a particular time the incentive to hoard water is gone and agriculture has to contend with the real worth of this most undervalued of resources. In times of drought, for example, the price of water would go up, so incentivising conservation (no longer, says Raffensperger, would we see irrigators operating during blistering nor'westers). Periods of low demand, on the other hand, would encourage diversification into non-traditional farming practices.

Across the world smart markets are being used for natural gas, radio spectrums, university enrolments (including at Raffensperger's alma mater, the University of Chicago) and, most commonly, electricity. "The idea is to think collaboratively, to be more aware of what is happening over the fence. The current system is litigious but if you have a smart market people are incentivised to get along they have to be fair."

"You can't actually define how a particular unit of electricity flows from producer to consumer," says Read. "It is more as a set of equations in which flows are driven by changes in [electrical] pressure. Underground water is much the same. If I pull out one more unit of water here it doesn't take one unit off someone somewhere else — it will take part of a unit over here and part of a unit over there — it will have quite diverse effects."

Unlike electricity, however, there is a delayed effect with groundwater use — you can suck water out of the ground for quite a long time before seeing the impact somewhere else. By then, too, the quality of the water may have dropped as lower pressure results in more saltwater intrusion.

Concerns that smart water markets will be dominated by big users are, says Raffensperger, unfounded. "They still need land to irrigate and the water is so dispersed in the ground it is difficult to stand in one place and get all the water. Big operations will have a bigger benefit but proportionately the smaller user will benefit just as well."

The benefits are considerable. Under a smart market the consent process is faster, application costs (usually around \$5000) are lower and farmers can sell unwanted water.

And all it requires, says Raffensperger, is a secure website, an accounting system and a "modest office".

The system can also be adapted for other forms of water use. Management science student Stephen Starkey is examining smart markets for urban water networks, using an optimisation model to manage trade between reservoir operators, desalinisation plant operators and retail water suppliers.

Fellow student Antonio Pinto, co-supervised by senior lecturer Tom Cochrane in the Department of Civil and Natural Resource Engineering, is studying smart markets for sediment and runoff, so improving water quality, reducing flooding and incentivising the planting of more green spaces. Management science PhD student Indra Mahakalanda is studying the relationship between electricity and water (electricity generation uses a lot of water and water pumping uses a lot of electricity).

As senior lecturer in management science Dr Shane Dye explains, all these smart market models facilitate things people want to do. "It just makes it easier, and instead of spending money on litigation you are helping each other."

By Sally Blundell

47

# Power computing

### High Performance Computing (HPC) is now an indispensable component of modern science.

"Our world is based on computation now and we can't solve the big science problems without it," says Professor Tim David, Director of the Blue Fern Supercomputer at the University of Canterbury.

David says that although New Zealand is a small country it experiences some of the world's most complex scientific problems and computational research is vital in order to address these.

The original Blue Fern computer was the result of collaboration in 2007 between the University of Canterbury and IBM as part of the Partnerships for Excellence Project and was the first Blue Gene in the southern hemisphere.

"Three years ago we began to lobby government saying that from an economic benefit point of view you need to support High Performance Computing as part of your infrastructure policy."

In 2011 as part of the government matched funded National e-Science Initiative (NeSI) UC upgraded Blue Fern to a Power 7 system along with the new IBM Blue Gene P, enabling 10 times the operational capacity.

"The new computer is half the size but 10 times faster. An absolutely brilliant piece of technology," David says.

The Blue Gene now has 8192 processors with eight times more memory per block than before.

Each processor acts individually but also has the capability to "talk" to other processors on thousands of different levels "so you have this massively parallel architecture".

Another significant aspect of the Blue Gene is its "greenness". With a maximum power requirement of 60kw (per rack of 4096 cores) it exhibits a very efficient way of utilising thousands of processors. The total cost of operation is an important factor as huge electricity bills would eventually end up costing more than the technology itself.

Blue Fern is capable of mathematical computations on an unprecedented scale and has been used in numerous projects.

"We run a number of challenges as a way of promoting the use of massive supercomputing requirements and offer over a million processing hours [on the HPC] to the person who comes up with the best academic project."

The 2010 winner was Dr Nick Golledge from the University of Victoria. He studied glacier motion in the Southern Alps over thousands of years using mathematical modelling to predict outcomes for a variety of different scenarios including predicted climate change. He could never have done it without HPC.

"The glaciers at the northern end of Lake Pukaki provide your electricity every morning so it is extremely important to understand what our glacial environments will look like over the next 50 to 60 years."

in 2011 UC ran the Fast Start Grand Challenge open to young researchers within five years of completing their PhD, giving the two winners one million CPU hours each.

One is using Blue Fern for investigating phylogenetic trees whilst the second is looking at DNA sequence recognition by electrostatic DNA-DNA interactions.

The first Blue Fern PhD scholarship recipient, Nick Baker, is about to start work with Dr Daniel Stouffer (Biological Sciences) on understanding the relationships between animal species. This research is important from a variety of perspectives including future eradication programmes.

In 2011 Dr Mohsin Shaikh, a post-doctoral researcher funded by the National Heart Foundation of New Zealand, used Blue Fern for multi-scale modelling to understand the propagation of information between millions of different cells particularly in relation to cardiovascular disease. Using HPC he was able to model both individual cells and the arteries, in scales ranging from 25mm to 25 microns.

"It paints a picture that no one could ever see before. For the first time we are beginning to understand how our own cells interact with each other and why cardiovascular disease only occurs in specific sites in the body. If you can understand why these cells initiate cardiovascular disease then you are well on the way to solving one of the world's biggest problems," David says.

"We can't do these experiments in the lab but we can do it numerically. That's what makes it interesting — computers have become the new laboratories."

In the future, David hopes to use HPC for social agent-base modelling to examine how an individual may react to an environment given a set of parameters and the outcomes of modifying them — but on a scale of thousands. Through this research we could explore, for example, the impact of changes in government policies on thousands of different stakeholders.

One of David's PhD students is studying diabetes using HPC to model the entire cardiovascular system of the brain. Using much of Harvard Medical School Vera Novak's real human data along with numerical computation, HPC can replicate and understand relationships on a cellular level.

"We are answering science questions now no-one would be able to answer without this kind of kit."

As a result of the upgrade, the old supercomputer is now used exclusively for education, making UC the only university in the



### Blue Gene/P

world which has a Blue Gene used specifically to train students in HPC.

Blue Fern also operates commercial contracts with industry both as student projects and on a purely commercial basis and provides a service as a collaborative partner in NeSI to researchers outside the University by making application and support staff available to help with projects.

Blue Fern was used as a data depository for the earthquake but David believes the supercomputer's massive computational ability could be used to help create "the whole picture" in the decision-making processes regarding the CBD re-build by modelling potential scenarios and their outcomes.

"We would love to help Christchurch get back on its feet. The environment will be very different and town planners and civil engineers may not fully comprehend the impacts on every level."

David says scientific discovery has been a fairly slow process.

"We are still relying on the theories of Newton and Einstein. Technology is the opposite. If we can link the two we can use it to benefit the community.

"Computation will only grow. The University of Canterbury has been at the forefront and we will continue to be."

By Vicky Cran

Section Storage

"We can't do these experiments in the lab but we can do it numerically. That's what makes it interesting – computers have become the new laboratories."

### Schools can benefit from better parental involvement

Parents can have a positive effect on their children's development when they get involved in their education. Schools stand to gain significantly by forming strong relationships with their students' parents and caregivers through co-ordinated parental involvement policies and practices, and staff development programmes. Better yet, it doesn't have to be a costly exercise, according to research by Professor Garry Hornby of the University of Canterbury's School of Sciences and Physical Education.

Research consistently shows that parents' contributions to their children's education lead to improvements in their academic and behavioural outcomes. Hornby has been involved in extensive research over the last four years with schools in the Canterbury region — 11 intermediate schools, 21 city primary schools, 22 rural primary schools and 21 secondary schools.

Hornby's new book provides an overview of parental involvement and offers practitioners such as teachers and psychologists a detailed understanding of how to optimise parentteacher collaboration. *Parental Involvement in Childhood Education: Building Effective School-Family Partnerships* (Springer, 2011), summarises results of the studies conducted in Canterbury schools. It also provides methods for evaluating parental involvement and presents a model for developing and maintaining strong parental relationships, with an emphasis on flexible communication and greater understanding of parents' needs. "I've been investigating what schools do in terms of parent involvement with the aim of saying 'how could they improve this?;" Hornby said.

"What we have found is that there are many examples of excellent and innovative practices found at all levels, but effective practice of parental involvement isn't consistent across the schools."

One of the most notable gaps was a lack of written school policies on parental involvement.

"Basically, schools need to have a written policy on parental involvement developed by the board of trustees in collaboration with the staff and parent community," he said.

"They then need to have effective organisation for parents' involvement with the school led by a parental involvement co-ordinator, who would be an experienced teacher. That teacher can do an audit of existing practice, check out whether it needs to be improved and do some training with less-experienced teachers."

Hornby also found that parental involvement declined as children progressed through primary and intermediate schools and was at its lowest at secondary schools. Practices within schools were often ad-hoc and reliant on senior teachers who saw value in establishing initiatives.

"In the studies, we asked teachers what professional development they got in parental involvement and most schools said very little. A couple of principals said they did training sessions with staff before parent evenings, so there are some good things going on, but they are dotted here and there and it's very much dependent on the experiences of the senior staff." Specific strategies to involve parents from diverse backgrounds also need to be developed.

"Schools need to think more about how they are going to get involved with parents who are not your 'standard parent'. Some parents have English as a second language or come from different cultures. Some are parents who have children with special needs, or who are gifted or have health problems," Hornby said.

Rather than being a costly enterprise, often a school can gain substantially by merely committing to establishing better parental involvement practices.

"In terms of its impact on academic achievement, parental involvement is an important factor and it's not actually an expensive thing to do. If schools take on board the role of improving their relationships with parents and giving them more guidance on what they can do with their children at home it's not going to cost any money but can potentially have quite a big impact. As parents, we don't get any training or advice on what we should be doing to help our children's development and it's a constant challenge, so parent education provided by schools can be very useful."

Hornby also considers that teacher education providers need to equip teacher trainees with skills to better foster parental involvement strategies.

"People like me, in teacher-training institutions, need to think about how we can better train



Professor Garry Hornby

teachers for working with parents, both preservice and in-service teachers. We definitely have an important role to play in preparing teachers to work with parents."

By Nick Maitland

### New software renders city in pre-quake glory

Based on current estimates, the Christchurch city centre may take years to rebuild, but staff and students from the University of Canterbury's HIT Lab NZ have managed to reconstruct its buildings in a fraction of that time.

Using Augmented Reality, technology that blends Virtual Reality with real-world objects, the team has constructed a 3D remodelling which enables the user to walk around and view the cityscape as it was pre-earthquake.

The project, spearheaded by Professor Mark Billinghurst and Dr Raphael Grasset, has been two years in the making. Hit Lab NZ was developing the software base used by the system when the earthquakes of September 2010 provided the catalyst for an alternative application.

"Two years ago we started writing software that let you overlay 3D content on the real world. One of the initial applications was for architects to walk around and see buildings in place. We had a prototype working last year and when the earthquake happened we wanted to help support the rebuild of the city so thought about taking what we'd done and expanding it to work with dozens or hundreds of buildings rather than just a single one," said Billinghurst.

The team then joined forces with Christchurch architecture firm ZNO, which helped overcome the challenges of providing accurate content for the programme.

"We didn't have the resources to create 3D models ourselves so we partnered up with Jason Mills from ZNO who had been modelling Christchurch before the earthquake and was happy to donate those models to us. We also had other partners. CEISMIC, a group from UC's School of Humanities that is collecting a digital repository of information about the earthquake, gave us photographs of buildings before and after [the earthquake]. We are still getting content in so it will be an ongoing project."

The application, released in October 2011, is free for anyone with an Android phone to download and view. It is also being utilised by government agencies charged with rebuilding Christchurch.

"For the public it will be a helpful way of creating a remembrance of the city. We are now working with CEISMIC to get more historical content so

"We are hoping to create a platform that's easy enough to take and drop into a city somewhere else. Christchurch is really a test bed of what we could do internationally." people can go back in time 50 or 100 years. Then we're working with the Christchurch City Council and CERA [Canterbury Earthquake Recovery Authority] to go forward in time so people can use the platform to visualise buildings yet to be built, which could be useful for the council in getting community feedback on their designs."

It is hoped the software will eventually aid other earthquake-prone areas to catalogue buildings and potentially assist in rescue and rebuilding works.

"We are hoping to create a platform that's easy enough to take and drop into a city somewhere else. Christchurch is really a test bed of what we could do internationally.

"We have a related project in development that will allow live video feeds using mobile phones to be sent to search and rescue teams. For example, you may have a team looking at entering a building but are unsure whether it is safe or not. They would be able to use their phones to take a live video feed, send it to a civil engineer remotely and the expert could then look at the feed and take images and provide feedback annotations to the people in the field."

The technology is not limited to cityscapes. The software is aimed at overlaying 3D content outdoors so could be used to show old Māori pa sites or battlefields onto which historical information could be superimposed.

The HIT Lab NZ has already received much positive feedback, based only on a website, an appearance on TVNZ's *Close Up* and word of mouth.



Professor Mark Billinghurst

"We've shown the software to a number of people at the University. They have come up with their own ideas of how it could be applied so we are getting new ideas for uses and people have been very impressed by the technology."

By Mike Anstee

# Treasures brought to light

Many seldom-seen historical items belonging to the University of Canterbury are being showcased in a newly published book, *Treasures of the University of Canterbury Library*.

Thirty-seven people from within the University and from around Christchurch have worked together to create the illustrated book published by Canterbury University Press.

The book details the history and significance of about 60 of the historical items in the University collection, including photographs, books and printed material which have been given by the public over the years.

The book's general editor, Senior Lecturer in Medieval History Dr Chris Jones (Humanities), said the University's collection differs from that of many universities' collections in that it had come in the form of many small donations over the past century, rather than the usual method of one large donation coming from a single donor.

"That's often been regarded as a sort of disadvantage because it doesn't give an obvious structure to the collection. But, actually, the great strength of this is that you can write the history of Christchurch and the whole community based on the items we've accumulated over the years," Jones said.

Another bonus was that it gave the University's collection a great range of items from diverse backgrounds. Jones said they had not realised how rare several items were until they researched them for the book.

One of the discoveries was a rare 1494 Lubeck Bible, the only one in the southern hemisphere and one of only 72 known copies in the world. It was donated to Christ's College by Arthur Perceval, chaplain to Queen Victoria, who was given the bible in 1846. Christ's College subsequently presented it to the University. "There are some extremely unusual items. We have a 15<sup>th</sup> century English genealogical roll, which is 16 feet [almost 5 metres] long. It's an unusual and unique item, a family tree written by hand from Noah down to the English king Edward IV."

This genealogical roll, known as the Canterbury Roll, was purchased by the then Canterbury College in 1918 from Sibylla Maude, better known as Nurse Maude. Little is known about the roll's history between 1483 and the early 20<sup>th</sup> century.

Another interesting item was the Tokyo War Crimes Collection, the only item, along with the Treaty of Waitangi and Women's suffrage petition, that is recognised in UNESCO's Asia/ Pacific Memory of the World Register.

The collection — the Pacific's equivalent of the Nuremberg Trials — contains almost 380 volumes and nearly 110,000 pages from the trial of Japanese war criminals held between April 1946 and November 1948. The papers were donated to the then University of Canterbury College by Justice Erima Harvey Northcroft, New Zealand's representative on the International Military Tribunal for the Far East, after the trial ended.

Other items surveyed include medieval manuscripts, Māori whakapapa books, an original printing of the 1611 King James Bible, the papers of the philosopher Karl Popper, a 15<sup>th</sup> century copy of the Nuremberg Chronicle, the Pacific Leprosy Foundation Archive, a Tudor statute book, a signed author's edition of *Leaves* of Grass (1882) by American poet and journalist Walt Whitman, and documents, photographs and watercolour paintings from the Ursula Bethell Collection. "Sometimes this sort of material gets hidden away and forgotten about. What we want to do here, particularly in the wake of the earthquakes, is to say 'we've got this fascinating material right here at Canterbury. Come and look at it," said Jones.

Jones said the desire to increase public knowledge and interest in the University's collection was one of the main goals of the project.

"It's not intended to be academic-light. It's intended to be solid stuff but absolutely jargonfree, absolutely comprehensible. That's the guiding principle."

Accompanying the book's official launch in May 2012 will be a three-month exhibition of treasures featured in the book, called *Canterbury Tales*, which will be run jointly with the Canterbury Museum. Jones hoped the exhibition, which will run from 20 April to 22 July, would help establish the importance of the University's collection.

"We're aiming to take some of these fascinating items out of our vaults, explain them to the public and say to people these are things that are uniquely Canterbury. Together they tell the story of both the University and the community."

Treasures of the University of Canterbury Library, edited by Chris Jones and Bronwyn Matthews with Jennifer Clement, published by Canterbury University Press, 2011, RRP \$40, paperback, ISBN 978-1-9277145-04-3.

•

By Martin Moore

Dr Chris Jones



# **Unpicking communication**

Professor Jennifer Hay, Director of the New Zealand Institute of Language, Brain and Behaviour (NZILBB), describes University of Canterbury's decision to fund the institute as "insightful". Associating related fields under one umbrella has enabled 30 academics from 11 different departments to "nudge towards one another to be able to focus on ideas we would never have researched independently".

NZILBB was first formed in 2010. Since then it has hired postdoctoral researchers, recruited new graduate students, and set up new labs. Hay (Languages, Cultures and Linguistics) is happy to say they are "really hitting their stride now and conducting exciting multidisciplinary work".

NZILBB has many external partners, including MARCS Auditory Laboratories in Sydney. A joint postdoctoral fellow has helped cement the relationship with MARCS. NZILBB's expertise, impressive laboratory equipment, and a unique depth of historical and multimedia recordings and resources have also been a drawcard for international visitors and fellows to UC — all substantiating a new, more "open" approach to research and contributing to their knowledge. NZILBB aims to produce a complete model of how people communicate in differing social contexts. New research shows that how we interact is more than just acoustic; it's about the subtle combination of perception, surrounding influences, gesture and memory. Looking at the entire system of how a person conveys and understands information is both fascinating and enlightening. Immediately the potential application of these studies becomes apparent — speech language therapies, bilingual studies, multimedia and digital industries, advertising, psychiatry, the list is endless.

Our brains store patterns or strategies to help us understand speech and words. Experiments conducted by NZILBB are honing in on these, exploring our perception mechanisms to see how people respond in different circumstances. For example, Hay's research, funded by the Rutherford Foundation, asks questions such as: Who do you think you are listening to? What do you think you have heard? What has been added to this by your preconceptions, your surrounding impressions, or through the non-verbal language of the speaker? One such study involved candidates being influenced in their perception of vowel sounds. The participants who viewed a stuffed kangaroo toy in the corner of the room heard more Australian vowels than the people who could see a stuffed kiwi.

Speaking to someone who appears in a certain socio-economic class, gender, or age can affect you. For example, a recent PhD study involving both psychology and linguistics gave participants an opinion-based questionnaire regarding social issues. A change in the voice asking the questions elicited differing responses — a female voice evoked more supportive feedback.

Five major themes are being researched at NZILBB — language and ageing, language and social cognition, language variation and change, language acquisition, and bilingualism.

Associate Professor Megan McAuliffe (Communication Disorders) is leading the language and ageing projects. Studying hearing loss and neuro-degeneration in the elderly is one of the major research themes of the NZILBB. They are focused both on normal ageing and on conditions like Alzheimer's, Parkinson's or stroke. The relationship between language and social cognition is being led by Professor Lucy Johnston (NZILBB). A ubiquitous view of language speech, gait, gesticulation, emotion and expression is closely tied to the other research themes.

Language variation and change looks at how language varies across speakers and time, and how listeners cope with this variation. The University of Canterbury is lucky to have more than one thousand hours of audio recording, capturing the entire history of New Zealand English. This collection — known as the Origins of New Zealand English project — facilitates research into how early settlers' accents have blended over time to what we now call the New Zealand dialect. NZILBB continues to grow its collection of recordings — studying language across the entire lifespan, and including high quality video — in order to understand the relationship between speech and gesture.

Studies of bilingualism are headed by Associate Professor Jeanette King (Māori and Indigenous Studies). Working with Te Kura Whakapumau i te Reo Tuturu ki Waitaha, NZILBB is looking at how Māori language is acquired. The group is particularly interested in the whole-body effects of bilingualism. How does what language you are speaking affect how you gesture or how you walk?

The research into language acquisition looks at the development of language in children. One aim is to produce data that can be used by health professionals, speech language pathologists, teachers and parents. Studies are being undertaken on the speech of normal children and those with disorders such as autism, dyslexia, apraxia, multisystem developmental delay or brain trauma. NZILBB also works with early intervention at The Champion Centre — funding an observation laboratory for children with severe developmental delay.

"We have a lot of exciting new toys that really change the way we can look at a lot of these questions", says Hay, referring to the institute's new 3D suit to track inertial movement. They also have equipment for tongue tracking, eye and motion trackers, an ultra-sound, an electromagnetic articulograph, an EEG machine, and state-of-the-art observation laboratories all capable of capturing the nitty-gritty of "mouths, minds and movement". Much of this equipment is unique in New Zealand. Institute researchers also make use of the Human Interface Technology Laboratory (HIT Lab NZ) on campus, using augmented or immersed realities. Human/robot interaction is also recognised, with humans learning ROILA, a robot interaction language.

Hay says research findings will be published in international journals and released as annual reports. What's more, this innovative research is already trickling down into the community, with work under way with TAIT Communications on a project aimed at optimising communication in noisy and stressful circumstances. This sort of collaboration is part of the future challenge for Hay and her team: viable applications, new interfaces for video or voice recognition, speech synthesis devices, refined recognition systems that identify speaker dialects.

"Our research is answering questions that can feed directly into this technology," says Hay. "It's a big leap."

By Amy McDaid



"With increasing developments in biological microelectromechanical systems and medical devices, understanding how cells interact with surfaces and materials is becoming very important."

¢.

1

### Bioimprints provide valuable research platform

A computer engineering laboratory is the last place one would expect to find biological cells, but at UC they are an intrinsic part of an innovative project led by Associate Professor Maan Alkaisi (Electrical and Computer Engineering).

Using nanotechnology, Alkaisi and his team are able to produce synthetic bioimprints platforms with structures that exactly mimic biological cells. They use these imprints to investigate how cells interact with different materials and different patterns and to study how the imprints affect cell growth, differentiation and various other processes.

"With increasing developments in biological microelectromechanical systems [BioMEMs] and medical devices, understanding how cells interact with surfaces and materials is becoming very important," says Alkaisi.

The technology for the imprints evolved out of another project employing high-resolution microscopy to observe cells at the nanoscale. To do this, researchers were using an extremely powerful atomic force microscope (AFM) which comprises a cantilever with a sharp probe at its end to scan the surface of specimens. The aim of the original project was to probe for cell abnormalities in an attempt to detect cancer at an exceptionally early stage.

Explaining what led them to create the imprints, Alkaisi says: "In imaging biological cells with the AFM at very high resolution we came across two particular problems. Either the exceptionally fine atomically sharp probe would get contaminated by the cell media, with a subsequent loss of resolution, or the cell surface would be damaged as the probe drew across it. The initial impulse, therefore, was to replicate cells to maintain the high-resolution imaging of the AFM and offer snapshots of events happening on the cell membrane.

"We can now make three-dimensional images, somewhat like taking a three-dimensional photograph of the cell itself and then replicating the surface. The surfaces themselves are passive, but there are certain shapes on them that resemble biological tissue. These are made out of a special type of plastic, or biocompatible polymer, that resembles biological tissue down to the finest detail.

"These platforms are utilised as culture growth surfaces. They can be made to have flat, lithographically defined patterns or bioimprinted cell patterns. The soft lithography technology used to define patterns is similar to that used to produce electronic devices. Firstly, living cells are placed on slides and a special polymer is applied over the top. The slide is then rotated rapidly while being exposed to UV light. The result is a hardened polymer platform which can then be peeled off. This platform exactly mimics the micro-nanoenvironment of the original biological cells. These platforms can then be used as casts to produce further copies on different materials.

"To date, we have replicated many different types of cells including pituitary and muscle cells. We have also been able to capture images of cell processes such as exocytosis at various stages. The work is very exciting and the applications could obviously be far-reaching," says Alkaisi.

"As a new medium for studying cell processes, they may well replace the traditional petrie dishes or glass slides used by medical researchers. But we see a major future application in improving the success of medical implants. Nanostructured materials which mimic the nanometric topography of the native tissue show improved biological responses and result in better integration in medical implants.

"With implants, there is always the issue of acceptance or rejection. It is therefore very important that implants are biocompatible to increase the probability that they will be accepted. They are also much more successful if they are bioactive, meaning that the implant itself will encourage the living cells in the recipient body to grow on it. We can see that if our bioimprints were used as surface coatings on implants they would greatly improve both their biocompatibility and their bioactivity and we are now exploring replication of other biological specimens for bioactive coatings with this in mind.

"We have also incubated individual cells and groups of cells on other substrates designed to mimic certain physical elements of the physiological environment and compared the results to substrates patterned by our bioimprint method. The bioimprint is a unique capability that we have developed and it has not been used before in this context." The project epitomises collaborative, multidisciplinary research. Alkaisi, an electrical engineer, leads the project with researcher Dr Volker Nock at his side. Nock is also an electrical engineer with substantial training in biological processes. Associate Professor John Evans, a cell regulation scientist from the Christchurch School of Medicine and Health Sciences at the University of Otago, is biologist on the project, providing the cell lines and the knowledge on how to culture, observe and analyse them. Dr John Mitchell, a chemist from the Plant and Food Research Centre in Hamilton, provides the biocompatible polymers.

Three PhD students have been involved in the project: Lynn Murray has worked on micro- and nanoscale patterning using bioimprints; Fahmi Samsuri on single cell analysis using atomic force microscopy; and Siti Noorjannah Ibrahim on integrations of the biochip/bioimprint for single cell analysis.

An international collaboration has also recently been established with researchers from National Cheng Kung University in Taiwan, whose interest in the bioimprints is prompted by their own work in fabricating 3D cell structures. In the future, Alkaisi hopes this collaboration will shed light on how the cells interact with the surrounding environment and how patterns affect or guide organs in forming their final shape and size. It will help in developing a model for cell-surface interface interactions and to differentiate between the roles of chemical and topographical environments in cell growth.

By Jann O'Keefe

### Chemical linked to development disorders

A chemical used to prevent New Zealand soldiers from contracting a tropical disease during the Malayan Emergency of the 1950s and 1960s has been linked by a University of Canterbury chemist to sexual development disorders in the soldiers' descendants. Toxicologist Professor Ian Shaw (Chemistry) has been working with members of the New Zealand Malayan Veterans Association to study the effects of exposure to the chemical dibutylphthalate (DBP).

During the Malayan Emergency, DBP was used by soldiers as an acaricide to avoid contracting bush typhus, which was transmitted by ticks. It was painted onto the seams of their uniforms where it came into contact with their skin.

A survey of veterans found the incidence of reproductive disorders associated with exposure to DBP to be high compared with the incidence of the disorders in the population as a whole.

"These findings were very, very interesting and are incredibly controversial. We found that those exposed to DBP didn't suffer any effects but their children did, particularly the male children," Shaw said.

DBP belongs to a group of chemicals known as endocrine-disrupting chemicals (EDC), some of which affect the balance of male and female hormones in the body by either mimicking the female hormone, oestrogen, or slowing down the production of the male hormone, testosterone. They do this because they have similar structures to hormones and so they can fool the body into believing it is reacting to a normal hormone rather than a foreign chemical, leading to a disruption of normal body functions such as sexual development. In men, high levels of oestrogen or their chemical mimics, or low levels of testosterone can cause feminisation.

Shaw said lab tests in animals carried out by researchers around the world had linked

exposure to DBP to reduced levels of testosterone and cryptorchidism — where the testicles fail to descend into the scrotum — and hypospadias, a birth defect where the opening of the urethra is on the underside of the penis. In addition some EDCs have been linked to breast cancer.

"Researchers worldwide are convinced these chemicals are causing these changes in sexual development but it's been very difficult to prove absolutely because we can't give DBP to people and wait 20 years to see what happens. So the DBP-exposed veterans have been an interesting, though small, cohort to study — we know they were exposed and we know how much they were exposed to — and it was 10 per cent higher than the minimum amount known to be needed to have an effect," he said.

"This is also the first time research has shown that exposure of a human male to an EDC can lead to defects in his children. The implications of this are huge. EDCs are present in the food we eat so we have no choice as to whether we are exposed to them or not."

Former serviceman and member of the Canterbury branch of the Malayan Veterans Association, Ray King-Turner, said members had long been concerned with the possible effects of DBP as there had been a lot of health issues among veterans' families.

"One of our members, Jack Stanaway, wrote to our national body suggesting we find someone who could do some scientific research for us. We saw Ian in the paper talking about a book he'd just written on the effects of chemicals on humans, so we called him and he was very keen to help us," said King-Turner, who served in the air force so did not come into contact with DBP.

He said the aim of the project was to ensure veterans' descendants had access to the best possible medical advice, if they needed it.

"It's been excellent working with Ian and he has found that our suspicions are justified. We were very lucky to have found the right man for the job."

As well as the survey, Shaw and honours and summer scholarship student Matt Carran looked at how much of the chemical was needed to cause defects, tested how much of the DBP was likely to pass through the soldiers' uniforms, and how much could be absorbed through the skin.

"As best we can, and with the data we have, we've shown that it is very likely the veterans' exposure to DBP did have an effect on them and their children. The huge question we have now is how these chemicals affected their DNA."

Shaw said one idea he had was that the chemicals affected the DNA in the sperm chromosomes. When the ovum was fertilised the altered DNA had an impact on the developing child. To follow this up, Shaw is now working with Professor Martin Kennedy, from the University of Otago Christchurch, and MSc student Hannah Acram to find out what effects DBP has on genes. Shaw hopes to extend the survey to the descendants of the veterans and to the soldiers of the Auckland area who also served in Malaya.

By Stacey Doornenbal



8

HARE CLUSTER

\*

also -

# **Celebrating innovation**

Mechanical engineering associate professor Keith Alexander – well-known for his "spring-free" trampoline invention which is sold around the world – has been honoured with the 2010 University of Canterbury Innovation Medal.

Deputy Vice-Chancellor Professor Ian Town said there was very strong competition for the medal and he was "delighted to see the breadth and depth of innovation at UC as evidenced by the nominations received". He said Alexander was a very worthy recipient of the inaugural award.

"Many people may not be aware of his many other ideas which are in various stages on the way to commercialisation. These innovations range from jet boat steering mechanisms, snow probes, 'nifty lifters', through to microhydro plants.

"In the case of the Springfree Trampoline, his innovation creates both wealth — selling well in a competitive international market — and beneficial value to the community by cutting down on the number of trampoline injuries. It has been estimated that if all the trampolines in the US were spring-free there would be 34,000 fewer children going to emergency departments each year," said Town.

"Keith's invention has created many jobs in New Zealand. All of the special rods for the trampolines are made by a firm in Gisborne that ships out more than 10 containers of product per year. Furthermore, the Chinese company which makes the trampolines has employed 10 UC graduates to help improve the design and manufacture of the product." Alexander said he had a rocky start to his engineering career, "failing miserably" in his first two attempts, but a trip exploring for gold in the South Island confirmed his love of the subject.

"I made a pump system for getting gold out of rivers. I liked doing that stuff — although I only found enough gold for a filling, I think."

Alexander started his engineering degree at UC in 1975, during which he developed a new amphibious vehicle with bladed wheels, which later became his PhD study.

"I think the staff were somewhat bemused."

He funded much of his PhD by winning Radio Avon's "walk on water" contests.

"They offered \$1000 dollars to the person who could walk the furthest on water so I developed shoes to win the competition, won it two years running and used them to rescue prototypes of my amphibious vehicle from the middle of lakes."

At his first job at an Auckland engineering consultancy he developed a new design for the wool dumping presses which compressed three bales into one thus enabling treble the amount of wool to be exported in one container.

Alexander then worked at Hamilton Jet and later, while teaching at UC, developed his

own improved steering system for another jet company.

During a university summer break he worked in England on Alan Gibbs' Aquada amphibious vehicle.

Alexander said one of his most enduring memories of this time was "driving around in winter, in the dark, on a little lake in England, with this incongruous feeling of sitting in an open-topped sports car. There's the steering wheel and the dashboard. Outside is all the water going past and the headlights are pointing up into the sky."

Many of Alexander's ideas became final year projects for his students including a "nifty lifter", a device to help a polio sufferer transfer from his wheelchair to his car, as well as a quieter fan for a hovercraft.

They also developed a snow probe after being approached with the original concept by Arthur Tyndall, former president of the Broken River Ski Field. The device is used to test the shear strength of snow layers, thus identifying areas prone to avalanche. Data collected is transmitted directly to a PDA enabling quick assessments and records for future use. In a recent final year project he had students working on a Martin Jetpack simulator. Alexander's greatest success so far is his Springfree trampoline.

The project began in 1987 when Alexander's wife felt a backyard trampoline would be unsafe for their young daughter. He identified the main causes of trampoline-related injuries: the steel surround, the springs and the risk of falling off.

His first commercial partner required that "it could be assembled by a solo mum with no tools in half an hour". While he never achieved this ease of assembly it has become a commercial success.

"We now have 14 patents in seven different countries."

Alexander is on the Trampoline standards committee in the US and has contributed to the Australian standard and sees this as a career high-point.

"At the moment they are looking at mandating the standard in NSW, Australia, using a lot of my input which is hugely satisfying."

Alexander has received numerous international awards including 2010 Product of the year USA, 2010 Product of the Year Canada, 2010 New Zealand Engineering Innovator of the Year, 2009 International Design Award Australia and the 2009 Parents' Choice Award, USA. "Many people may not be aware of his many other ideas which are in various stages on the way to commercialisation. These innovations range from jet boat steering mechanisms, snow probes, 'nifty lifters', through to microhydro plants."

He said his most meaningful was the 2010 Children's Product of the Year, USA, for his Springfree trampoline.

"When I had originally made it, my vision was so small. I thought we would sell maybe 30 a year in New Zealand. For it to not only get to America but to win product of the year was a big boost."

Alexander played an integral part in establishing the University's Product Innovation Centre and is the current director.

"The idea of an innovation centre has been around for a long time. It is an internal consultancy which specialises in providing services for people (both within and outside the university) developing new products they want to get to market."

These services include mechanical engineering analysis, computer assisted design, and mechanical design. The knowledge-rich environment provides access to a huge range of expertise in one place and is particularly valuable if there is a research component to the project.

One example to use the Product innovation Centre was the "instrumented climbing hold" — a training aid that identifies climbers' hold techniques and necessary adjustments for improvement.

"Our role was to design something that would fit inside the hold and give out an electrical output that indicated what the forces were." Currently Alexander is working on microhydro plants — small hydroelectricity systems continuing the work of the late Peter Giddens.

Power is generated from a combination of head (the height from which the water is falling) multiplied by flow. In mountainous areas such as Nepal, head is large so required flow is minimal meaning necessary pipes and turbines are small and therefore low cost. Giddens believed sites with low head while more costly were much more common, but turbines had not been designed for them. A project was started to develop suitable turbines.

Over a dozen honours students and one PhD student have worked on the project. Once the project is completed a website will be set up to provide free information. By entering specific site details, the necessary drawings and system parts lists will be provided, thus making the plant more economically available.

Alexander is also working on a patient lifter.

"We need a piece of machinery that is simple, small and light — no batteries, no hydraulics, no electrics — to help carers transfer someone from one place to another so elderly people can stay at home longer. This started in 1996. "We are close to getting there. This would be my most demanding project. Prototype 16 is in my garage now!"

By Vicky Cran



## Modern technology built upon ancient knowledge

Associate Professor Stefano Pampanin (Civil and Natural Resources Engineering) is current champion of a seismic engineering legacy that originated with European ancestors and continued through his predecessors at the University of Canterbury. He recognises his research today is founded on the work of many great engineers who have come before and acknowledges that he is standing on mighty shoulders.

Pampanin observes that historically, the ancient Greeks excelled as earthquake engineers, protecting the columns of their beautiful Doric and Ionic temples by placing marble blocks on top of each other.

"In an earthquake, these blocks would rock one against the other before settling back into place intact. Structures like the Parthenon, the Temple of Hephaestus and the magnificent columns at the Sanctuary of Apollo bear testimony to this efficacy of design by standing proud for 2500 years or more."

These early design principles were the inspiration for a pre-cast seismic structural

system with the potential to revolutionise earthquake-proof construction, and with strong University of Canterbury connections.

"What we have is modern technology built upon ancient knowledge of earthquakes that can produce the damage-free buildings of the future," says Pampanin.

Until recently, modern seismic engineering worked on the principle of maximum strength. For decades, the traditional approach has been to construct stronger and stronger buildings to withstand earthquakes. Unfortunately, the 1995 earthquake in Kobe, Japan, and other more recent seismic events, highlighted the error of this reasoning. "Although stronger, the buildings were brittle and inflexible, and thus destined to fail in a severe earthquake, almost as if they were made of glass. The lesson learnt was that we should not try to play arm wrestle with nature and earthquakes, we will never win, but we can try to find smarter solutions."

The University of Canterbury connection with the new technology began in the 1990s when a much younger Pampanin travelled to the University of California in San Diego to join Professor Nigel Priestley under a Fulbright Visiting Researcher Scholarship. Born in New Zealand, educated at UC and then a seismic engineering lecturer here, Priestley was coordinating the PREcast Seismic Structural System (US-PRESSS) Research Programme. The work was aimed at designing high-performance, low-cost seismic-resisting solutions for multistorey precast concrete buildings. The design incorporated prefabricated elements that could withstand seismic forces by lifting up or rocking back and forth before returning into place with no damage to the structure.

The project culminated in a successful test on a five-storey structure which proved the effectiveness of what is now well known to structural engineers around the world as PRESSS Technology. Based around ductile rather than rigid reinforcement of concrete and other building materials, the success of the system relies on the use of post-tensioning techniques to connect prefabricated (precast) elements.

Post-tensioning reinforces building materials with high-strength steel bars or rebars, reminiscent of a rubber band threaded through a series of wooden blocks. It operates very much like the ancient Greek marble block columns but with additional tensile reinforcement through the core. The components still rock against each other in an earthquake, but then settle back into place — undamaged. The system allows for longer spans, thinner slabs, fewer beams and a lower overall building height for the same floor-to-floor height, all of which translates into a lighter foundation load that is a major advantage in seismic areas. It has also proven cost-comparable if not more economical than conventional construction.

The potential of PRESSS systems motivated Pampanin to take back and further develop the technology in his native Italy. He was then drawn to the University of Canterbury through an international concrete committee connection with Professor Robert Park. Park and his UC colleague, Professor Tom Paulay, were already world-renowned for introducing the concept of capacity design into earthquake engineering in the 1960s. This visionary concept, which calculates a hierarchy of strength into a building so that it performs in the best possible manner during an earthquake, is universally accepted as a milestone in seismic design philosophy. Pampanin could not have chosen more fitting and inspirational predecessors from which to continue his own research.

Multi-storey concrete buildings using PRESSS technology have now been constructed or are under design in Wellington and Christchurch. The Southern Cross Hospital in Christchurch was constructed using this system and came through the 2010 and 2011 earthquakes and all subsequent aftershocks basically unscathed.

After many years of research and during a recent sabbatical, Pampanin completed the *PRESSS Design Handbook*, a code of practice for the New Zealand Concrete Society, on how to design with the new technology. Pampanin says the new design guide is intended to assist designers and contractors to adapt to a new way of thinking, with the primary aim of lessening the economic impact of major earthquakes in New Zealand.

Collaboration with Andy Buchanan, Professor of Timber Design at UC, seemed a natural advance in the development of the technology. Together with their colleague Dr Alessandro Palermo (Civil and Natural Resources Engineering), they managed to demonstrate that, using the same technology, engineered timber can compete with concrete and steel as a construction material for large structures up to six storeys tall. Since 2004, they have tested the system using LVL (Laminated Veneer Lumber) assembled on site with steel connection devices and prestressing cables.

This led to the development of the Pres-Lam (Pres-stressed Laminated) system, a timber system that was similar to precast concrete and of which Pampanin, Buchanan and Palermo are the registered inventors. After a visit to the research programme in 2007, the then Minister of Forestry, Jim Anderton, was motivated to release three initiatives to promote the use of wood or wood-based products as the main structural materials in commercial buildings.

Buchanan recognised that a major reason there were so few large timber buildings was the lack of engineers who knew how to design them. In order to give a real timber alternative to the marketplace, there needed to be more research into timber structures. In 2008. \$10 million in external funding, half from industry and matched by government, made this possible. A major collaborative enterprise saw government, academia and industry joining forces to establish the Structural Timber Innovation Company Ltd (STIC) with the intent of developing innovative solutions to promote the construction of largescale timber buildings worldwide. The three UC inventors placed their LVL IP on the table at no cost, to enhance the potential for STIC to

#### commercialise the system in Australia and New Zealand.

Investment in the consortium by the timber industry is represented by Carter Holt Harvey, Nelson Pine Industries, Wesbeam, Forest and Wood Products Australia, and the Pine Manufacturers Association. Other shareholders include the University of Canterbury, the University of Auckland and the Building Research Association of New Zealand (BRANZ), all of which have research contracts, alongside the University of Technology in Sydney.

In February 2011 STIC launched a range of prefabricated timber technologies that will enable commercial and long-span industrial portal frame buildings to be easily designed and rapidly constructed using engineered timber products.

The new timber technology illustrates the power of collaboration between industry, academia and government and the strength of each in bringing innovative solutions to life and into the economy. Timber can now effectively compete structurally with concrete and steel, but with superior performance in earthquakes that New Zealanders are now acutely aware of.

By Jann O'Keefe



# Understanding human-animal relationships in a disaster

The relationship between a petowner and their animal companion can sometimes be as intense and as rewarding as the relationship the petowner has with other people. So, when the dynamics of that human-animal relationship are thrown into turmoil by an event such as a natural disaster, what happens?

This is the question University of Canterbury social work lecturer Nikki Evans (Social and Political Sciences) is currently investigating. Spurred into action by the Christchurch earthquake of September 2010, Evans says it became clear that New Zealand had little in the way of a clear set of policies or processes to deal with issues surrounding the human-animal relationships during or after a major disaster.

"After the September earthquake this became particularly clear in relation to people dealing with the disaster in rural settings around Canterbury. While large-scale farms generally had access to networks and semi-formal supports, there was nothing in place to help small-holding or lifestyle block owners who had fences down from fallen trees, collapsed buildings, lost animals through injury or stress or had to relocate stock. Stock losses in this context can impact on multiple levels, not the least if the animal was of significance financially. "But after the February 2011 earthquake I became more aware of the issues surrounding companion animals. Because people know I have researched animal-human relationships and used animal-assisted therapy in my practice, they began telling me about their experiences. Then news stories began to appear about people breaking cordons to rescue animals, about people who were distressed at losing their pets or having to re-home them while also having to deal with the trauma of damaged homes and aftershocks," she says.

"It really got me thinking about the processes that were, or weren't in place, and the psychological impacts these events would have on people who lose animals to an event that's out of their control."

Evans says animals often provide strong emotional and psychological support for people, and are regarded as members of the family. So what happens when this support is removed or the nature of the relationship is altered?

She says that the changes caused to the dynamics of such a relationship after a disaster are largely unexplored. Changes to an animal's behaviour may be difficult to manage: living in temporary accommodation that is overcrowded or not suited to the animal's needs may result in "inside" animals becoming "outside" animals or vice versa. In other situations, the support that people have sought and that animals have given during these difficult times may have increased. Evans says owning animals can also create habits of a lifetime. The 7am jog along New Brighton beach or the 11am walk around Hagley Park with friends or similar, is a daily event for many Christchurch residents. When the environment is altered by earthquakes and these walking routes become inaccessible or contaminated, people can experience further stress-evoking change. She says the loss of social contact, exercise opportunity and routine should not be underestimated — nor should the impact on a dog that has not had a walk.

Evans, whose research interests include the ethics and practice of animal-assisted intervention and therapy, says she is also interested in the issues surrounding the co-ordination of services by animal welfare and rescue groups.

"They did a phenomenal job under the circumstances. Documentation of the actions people and services took during these times will help in the ongoing development of policy and protocols.

"We know that there were people breaking cordons to save animals and people putting themselves in danger by refusing to leave condemned homes or buildings until their animal was found. We also know that following the crisis period many stranded animals were lost."

Evans is interested in looking at who decides what priority animals have under emergency conditions. She says research carried out

### "We know that there were people breaking cordons to save animals."

overseas after Hurricane Katrina destroyed large parts of New Orleans and after the 9/11 terrorist attacks in New York, showed that even internationally there were no clear policies to manage human-animal relationships in a disaster situation.

"I'm aware that there are people now working on these issues in New Zealand and I believe some things will change as a result of the Christchurch earthquakes."

Evans says she would like to contribute to those changes by interviewing people in Christchurch about their experiences during and after the earthquakes — to find out how their relationship with their companion animal has changed, stressors that have arisen, how they've managed since the earthquakes, if they had any emergency plans in place for their animal such as extra food and water, and what they've put in place since.

By Stacey Doornenbal

# Helping late talkers

Late-talking tots who fail to catch up to their peers by the age of four in New Zealand are the focus of a new study at UC's Child Language Centre by Co-Directors Professor Thomas Klee and Professor Stephanie Stokes, and Associate Professor Catherine Moran. Information gathered will provide the opportunity to catch and correct this high-risk group with speech and language impairments before they enter the school system.

"There is currently limited service provision for late-talking children in New Zealand," Stokes says. This is a situation the researchers plan to rectify. "There is very limited data on the early language development of children growing up in New Zealand and our study is looking to address that, says Klee. "Most of the research our health and education services currently use is based on US studies."

This research is not just interesting, but also overdue. "Parents want answers," says Klee.

Children with speech and language delay who enter the school system often find it hard to assimilate socially and have learning issues, particularly with respect to literacy, and they can be disruptive. Many go on to have adult communication difficulties, higher rates of anxiety disorders, and lower rates of education attainment and occupational status. The Marsden-funded study, being done in collaboration with PhD student Jayne Moyle, is studying 200 healthy 24 to 30-month-old children, 100 of whom are late in learning to talk. In New Zealand, early hearing and medical screening streams children with hearing impairment or conditions, such as cleft palate or cerebral palsy, into Special Education Services. This leaves children with speech or language delay in the "typically developing" group. Without data to disprove this, speech and language therapists, teachers and health professionals often advise parents that "they'll catch up".

Klee and Stokes cite research findings that indicate that as many as one-third of late-talking toddlers will not catch up by school age. Their current research focuses on predicting which children are likely to have prolonged problems, from an earlier age than is currently possible.

Diagnosis to date is episodic — a snapshot of how a child performed at a specific point in time. Children are currently defined as late talking if they have fewer than 50 words in their vocabulary or are not combining two words by the time they are two years of age. Other cues include using gestures to communicate rather than what should be rapidly developing vocabulary. By 30 months of age the average child knows between 400 to 600 words and can put short sentences and questions together such as "Daddy go" or "more ice cream?" Stokes notes some children progress their vocabulary but are still not forming sentences or conversations correctly on entering school. Stokes explains that in their longitudinal study children are seen twice, first with an initial visit then again in 18 months. Parents complete a vocabulary checklist three times. The testing is comprehensive, measuring vocabulary as well as memory skills, using a non-word or "nonsense" memory game.

Simple mimicry has been identified as a core feature of language learning in most children and begins at about 12 months. There is a suggestion that late talkers may not be so good at mimicry/imitation of new words. Recently published research by Stokes demonstrates that many late talkers get "stuck" in learning new words that sound like many other words they have heard their parent say (for example, cat/hat/sat). Children who are good language learners rapidly progress to learn "sparse" vocabulary, for example words such as "mouth" or "fish", which have fewer like-sounding words. Stokes' research has demonstrated that 200 English, 200 French, and 900 Danish children all show similar findings.

Klee and Stokes plan to summarise their findings periodically on the Child Language Centre's website (www.cmds.canterbury.ac.nz/clc) and the full results will be published at the end of the three-year project.

In the meantime, awareness of the importance of research to provide data for health professionals is spreading. In 2006 the US Preventative Services Task Force recommended more research into early diagnosis of speech and language disorders. The Bercow Report in the UK in 2008 did the same. A recent study of 1766 children in Perth, Australia, found that factors such as low birth weight and prematurity, male gender, and family history of late talking were all associated with late talking. Interestingly, things like soothers, tongue ties or being a second sibling did not affect long-term speech and language development, nor did being raised in a multilingual family/whānau.

Communication is a basic human trait with some children sadly struggling to ever "crack the code" of language learning. Stokes poses questions as to why some children have maladaptive learning mechanisms: what is the root cause which pauses the rapid acquisition of a native language? Potentially, factors include poor memory skills, neurobiological reasons (the brain not processing language as it should), poor intra-uterine growth, or malnutrition. There is evidence of genetic or familial links in studies of five-year-olds and up. Stokes says these are the "next" questions for a potential follow-on study.

"We are a product of our experience and environment. What you give to your child as a learning experience has a very powerful effect across time," Stokes says. She recommends less TV and more storybook reading. More reading, talking, listening and face-to-face interaction also helps brain, and therefore language, development.

By Amy McDaid



-

-



### Facilitating Māori research

It has been a very busy and rewarding few years for Professor Angus Hikairo Macfarlane.

Macfarlane, who is based in the Assistant Vice-Chancellor Māori Office and the School of Māori, Social and Cultural Studies in Education, was appointed the University of Canterbury's inaugural Professor of Māori Research in 2009.

His role is to facilitate Māori research and scholarship throughout the University, providing academic leadership across the disciplines and across cultures and he has certainly been active in doing that.

In the past two and a half years, since taking up the UC position in April 2009, he has organised two very successful Māori research wānanga on campus, been involved in a number of highprofile Ministry of Education research contracts, helped facilitate a new alliance with Macquarie University, Sydney, added to his extensive publication list — with two edited books, 14 chapters in books and six journal articles — and delivered almost 40 keynote presentations. Plus he has received some notable awards, grants and key appointments.

In December 2010, he was honoured for his commitment to Māori education and prolonged research achievement with the New Zealand Association for Research in Education's Te Tohu Pae Tawhiti Award, which he counts as a personal career highlight.

He also feels very honoured by his recent appointment by the Tertiary Education Commission as a member of the Māori Knowledge and Development panel for the Performance-Based Research Fund 2012 Quality Evaluation.

On a university level and on an international scale, Macfarlane says the signing in 2011 of a memorandum of understanding (MOU) between UC and Macquarie University in Sydney was a definite highlight.

"Under the MOU we have introduced a staff and student exchange programme, providing the opportunity for our emerging postgraduate students and academic staff to gain access to leading Australian research and thinking with a uniquely indigenous context.

"This international alliance will see our two universities enhance relations by developing academic co-operation and exchange of information in respect of indigenous research in Australasia and beyond."

Macfarlane, who has a background in education psychology, says a feature from 2011 was the inaugural offering of a new specialist qualification in special education.

In partnership with Massey University, UC now offers a Postgraduate Diploma in Specialist

Teaching that provides students with both a strong appreciation of specialist teaching as an interdisciplinary field of practice and the ability to apply their specialist knowledge and skills in diverse cultural contexts.

A recent high point on the publication front was the October 2011 launch of a book he co-edited with Dr Valerie Margrain from Massey University titled *Responsive Pedagogy: Engaging Restoratively with Challenging Behaviour* (New Zealand Council for Educational Research, 2011). It was described by respected leadership consultant Professor Jan Robertson as a text that should be "compulsory reading for every teacher and teacher trainee in Aotearoa New Zealand".

Parallel to encouraging research and driving strategy, Macfarlane is leading by example, pushing out significant research that is informing and impacting classroom practice.

He received a Good Practice Publication Grant (GPPG) from Ako Aotearoa (the National Centre for Tertiary Teaching Excellence) in 2010. The GPPG scheme is a key mechanism by which good tertiary teaching and learning practice is shared, celebrated and promoted across the sector, with written summaries and multimedia presentations published in tha Ako Aotearoa Good Practice Publication Grants e-book on the Ako Aotearoa website. Macfarlane's contribution to this is entitled Huakina mai: Doorways towards culturally responsible education (2012). In 2010 he was part of a team that won the UC College of Education Research Team Award for a project that required it to synthesise key information from four New Zealand Ministry of Education Best Evidence Synthesis reports as well as kaupapa Māori research associated with the ministry's Ka Hikitia Māori Education Strategy.

"The key messages outlined in the report were translated into an academic paper, which offered a tool for educators to assist whānau and iwi to actively engage in New Zealand schooling."

Macfarlane is also part of a team of five researchers — including two fellow UC academics, Professor Letitia Fickel (Māori, Social and Cultural Studies) and Sonja Macfarlane (Health Sciences Centre), and two Te Tapuae o Rehua researchers — that secured a Ministry of Education research contract in July 2011 to investigate the effectiveness, sustainability and possible replication of four special education service delivery teams based in the Auckland region known as Kaupapa Māori Teams.

"Our research will seek to unpack such intricacies as the strategic planning that has driven the teams' structure to date, staff perceptions and professional development needs, schools' perceptions, whānau perspectives and the impact on student outcomes."

By Maria De Cort

## Proteins promote partnerships

The same spirit of cooperation that brought the Biomolecular Interaction Centre (BIC) at UC into being in 2007 is at work again in a major new research fellowship programme which is collaborating with industry in a search for new and different ways to use proteins.

The IRL Industry and Outreach Fellowship is held by Professor Juliet Gerrard, a biochemist specialising in the structure, function and reactivity of proteins. Gerrard was one of the original researchers who helped establish BIC at UC in 2007, together with Professor Conan Fee, an engineer who applies novel technology in the bioprocessing field of chemical engineering, and Associate Professor Emily Parker, a biological chemist with an interest in drug design. BIC was made one of UC's two premier research institutes in 2010 along with the New Zealand Institute of Language, Brain and Behaviour.

"The IRL Fellowship Programme is all about making connections," says Gerrard. "It's about bridging the gap between fundamental and applied research and strengthening the links between institutional researchers and industry. It's also about applying both scientific and engineering knowledge in the creation of structures from biological materials.

"The fellowship is funded for five years and aims to establish an integrated programme across BIC and IRL with collaborating students and a postdoc in each organisation. In all, there are 12 people at UC and three more in Wellington working directly on the programme, as well as input from other BIC researchers who would total about 50 all up.

"We are in search of novel and innovative uses for proteins," says Gerrard. "At one end of the spectrum, we look at really fundamental properties of proteins — how they fold up, what their structure is and how that enables their function within the body. Then we find ways to apply that knowledge outside the cells. We are bridging the gap between science and engineering. If we find an interesting protein, we will explore what we can do with it, and how it might be used in a totally new and different context.

"The work is taking us into so many exciting areas that a major challenge is in choosing the ones that show the most potential. One of our stronger areas is in making biomaterials, taking waste proteins and using them to create interesting structures that can be applied in bionanotechnology."

In one project the group uses fish eye lenses, a waste product that is usually thrown back to sea but has proven a valuable and almost pure source of protein. After simple manipulation in the laboratory, elaborate nanostructures are formed from this material — long, thin fibrils about 50 nanometres across, much thinner than a human hair but with the strength of spider silk. These fibres can then form the foundation for strong materials or be used as biosensors in nanodevices and as nanoscaffolding upon which to arrange other molecules.

"We are exploring these fibrils as a framework to put enzymes on," explains Gerrard. "Enzymes are catalysts with many applications but they are not very stable. Attached to a nanoscaffold, however, the result is a really high surface area coated in enzymes which increases activity and stability. We have done this both in solution and on substrates of glass or cotton in an attempt to make activated surfaces with the enzymes on them. We've also used them to make a strong film, and then combined the two processes put enzymes on fibrils, then put the fibrils into the film, to produce antimicrobial films."

The mutual benefits of this collaboration are obvious in a new project with Associate Professor Mark Hampton from the University of Otago Christchurch Medical School. Hampton is particularly interested in peroxiredoxin, an antioxidant protein which helps protect the body from free radical damage, and is currently working on the structure of the protein and how this might be related to its function.

"Hampton is seeking to understand how peroxiredoxin helps prevent the buildup of hydrogen peroxide that occurs in the body under a free radical attack," says Gerrard, "whereas we are looking at using the protein outside the cell. The protein has an amazing structure with several units arranged in donut like rings. These then stack on top of each other to form long structures as well as interconnecting structures. It is these capabilities that attract us, from a protein engineering point of view, and that we think can be engineered into something useful — perhaps to make nanodevices or selfhealing materials. So we are both researching the same protein but have different end uses in mind. When we have engineered changes into the proteins, Hampton can test these altered proteins in his cellular systems to help unravel how structure affects function. It is a very beneficial partnership."

Another medical application of Gerrard's work was harnessed in a collaboration with colleagues from the University of Melbourne. This group used the fact that proteins cluster together in a bacterial cell differently from how they group within human cells. They designed new drugs that prevented the bacterial proteins forming their clusters, thereby killing the bacterial cells, but hopefully leaving the human cells untouched. This approach is being used to find new ways to combat diseases like tuberculosis and meningitis.

If anyone can drive this new partnership to its full potential and ensure both the quality and quantity of research outputs are equalled by the industrial applications, it is Gerrard. Co-director of BIC at UC and principal investigator at both the MacDiarmid and Riddet Institutes, she has recently been appointed Chair of the Marsden Council. She has worked for Crop and Food Research Ltd and done research for Fonterra, AgResearch, and now IRL, so has strong credentials in industry collaborations as well. Besides all this, her passion for both proteins and partnerships is patently apparent.

By Jann O'Keefe
"The work is taking us into so many exciting areas that a major challenge is in choosing the ones that show the most potential. One of our stronger areas is in making biomaterials, taking waste proteins and using them to create interesting structures that can be applied in bionanotechnology."

## College of Arts



Professor Ed Adelson Pro-Vice-Chancellor, College of Arts

Research productivity in the College of Arts proceeded at an impressive pace in 2011, despite the interruptions from earthquakes and temporary loss of library resources. Researchers in the College engaged in explorations spanning the globe and embracing wide aspects of social, creative and humanistic pursuit.

In the Centre for Fine Arts, Music and Theatre, for instance, 145 outputs were chronicled, including compositions for Ensemble Selish (Frieburg) and the Forbidden City Chamber Orchestra (Beijing), conference papers on photography and theatre studies in Greece and Canada, and concerts and exhibitions in Thailand, the US, Germany and Turkey.

The College's research centres contributed significantly to its international profile, with the New Zealand Institute for Language, Brain and Behaviour (including staff from the School of Languages, Cultures and Linguistics) involved in approximately \$3.7 million in grants, and the Te Awatea Violence Research Centre (in the School of Social and Political Sciences) engaged in three major externally funded projects on community violence.

In the School of Humanities, research spanned areas such as Medieval European history, the American Civil War, New Zealand literary/cultural criticism, Hellenistic poetry, art in literature in 19<sup>th</sup> century France, and a commentary on the 4<sup>th</sup> century B.C. historian Ephorus. The School of Social and Political Sciences highlights contributions to a substantial (more than \$1 million) grant studying the lives of young Norwegians, and a large longitudinal survey of children and adults sponsored by the United Nations.

Academic Departments/Schools	Centre for Fine Arts, Music and Theatre				
	Humanities				
	Languages, Cultures and Linguistics				
	Māori and Indigenous Studies				
	Social and Political Sciences				
	Macmillan Brown Centre for Pacific Studies				

	:	2010		2011
Academic staff <sup>1</sup>		135		136
Adjuncts and research fellows <sup>2</sup>		43		46
Post-doctoral fellows <sup>3</sup>		1		1
Outputs⁴		734		660
Postgraduate degrees completed <sup>5</sup>	PhD	12	PhD	14
	MA	33	MA	22
	MFA	5	MFA	8
	MFA		MFA	
	(Creative Writing)	3	(Creative Writing)	2
	MMus	1	MMus	1
Research Income	\$1,084	4,133	\$1,21	1,778

1 FTE; includes continuing and fixed-term staff members employed throughout the year

- 2 FTE; includes adjuncts and research fellows employed for greater than one year during the year
- 3 FTE; includes fellows employed for greater than one year during the year
- 4 Outputs may be counted under more than one College due to co-authorship

### College of Business and Economics



Professor Adrian Sawyer Acting Pro-Vice-Chancellor, College of Business and Economics

(The previous PVC, Professor Nigel Healey, left in July 2011)

The College of Business and Economics remains committed, notwithstanding the impact of the Canterbury earthquakes, to providing a supportive, vibrant research environment, which allows the production of outputs with both significant impact and relevance.

Despite this challenging environment the College has been able to provide funding to support individual staff research, to host several international conferences, and to support the application for external research grants. Over the period College staff have been undertaking research with the support of three Marsden grants and have received external funds to support other research and consultancy activities. In line with the College's goal of incentivising, supporting and celebrating research excellence, the College has recognised emerging researchers through the Early Career Award. A number of academic staff have also received recognition of their research through best paper awards. In 2011 the New Zealand Experimental Economics Laboratory was officially launched. The College continues to support the annual series of memorial lectures to showcase research in the areas of accounting, economics and management, respectively through the Pallot, Condliffe and Hight lectures. The National Centre for Research on Europe (NCRE) moved to become part of the College of Arts from 1 January 2012.

Academic Departments	Accounting & Information Systems				
	Economics	Economics & Finance			
	Manageme	nt			
	National Ce	ntre for Rese	arch on Euro	ре	
	2010 2011				
Academic staff		83		87	
Adjuncts and research fellows <sup>2</sup>		23		23	
Post-doctoral fellows <sup>3</sup>		12		5	
Outputs <sup>4</sup>		492		461	
Postgraduate degrees completed <sup>5</sup>	PhD	5	PhD	9	
	MA	3	MA	3	
	MCom	5	MCom	6	
			MSc	5	
Research Income		\$598,588		\$824,974	

1 FTE; includes continuing and fixed-term staff members employed throughout the year

2 FTE; includes adjuncts and research fellows employed for greater than one year during the year

3 FTE; includes fellows employed for greater than one year during the year

4 Outputs may be counted under more than one College due to co-authorship

## College of Education



Professor Gail Gillon Pro-Vice-Chancellor, College of Education

#### The College of Education is committed to research excellence in educational studies and human development, teacher education and health sciences.

Key areas of scholarly strength include, but are not limited to, those represented by the College's recently established research labs: the e-Learning Research Lab, the Inclusive and Special Education Research Group, the Health Sciences Assessment Collaboration Research Lab, the Olympic Studies Research Lab, the Early Years Enquiry Hub, the Language and Literacy Research Lab, the Creative and Participatory Research Lab, the Science and Technology Education Research Lab, the Educational Theory, Policy and Practice Research Hub, the Wayne Francis Cancer Epidemiology Research Group, the Te Rū Rangahau: Māori Education Research Lab, the Education History Research Lab, and the Teacher Learning and Innovations in Practice Research Hub. These research groups are contributing to research of international significance as well as fostering the development of emerging research in areas of local and national priority.

Academic Departments/Schools	Educational Studies and Human Development Literacies and Arts in Education Māori, Social and Cultural Studies in Education Science and Physical Education Health Sciences Centre			
		2010		2011
Academic staff		139		117
Adjuncts and research fellows <sup>2</sup>	15			
Outputs <sup>4</sup>	593			
Postgraduate degrees completed <sup>5</sup>	PhD	9	PhD	5
	MEd	7	MA	1
	MHealSc	4	MEd	24
	MSLT	1	MHealSc	7
	MTchLn	11	MSc	1
			MTchLn	10
Research Income		\$1,003,955		\$502,314

1 FTE; includes continuing and fixed-term staff members employed throughout the year

2 FTE; includes adjuncts and research fellows employed for greater than one year during the year

3 FTE; includes fellows employed for greater than one year during the year

4 Outputs may be counted under more than one College due to co-authorship

# College of Engineering



Professor Jan Evans-Freeman Pro-Vice-Chancellor, College of Engineering

Research in the College of Engineering covers a broad range of disciplines, from large scale structural engineering to nano-technology.

Together with research encompassing mathematics, forestry engineering and computer science, the College aims to carry out research in areas that will be of benefit to society. This has been put sharply into focus in the last year or so, with many of our researchers being actively involved in Christchurch-based activities to support the city's rebuild.

Our staff attract considerable external research funding and many renowned international researchers choose to come and work with us. This year national recognition was given to Dr Christopher Hann (Electrical and Computer Engineering) who was awarded a Rutherford Discovery Fellowship for five years to enable him to continue his research on control systems for rockets.

A priority for College academics in the near future will be to provide engineers and scientists to support the local and national infrastructure, to enable the development of the high-value manufacturing sector in New Zealand, and to provide expertise to the growing energy sector in this country.

Academic Departments/Schools	Chemical and Process Engineering
	Civil and Natural Resources Engineering
	Computer Science and Software Engineering
	Electrical and Computer Engineering
	Mathematics and Statistics
	Mechanical Engineering
	Forestry
	Human Interface Technology Laboratory (HIT Lab NZ)

		2010		2011
Academic staff		132		139
Adjuncts and research fellows <sup>2</sup>		61		69
Post-doctoral fellows <sup>3</sup>		23		26
Outputs⁴		1,054		910
Postgraduate degrees completed <sup>5</sup>	PhD	36	PhD	43
	MA	1	ME	21
	ME	20	MEFE	2
	MEFE	13	MEM	15
	MEM	19	MET	5
	MET	2	MSc	10
	MForSc	2		
	MSc	9		
External Research Income		\$11,427,882		\$11,101,787

1 FTE; includes continuing and fixed-term staff members employed throughout the year

2 FTE; includes adjuncts and research fellows employed for greater than one year during the year

3 FTE; includes fellows employed for greater than one year during the year

4 Outputs may be counted under more than one College due to co-authorship

5 Theses are listed under the supervisor(s)' College and may be counted under more than one College due to co-supervision

#### www.canterbury.ac.nz/spark/eng

### College of Science



Professor Paul Fleming Pro-Vice-Chancellor, College of Science

### Science research at Canterbury experienced one of its most challenging years in 2011.

Having successfully recovered from the September 2010 earthquake, it was to the great credit of our staff and postgraduate students that we quickly regained our high levels of research activity after the February and June earthquakes in 2011. A particular highlight was the award by the Royal Society of New Zealand of the third Rutherford Discovery Fellowship in the College to Dr Anthony Poole of the School of Biological Sciences. As we move forward, we aim to enhance our already strong international reputation in a number of key disciplines through further exploiting the potential for collaborative partnerships with external partners such as Crown Research Institutes and diversifying our funding sources, particularly in the private sector. Our greater emphasis on developing an innovation culture will also continue. Overall, science research at the University of Canterbury is well placed to justify the University's claim that, as science researchers, we are "people prepared to make a difference".

Academic Departments/Schools	Biological Sciences
	Chemistry
	Communication Disorders
	Geography
	Geological Sciences
	Physics and Astronomy
	Psychology
	Gateway Antarctica

		2010		2011
Academic staff <sup>1</sup>		128		135
Adjuncts and research fellows <sup>2</sup>		100		105
Post-doctoral fellows <sup>3</sup>		21		24
Outputs⁴		1,104		981
Postgraduate degrees completed⁵	PhD	48	PhD	26
	MA	4	MAntaStud	1
	MAud	10	MA	8
	MHealSc	1	MAud	10
	MSc	58	MSc	58
	MSLT	9	MSLT	5
Research Income		\$8,778,609		\$9,237,333

1 FTE; includes continuing and fixed-term staff members employed throughout the year

2 FTE; includes adjuncts and research fellows employed for greater than one year during the year

3 FTE; includes fellows employed for greater than one year during the year

4 Outputs may be counted under more than one College due to co-authorship

5 Theses are listed under the supervisor(s)' College and may be counted under more than one College due to co-supervision

#### www.canterbury.ac.nz/spark/sci

### School of Law



Associate Professor Richard Scragg Dean, School of Law

Despite the disruptions caused by the 2010 and 2011 earthquakes and their continuing consequences, staff in the School of Law continued to research and publish widely.

In 2011 there were 99 outputs by law academics, of which a third were in overseas publications or at international conferences. While the Law School's traditional strength in "black letter law", core law areas such as public law, criminal law, torts, land law and family law, continued to be a focus of much of the published research, there were numerous substantial pieces dealing with broader fields such as international law and environmental law. The year has also seen a continued growth in the publications of results of externally funded research — and a number of successes in attracting such funding which will bear fruit in future years.

Professor Jeremy Finn, Associate Dean of Research, School of Law

		2010		2011
Academic staff <sup>1</sup>		22		23
Adjuncts and research fellows <sup>2</sup>		6		7
Outputs <sup>4</sup>		172		99
Postgraduate degrees completed⁵	PhD	4	LLM	1
External Research Income		\$25,284		\$14,023

1 FTE; includes continuing and fixed-term staff members employed throughout the year

2 FTE; includes adjuncts and research fellows employed for greater than one year during the year

3 FTE; includes fellows employed for greater than one year during the year

4 Outputs may be counted under more than one College due to co-authorship

### **Research Institutes and Centres**

#### Biomolecular Interaction Centre (BIC)

The Biomolecular Interaction Centre (BIC) is a multi-disciplinary centre dedicated to the study of molecular interactions critical to biological function. Understanding biomolecular interactions is central to a range of fundamental sciences, new treatments for disease, and a wide range of highly functional products.

The centre includes University of Canterbury researchers from the Colleges of Science and Engineering, as well as Education and Arts, and partners with several New Zealand Crown Research Institutes and universities.

The centre was founded in 2007 after being awarded funding from the Innovation and Development Fund from the Tertiary Education Commission (TEC). The primary investment of \$1.85 million was used to purchase a suite of state-of-the-art equipment that was supplied by Bio-Rad Laboratories. BIC has recently received a multi-million dollar investment from the University of Canterbury to become one of two new premier research institutes on campus. BIC researchers seek to understand the molecular interactions vital to biology and harness them in a wide range of applications. BIC has a number of principal, partner, associate and affliated investigators, together with postdoctoral fellows, Postgraduate students and technicians from the University of Canterbury, as well as other national and international institutions. Many of these investigators directly support the research themes of the centre while others have related research projects that benefit from BIC support.

www.canterbury.ac.nz/spark/bic

#### **Gateway Antarctica**

Gateway Antarctica is a centre for Antarctic studies and research at UC.

The purpose of Gateway Antarctica is to contribute to increased understanding and more effective management of the Antarctic and the Southern Ocean by being a focal point and a catalyst for Antarctic scholarship, attracting national and international participation in collaborative research, analysis, learning and networking.

www.canterbury.ac.nz/spark/anta

#### Health Sciences Centre (HSC)

The Health Sciences Centre was established in 2004 to develop postgraduate programmes and associated research activities in the health sciences. The centre will foster health-related interdisciplinary and collaborative initiatives, within the University, with other tertiary education providers in Canterbury and beyond, and with the health sector.

These new initiatives will complement the University's existing programmes in clinical psychology, social work, child and family psychology, counselling, speech and language therapy, and medical physics, as well as health sciences programmes available through the University of Otago's Christchurch School of Medicine and Health Sciences.

www.canterbury.ac.nz/spark/hsc

#### Human Interface Technology Laboratory (HIT Lab NZ)

The Human Interface Technology Laboratory New Zealand (HIT Lab NZ) is a human-computer interface research centre hosted at the University of Canterbury. The lab is a partner of the worldleading HIT Lab US based at the University of Washington in Seattle.

HIT Lab NZ is revolutionising the way people interact with computers, by creating cuttingedge interfaces to:

- enhance human capabilities
- vanquish human limitations
- increase the flexibility and utility of industry's existing products

HIT Lab's multi-disciplinary approach to research and education facilitates an entrepreneurial climate, which fosters a wealth of innovative ideas. Currently the lab is working on a range of projects in collaboration with industry and academia.

One of HIT Lab's key goals is to expedite economic development within New Zealand by transitioning breakthrough interface technologies to industry.

www.canterbury.ac.nz/spark/hitlab

#### Macmillan Brown Centre for Pacific Studies

The Macmillan Brown Centre for Pacific Studies was founded through a bequest from the late Professor John Macmillan Brown (1846-1935), a founding professor of the University of Canterbury and a former Vice-Chancellor of the University of New Zealand who spent a considerable time travelling and studying the countries of the Pacific.

Under the terms of Professor Macmillan Brown's will, the centre was established in 1988 at the University of Canterbury to facilitate the "investigation and research of the history, traditions, customs, laws, and ideas of the peoples of the Pacific generally".

The main areas of research of the centre are the societies and cultures, past and present, of the indigenous peoples of Oceania (including New Zealand). In developing its research programme, the centre is responsive to concerns expressed by these people.

www.canterbury.ac.nz/spark/pacs

### National Centre for Research on Europe (NCRE)

In 2000, the forerunner to the National Centre for Research on Europe (NCRE) — the Centre for Research on Europe – was founded at UC. In 2002 a grant from the European Commission was awarded and at this time the centre became the National Centre for Research on Europe. NCRE remains the only EU-dedicated tertiary level centre in New Zealand. Since then, NCRE has developed significantly in both academic and outreach activities, involving a variety of roles and mechanisms. Since 2006, NCRE has managed the EU Centres Network of New Zealand incorporating all eight New Zealand universities and has formal links with similar EU centres in the Asia-Pacific, including Monash, RMIT and the ANU in Australia. Waseda and Keio universities in Japan, NUS in Singapore, and Fudan and Tsinghua in China.

The main focus of NCRE is on research into how the European Union impacts on the Asia-Pacific region, with special emphasis on media perceptions, development policy, trade and regional integration.

www.canterbury.ac.nz/spark/ncre

#### New Zealand Institute of Language, Brain and Behaviour (NZILBB)

The New Zealand Institute of Language, Brain and Behaviour is a multi-disciplinary centre dedicated to the study of human language. The researchers come from a wide range of disciplines, forging connections across linguistics, speech production and perception, language acquisition, language disorders, social cognition, memory, brain imaging, cognitive science, bilingual education and interface technologies. This highly interdisciplinary team is working together toward a truly unified understanding of how language is acquired, produced and understood in its social and physical contexts.

www.canterbury.ac.nz/spark/nzilbb

### Ngāi Tahu Research Centre (NTRC)

The Ngāi Tahu Research Centre (NTRC) was established in August 2011 as a joint initiative between Ngāi Tahu and the University of Canterbury. NTRC was founded for the purpose of being a leader in indigenous scholarship and to provide a centre for the intellectual capital and development of Ngāi Tahu.

www.canterbury.ac.nz/spark/ntrc

#### Waterways Centre for Freshwater Management

A joint venture between the University of Canterbury and Lincoln University, the Waterways Centre for Freshwater Management is a focal point for improving knowledge-driven water resource management in New Zealand. The centre offers undergraduate courses and postgraduate degrees in water resource management, to serve the ever increasing demand for graduates in this field. A strong connection is maintained with private sector and water research organisations to ensure the skills, knowledge and awareness conveyed in the classroom, is relevant to the whole water sector. The centre also acts as first point of contact for external groups seeking research expertise and community or professional development education in the field. It is an example of strong co-operation between the two universities, leading to better education outcomes for the country.

www.canterbury.ac.nz/spark/waterways

### We have a vision of people prepared to make a difference – tangata tū, tangata ora.

Our mission is to contribute to society through knowledge in chosen areas of endeavour by promoting a world-class learning environment known for attracting people with the greatest potential to make a difference.

We seek to be known as a University where knowledge is created, critiqued, disseminated and protected and where research, teaching and learning take place in ways that are inspirational and innovative.

Looking towards 2023, the 150<sup>th</sup> anniversary of our founding, the primary components of our strategy are to Challenge, Concentrate and Connect.

University of Canterbury Statement of Strategic Intent

The Research 2010/2011 CD contains an electronic copy of this publication and lists of 2010/2011 research outputs.

University of Canterbury Te Whare Wānanga o Waitaha

Private Bag 4800 Christchurch 8140 New Zealand Telephone: +64 3 366 7001 Facsimile: +64 3 3642999 Email: info@canterbury.ac.nz

www.research.canterbury.ac.nz

