

# MASSEY RESEARCH

The rebirth of plastic

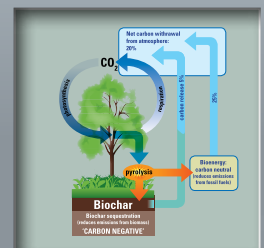
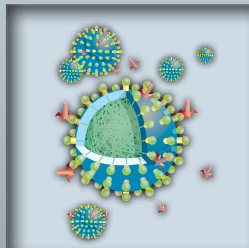
Evolution at work

The joy of sects

Research, Scholarship  
and Creativity

September  
**2009**

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Fire and ice  
Living with volcanoes



MASSEY UNIVERSITY



## Why science matters

Ask Professor Peter Gluckman about how New Zealand's reporting of science stacks up, and he will make no bones about it. "Right now the general quality of science reporting in New Zealand is terrible by international standards; there is no coherent attempt to explain the issues of the day or to explore what New Zealand science is delivering," the newly appointed Chief Science Adviser told an audience on Massey's Manawatu campus in July of this year.

I agree with him: we are not as well served as we should be by the media's coverage of science, and the lack of serious coverage both diminishes the richness of our understanding of the times we live in – as extraordinary, in their way, as the Renaissance or Enlightenment – and materially damages New Zealand's prospects as a nation.

How so? The obvious and well-used argument is that by undervaluing science we are undermining our future prosperity. If New Zealand is to lift its GDP ranking among the OECD nations, then the application of science and technology will be key.

But there is another way in which we lose out if we fail to give proper weight to good science: we will make bad decisions about important issues.

Should folate be a mandatory addition to bread to reduce the incidence of spina bifida? Should 1080 be used to control possum numbers? At what age should national superannuation kick in? Is smacking a legitimately useful way of disciplining children? What should we do to address the problem of drugs – of which alcohol is one – in society? What about obesity? What about climate change, its reality and our response to it?

In the sphere of public discourse, opinions abound, not all of them soundly based and not all of them disinterested. Special interests will use whatever tools are to hand – pseudoscience, conspiracy theory, misdirection and misinformation – to twist matters to their advantage.

So to whom should you look to when forming your thoughts? In matters that *are* complicated, that *do* concern subtle distinctions in uncertainty and risk, I suggest your first recourse should be to formally qualified specialists: to epidemiologists, medical practitioners and food scientists; to ecologists and veterinarians; to economists and demographers. I am not suggesting that the answer to all of life's problems is ask-the-expert, but we should give them due weight. Sometimes the folk wisdom, the gut instinct, the easy answer, the seductive story line, turns out to be at odds with the evidence, and when they are, the evidence should win. Should, but doesn't always.

Matters aren't helped by the media's tendency to run stories to a certain template in which, as Ben Goldacre writes in his book *Bad Science*, "science is portrayed as groundless, incomprehensible, didactic

truth statements from scientists, who themselves are socially powerful, arbitrary, unelected authority figures".

But, let us spare a thought for mainstream media – the MSM, as it is sometimes referred to – which has pressing concerns of its own. The Trademes and Seeks have run off with its advertisers. Bloggers and news sites have pilfered its paying readership. The industry has had to cut its suit according to its somewhat shabbier cloth. Struggling publications have folded and there has been a steady attrition of reporters from the newsrooms. At times such as these, high-mindedly calling on the members of the fourth estate to provide critical, fair and comprehensive science reporting will only yield so much.

What can we do about this? Some measures have already been taken. Professor Gluckman's own appointment will I believe help redress the balance, and the Science Media Centre (set up in June 2008 and modelled on equivalents in Britain and Australia) is working to improve the links between the media and science.

Yet, in the face of the technological and economic challenges faced by the mainstream media, even this will only go so far. In an article in *The Nation*, Chris Mooney and Sheril Kirschenbaum write

[perhaps] the answer lies outside the free market: with the creation of not-for-profit sources of science journalism and commentary, meant to last for long periods safely insulated from market upheaval.

Scientists themselves and the institutions they work for, they write, need to do more to put their work before the public.

At Massey, we value public engagement; it is part of our defining ethos. Take Professors Paul Rainey and David Parry. You can read about their work in this publication, or you can hear them directly: Professor Rainey's Darwin Year lecture is available as a Radio New Zealand podcast; Rutherford medal-winning Professor David Parry has been touring New Zealand on a national lecture tour. Every day you will see Massey academics making themselves available for comment, informing debate and explaining their work.

And the university itself does its bit, making the work of its staff known through its website and an array of publications: *MASSEY* magazine, the monthly magazine *DefiningNZ* and, of course, the publication you hold in your hands.

In it you will find all the proof you need that science is neither remote nor too complicated to explain, but the most human and fascinating of endeavours.

Steve Maharey  
Vice-Chancellor





## Doctorates in the house

**D**agmar Knoflach is one in a thousand. Or at least that was what the rather surprised Austrian postgraduate student found herself to be for few days in May 2009, with tea and cake being brought out to mark the momentous occasion.

In case you haven't guessed, the number is the count of currently enrolled doctoral students at Massey – a number that, as I write, has topped 1018. They include candidates for PhDs – a research degree whose abbreviation derives from the Latin *philosophiae doctor*, or Doctor of Philosophy – and for the named doctorates: Doctor of Business Administration, Doctor of Education, and Doctor of Clinical Psychology.

At most English-speaking universities the doctorate sits at the apex of academic achievement, and it is through doctorates that academic excellence is perpetuated. This is the gateway qualification to becoming a tenured researcher or professor.

Massey began offering doctoral degrees in 1949. The first doctoral thesis in the Massey library was penned by a certain William Anderson McGillivray who graduated in 1950, his topic being the conversion of carotene into vitamin A in the animal body. Since then, the university has conferred more than 1830 doctoral degrees, and, with another 120 or so conferred each year, the 2000 mark is expected to be passed in the next 18 months or so.

Working in the Institute of Veterinary, Animal and Biomedical Sciences, Dagmar is researching the reproductive development of nematode parasitic worms. Professor Heather Simpson, her supervisor, is herself the second woman to be awarded a PhD by Massey. (The first woman to be awarded a PhD by Massey was Christine Winterbourn in 1969.) Dagmar's topic is one with which William would probably identify. Like his own, it is based around science and agriculture and it promises to have practical application. But many other things about how his *alma mater* has developed might astonish him.

I suspect the PhD graduate of 1950 would be bemused at the range of disciplines in which Massey now offers postgraduate study – 28 per cent of Massey doctorates, for example, are now in the humanities and social sciences, disciplines not taught at Massey during his day – and he would certainly marvel at how international postgraduate study has become.

As a European – an Austrian in this case – Dagmar is far from unusual. Thirty per cent of Massey's doctoral students hail from overseas, particular sources being Europe, Asia, North America, and the Middle East.

One reason they come to Massey is the calibre of staff. If you want to, say, study volcanism, you could hardly do better than to have Professor Shane Cronin as your supervisor; for fine arts, Professor Jeremy Diggle; for neuropsychology Professor Janet Leatham.

Another reason is the value the university places on academic rigor and the regard in which its postgraduate qualifications are held. A Doctoral Research Committee oversees entry to each programme and monitors each student's progress, and a Graduate Research School, itself headed by an active researcher, administers doctoral degrees.

I wish Dagmar Knoflach all of the very best for her time with Massey, that she enjoys her time here and achieves great things, and I look forward to many others like her choosing Massey to pursue their academic aspirations.

Professor Nigel Long  
Assistant Vice-Chancellor Research



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Massey conferred its first doctoral degree in 1950, a PhD on William Anderson McGillivray. McGillivray, a Massey lecturer, went on to gain a DSc from the university in 1964.

With Dagmar Knoflach's arrival in May 2009 Massey had 1000 currently enrolled doctoral students.

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# MASSEY RESEARCH

## HERE & NOW

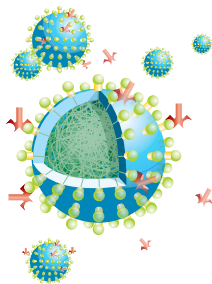


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They bought us beer, yoghurt and bread. Now bacteria are fashioning plastic to order, and the applications, from biodegradable packaging to sophisticated medical diagnostic tools, are extraordinary. Meet Professor Bernd Rehm.



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A few millilitres of nutrient broth, a bacterium, and a few days: these are all the ingredients needed to explore evolution at work. Professor Paul Rainey talks about the deep insights into evolutionary processes his research group is producing.





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A decent night's sleep is a commodity in surprisingly short supply: one in three New Zealanders regularly struggle to fall asleep or to stay asleep long enough to feel rested. Sarah-Jane Paine of the Sleep/Wake Centre is looking at the correlation between societal factors and sleep disorders, and particularly the high prevalence of sleep disorders among Māori.



**48 FIRE AND ICE**

Associate Professor Shane Cronin made his volcanological name during the 1995 eruption of Ruapehu. Now, among many other things, he is looking at the Auckland volcano field and its sibling on the Korean island of Jeju.



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Historian Professor Susan Mumm has focused her research on “women who find opportunity in a world of restraint”: the lives of women in convents, brothels, and charitable organisations.

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Meet Professor Jeremy Diggle, an artist whose work defies easy categorisation.

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Between 2000 and 3000 New Zealanders suffer moderate to severe traumatic brain injury (TBI) annually. At the forefront of dealing with the challenges TBI presents to the injured and those around them is Professor Janet Leatham.

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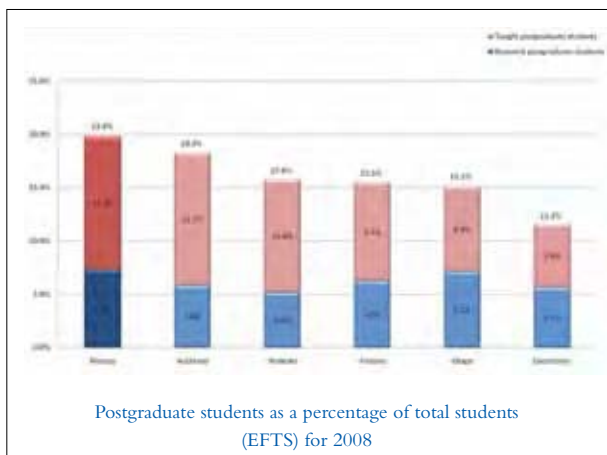


To learn more about Massey research and to view earlier issues of this publication visit <http://news.massey.ac.nz>



### An exceptional postgraduate research experience

Postgraduate student numbers are burgeoning at Massey. In 2006 more than 16.9 per cent of Massey’s student population were postgraduates, a proportion higher than that of any other New Zealand university. Now that percentage has risen to 19.8 per cent, again the highest percentage of any New Zealand university, and the percentage of research postgraduate students has climbed from 5.2 per cent to 7.3 per cent.



Postgraduate students as a percentage of total students (EFTS) for 2008

### A research powerhouse

Massey’s lineage as an agricultural college can still be seen in the university’s eminence in biosciences, but Massey has become much more. Currently the university has more than 700 research-active staff. They include acknowledged world experts in fields as disparate as sleep/wake research, the ‘handedness’ of molecules, and the Bartók Viola Concerto.

The Performance-Based Research Funding exercise has identified Massey as having strengths in a number of domains, including design; veterinary studies and large-animal science; nursing; theatre and dance, film, television and multimedia; public health; agriculture and other applied biological sciences; visual arts and crafts; and pure and applied mathematics.

The university intends to be internationally prominent in research programmes built around four themes. These are agriculture, food and biologicals; environment, ecology and biodiversity; promoting health and preventing disease; and business, cultural transformation and social change.

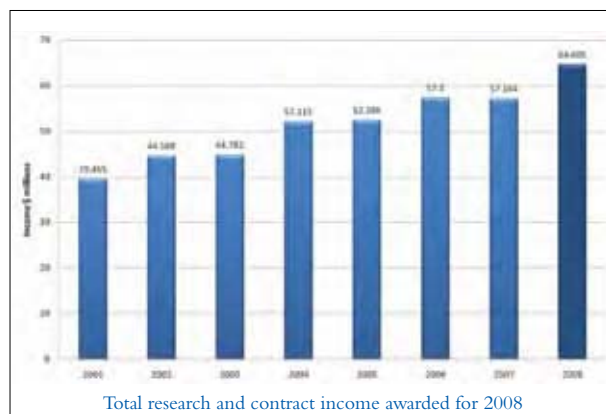
Massey is one of three New Zealand universities to make the Shanghai Jiao Tong University ranking of the top 500 universities worldwide and the top 100 in the Asia-Pacific region.

### Building a research infrastructure

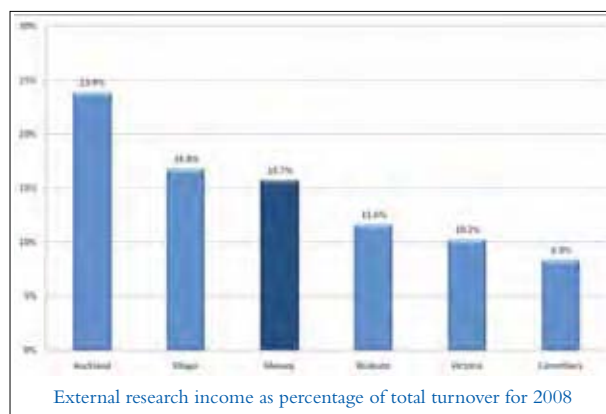
The university is committed to providing its researchers with an environment in which scholarship and creativity can flourish. This includes professional development programmes, generous leave provisions, a system of rewards and recognition, opportunities for promotion and, at the postgraduate level, a range of scholarships. It also includes investing in the equipment and infrastructure that make advanced scientific research possible. 2007 was marked by the opening of the Hopkirk Institute and of the Manawatu Microscopy and Imaging Centre, 2008 by the opening of a \$25 million state-of-the-art food pilot plant, and 2009 by the installation of a \$470,000 Philips CT scanner.

### A magnet for research investment

The research funding attracted by medical research – an expensive and well-funded activity – skews the totals for research funding across the universities. If this funding is excluded, however, Massey can be seen to attract more research and contract income from external sources than any other New Zealand university. External sponsors invested more than \$64 million in Massey’s researchers in 2008.



Total research and contract income awarded for 2008



External research income as percentage of total turnover for 2008

### The Graduate Research School

The Graduate Research School is responsible for doctoral degrees (in philosophy, business and administration, clinical psychology, and education), research masters degrees, and scholarships, both undergraduate and postgraduate. Massey has awarded 554 PhDs and 1936 research masterates since 2002, has more than 1000 doctoral

students currently enrolled, and has more Māori doctoral students than any other university in New Zealand.

The Dean of Graduate Research, Professor Margaret Tennant, is the chair of both the Doctoral Research Committee and the Scholarships Committee.



Back row: Dean Tilyard, CE Bio Commerce Centre, Professor Harjinder Singh, Co-Director of the Riddet Institute, Andrew West, CE AgResearch, Rod Titcombe, CE Manawatu District Council and Peter Landon-Lane, CE Plant & Food. Front row: Janneke van Wagtendonk, Group Research and Technical Operations Manager, Fonterra, Steve Maharey, Vice-Chancellor Massey University and Palmerston North mayor Jono Naylor.

### Food for thought

Six of New Zealand’s preeminent food research and development organisations have established a new brand, Food Innovation New Zealand, to market the nation’s food research expertise to the world. FINZ is a collaboration between Massey University, AgResearch, Plant and Food Research, Fonterra, the BioCommerce Centre and the Riddet Institute with the support of the Palmerston North City Council and the Manawatu District Council. University

Vice-Chancellor Steve Maharey, who is chairman of the Food Innovation steering committee says New Zealand and its leading food science organisations already have a global reputation for excellence.

“Collaboration between our organisations has helped grow the industry’s reputation for providing New Zealand Government and worldwide private sector clients with world-class food research services and capability,” Mr Maharey says. This is the first time the partners have formalised their collaborative efforts.

A similar collaboration is the internationally known Food Valley based in Wageningen in the Netherlands, which brings together private sector, state research and academic food science experts from Wageningen, across the Netherlands and beyond.

“We would like to be recognised as the southern hemisphere’s equivalent of Food Valley with a hub in the Manawatu but drawing on all of New Zealand’s expertise,” says Mr Maharey.

### From Cradle to Cradle: Life Cycle Assessment Centre announced

Take a commonplace commodity like a hamburger bun. Embodied in that bun are all of the processes it took to bring it to your table: the sowing, tending, harvesting, storage and shipment of wheat; the milling of flour; the kneading, baking and packaging of the bun. In turn, each of these processes can be unpacked into an intricate chain of inputs and facilities – water, fertiliser, pesticides, transport, industrial plant, warehousing, electricity – and these have environmental consequences. The humdrum hamburger bun has environmental costs: it draws on raw material and energy and, in some small measure, creates its share of pollution and CO<sub>2</sub> emissions.

The business of valuing the environmental impacts of a given product or service necessitated by its existence is known as life cycle assessment. Now Massey’s Manawatu campus is to be home to a Life Cycle Assessment Centre, a venture made possible by a \$1.3 million contract from the Ministry of Agriculture and Forestry. The centre, to be headed by a new professorial post, will be a

collaboration between Massey, AgResearch, Landcare Research, Scion and Plant and Food. As well as hosting the centre, Massey is to fund three doctoral scholarships and fees.

The centre will help New Zealand producers adopt environmentally sustainable practices, benefiting the planet as well as catering to the concerns of the rapidly growing ‘green’ consumer market.

Vice-Chancellor Steve Maharey thanked Professor Mike Hedley of the Institute of Natural Resources for his pivotal work in helping initiate the centre’s creation. Professor Hedley was also one of the principals in the 2008 creation of two new professorships in biochar.

The new centre will be hosted by Massey’s Agribusiness, Logistics and Supply Chain Management Group at the Institute of Food, Nutrition and Human Health, supported by the Agricultural and Horticultural Systems Management Group at the Institute of Natural Resources and the Sustainable Processing Cluster at the School of Engineering and Advanced Technology.

## Albany Human Nutrition Research Centre opens

Looking like a prop from *2001 a Space Odyssey*, an American-made Bod Pod was front and centre at the launch of the Human Nutrition Research Centre – Te Wāhanga Rangahau Kai at Massey’s Albany campus. The pod forms part of a suite of new facilities commissioned for the centre, including a bone density scanner, a purpose-built clinical laboratory, and video conferencing. The pod, which measures body fat and lean muscle mass using air displacement is one of two in the country, the other being on Massey’s Manawatu campus.



At the opening of the Human Nutrition Research Unit at Albany: Professor of Nutrition Bernhard Breier, guest lecturer Professor Philip Calder, Associate Professor Welma Stonehouse, Head of the Institute of Food, Nutrition and Human Health Professor Richard Archer, senior lecturer Dr Cath Conlon, Professor Gil Hardy (seated), laboratory technician Carlos Miranda and nutrition lecturer Pam von Hurst.



## Creating Māori leaders

An inter-university academy to support Māori academic and professional leadership has been launched. Manu Ao – the Māori Academy for Academic and Professional Advancement will be led by Massey University under the chairmanship of Assistant Vice-Chancellor (Māori) Professor Mason Durie and Te Kāhui Amokura, the Māori standing committee of the New Zealand Vice-Chancellors’ Committee.

Dr Selwyn Katene, the academy director, is based at Massey’s Wellington campus. He says there is a dearth of Māori academic leaders. “We have a crisis; where is the next Mason Durie? The academy is part of succession

## Catching some rays



As societies and individuals grapple with the twin issues of peak oil and climate change, there is an ever increasing interest in alternative sources of energy, one of them sunshine. The best commercial silicon photovoltaic cells are now achieving 15 per cent efficiency, and efficiencies of 20 per cent are being reached in the laboratory. Why then aren’t the rooftops of the nation glinting with silicon? One immediate sticking point is a worldwide shortage of polycrystalline silicon, the main component of silicon solar cells, but the more fundamental problem is cost: polycrystalline silicon is expensive and itself takes large amounts of energy to manufacture.

Are there viable alternatives? Not quite yet, but wait a while. For a number of years now, researchers within Massey’s Institute of Fundamental Sciences have been working with organic dyes similar to nature’s own sunlight harvester, chlorophyll. Though not as efficient as silicon, the dyes are many times cheaper – and with a recent Foundation for Research, Science and Technology funding announcement, it could be that you find your roof enlisted as a power source sooner than you think.

High Efficiency Organic Photovoltaics, a project led by Associate Professor Ashton



planning to promote and foster Māori leadership.”

The initiative has \$2.5 million funding from the Tertiary Education Commission for three years and is supported by all eight universities. A pilot project for the past two years has provided weekly seminars, Professor Durie says.

“It was established in response to the need for a well-qualified Māori academic and professional workforce of high calibre Māori leaders,” he says. “The expanded project has three main aims – advancing Māori scholarship, strengthening links between Māori professionals and Māori academics and accelerating Māori leadership. These aims will be met through a series of academy sponsored activities including seminars, lectures, leaders’ groups, fora and symposia.”

Dr Katene (Ngāti Toa, Ngāti Tama, Ngāti Tūwharetoa) is a graduate of Victoria and Massey universities with a Doctorate of Philosophy in Māori Studies in 2007 from Massey. His PhD research focused on the experiences of Ngāti Tama and its relationship with the Crown and other iwi and Māori groups in Wellington from 1997-2004.

Partridge of the Institute of Fundamental Sciences has been allocated \$5.76m to produce by 2016 an all-plastic, recyclable, high efficiency photovoltaic cell that can be incorporated into a roofing product and which is capable of providing the total average energy requirements for a household.

Cheaper cleaner energy and assurance of supply are the promise, says Partridge.

“It will also have significant impact on reducing the effects on the environment associated with generation and transmission of the grid-tied energy solutions. In the longer term, it will play a significant role in meeting a very real global need for clean, sustainable energy.”

The research will draw on intellectual property and know-how from research organisations and industry in New Zealand and the United States. The collaborating partners include the Massey-based MacDiarmid Institute for Advanced Materials and Nanotechnology and a number of Auckland University research centres whose expertise embraces materials science and engineering.

## Towards more liveable cities

A project that will develop an integrative (economic, social, environmental) scenario modelling capacity in New Zealand has been allocated funding of \$660,000 a year for six years by the Foundation for Research Science and Technology.

The project, Sustainable Pathways phase two, is led by Professor Murray Patterson of the Centre for Ecological Economics. Sustainable Pathways phase two will build on its completed first phase by introducing two state-of-the-art modelling methods – mediated modelling and spatial-dynamic modelling. It is designed to assist local, regional and national decision-makers in forecasting and assessing future pressures on New Zealand’s cities and settlements.

There are three inter-connected objectives: mediated modelling, led by Associate Professor van den Belt; spatial dynamic modelling; and embedding

scenario modelling into urban planning practice.

Taking Auckland and Wellington as its case study regions, the research will provide urban planners with robust state-of-the-art modelling methods that can be drawn on by urban planners. The outcomes, particularly for Auckland and Wellington, are likely to include improvements to land use and transportation planning, infrastructure and growth management, economic, social and environmental planning, and the competitiveness of Auckland’s economy.

There are also strong linkages into other cities and regions through an advisory group and two linked programmes.

The programme is a collaboration between the New Zealand Centre for Ecological Economics, Market Economics Ltd, and Research Institute for Knowledge Systems (Netherlands).

## Caring for coasts

A project that could have long term benefits for the ecological health of New Zealand’s coastline been granted \$6.6m by the Foundation for Research, Science and Technology. The project, Manaaki Taha Moana, is intended to restore and enhance coastal ecosystems that are important to Ngāti Raukawa and Tauranga Moana iwi. It will be led by Professor Murray Patterson of the Centre for Ecological Economics (a joint venture between Manaaki Whenua and Massey University).



The research will

- improve understanding of the causes of the degradation of coastal ecosystems and the best way these can be addressed
- result in action plans for improving coastal ecosystems in the iwi’s rohe
- empower iwi in resource management planning, by arming them with robust data about their coastal ecosystems and the causes of degradation
- build capacity in applied coastal ecosystems research.

Partners in the project are Tauranga Moana iwi, Ngāti Raukawa, the New Zealand Centre for Ecological Economics and the Cawthron Institute.

Iwi/hapū-based teams representing a mix of established and emerging researchers will be led by Dr Huhana Smith, Shad Rolleston and Carlton Bidois. Seventeen agencies have confirmed they will be helping to co-fund the research. Their contribution is expected to amount to an extra \$390,000 per year.

## Centre of Excellence for Research in Inclusive Education launches



Massey now hosts a Centre of Excellence for Research in Inclusive Education. The Manawatu-based centre, launched in April 2009, will conduct research and teaching in areas including gifted and talented students, home and school partnerships, violence and bullying, behaviour disorders, disability issues, Māori and Pacific Island students, and learners with a wide range of linguistic and cultural backgrounds. With a founding membership of 11 academics, the centre will focus on five areas that promote the inclusion of often marginalised learners. These include analysis of current policies and practices and examining the skills of professionals who work with them. Associate Professor Jill Bevan-Brown is the centre’s director.



### \$1 million to sleep studies

Two studies being carried out by the university's Sleep Wake Research Centre have been awarded funding totalling more than \$1 million by the Health Research

Council. Dr Leigh Signal has been awarded \$945,456 for a three-year study investigating the relationship between sleep in late pregnancy and birthing delivery methods, as well as sleep early in the period after a woman gives birth and her mood during this time.

Dr Sarah-Jane Paine (Tuhoe) has been awarded \$145,561 for a one-year feasibility study aimed at developing clinical sleep services for Māori.

Dr Signal's study will involve recruiting 500 Māori and 500 non-Māori women in the late stages of pregnancy to complete a questionnaire on their sleep patterns, lifestyle, social support, mood and health. There will be follow-up

questionnaires six and 12 weeks after their babies are born.

"This research will be fundamental in advancing understanding of the links between maternal sleep, birth outcomes and post natal mental health," Dr Signal says. The study will also be used to trial a sleep education intervention to improve the sleep of new mothers and their infants.

Dr Paine's feasibility study will involve developing contacts with relevant organisations including the 21 district health boards, face-to-face interviews and national workshops. She plans to apply for full funding in 2010-2011.

### Top Achiever Scholarships

Seven Massey research doctoral students are to receive nearly \$680,000 in Top Achiever Doctoral Scholarships.

Daniel Playne has been awarded \$91,831 for his project *Tools and Methods for High-Performance, Scientific Simulation and Visualisation*.

Gemma Cartwright has been awarded \$106,098 for her project *Signalling in the Epichloe Festucae-Lolium Perenne Symbiotic Association*.

Teo Susnjak has been awarded \$94,694 for his project *Accelerated Machine Learning for Classification Problems*.

Linda Johnson has been awarded \$82,974 for her project *Transnational Māori Activism: Generating Political Space Across Borders, 1945-1990*.

Rebecca Bloomer has been awarded \$100,611 for her project *Epidermal Trait Variation in Arabidopsis Thaliana: Understanding the Molecular Genetic Basis of Plant Adaptations*.

Jason Park has been awarded \$101,595 for her project *Enhancing Algae Biofuel Production from Wastewater Treatment Ponds*.

Michael Blewden has been awarded \$99,807 for *Tracing and Enhancing Process Use Outcome*.



### Memories are made of this

Dr Helen Fitzsimmons uses fruit flies to study the structural changes in chromosomes that occur during memory storage. Having been exposed to two odours in succession, one of them coupled with a mild electric shock, the fly is placed in a T-shaped maze, forcing it to choose between the odours. Dr Fitzsimmons hopes to elucidate the molecular pathways involved in learning and memory. Her research is funded by a three-year Foundation for Research Science and Technology postdoctoral fellowship.

### Young and old alike

Foundation for Research Science and Technology have awarded funding the Building an Inclusive Society portfolio to the following Massey staff:

- Professor Robyn Munford and Dr Jackie Sanders have received \$6.4 million for an eight-year project to study youth transitions.
- Associate Professor Chris Stephens and Dr Mary Breheny received \$1.05 million over three years for their project to develop an index of living standards for the elderly.



From left: Professor Robyn Munford, Dr Jackie Sanders, Professor Chris Stephens and Dr Mary Breheny.

## \$1.2 million for Māori cancer care and cervical cancer research



The disparity is troubling: Māori are 9 per cent more likely to get cancer than non-Māori and 77 per cent more likely to die of it than other New Zealanders.

In response, the Health Research Council is funding two research projects aimed at improving overall cancer care for Māori patients and increasing the rate of survival for cervical cancer.

Dr Lis Ellison-Loschmann from the university's Centre for Public Health Research in Wellington will lead both projects, which are funded by HRC grants totalling more than \$1.2 million.

One study will look at the care of Māori patients. The other will investigate differences in cervical cancer survival rates between women of different ethnicities and any correlations with socio-economic status, age, and proximity to health services at time of diagnosis.

A team of 16 researchers, including Professor Chris Cunningham, Professor Mason Durie and Professor Neil Pearce, will conduct a national study of Māori diagnosed with cancer, their whānau and cancer care service providers.

Other researchers in that study, which has funding of \$574,465, are drawn from District Health Boards, Māori primary health organisations, hospice organisations and the Cancer Society.

Dr Lis Ellison-Loschmann has also secured funding of \$665,198 for research into inequalities in cervical cancer survival in New Zealand. "Most of the attention to date has been focused on cervical cancer in general, and very little consideration given to demographic differences in cervical cancer risks, screening treatment or survival," she says.

For the next three years she will lead a team of 10 researchers, including Naomi Brewer who will work on the project for her PhD, and Massey researcher Associate Professor Barry Borman. They will link all cases of cervical cancer notified between 1994 and 2005, to death registrations to identify the factors that account for ethnic differences in survival. "The findings will ultimately be used to minimise barriers and reduce inequalities in cervical cancer survival in New Zealand."



## Young scientist gives hope to sufferers

PhD student Carlene Starck has won the Advancing Human Health and Wellbeing category of this year's MacDiarmid Young Scientist of the Year Awards for research into the role of protein misfolding in human disease.

Her focus has been on the precursor protein to myostatin, a growth factor protein that limits muscle tissue growth: a higher concentration of myostatin may lead to less developed muscles. The folding of the myostatin precursor protein – and the environmental and genetic factors affecting that folding – appears to play a role in the development of sporadic inclusion body myositis, a disease that leads to progressive muscle wasting and weakness. The research is supported by the Neuromuscular Alliance of New Zealand.

Two other Massey PhD students were finalists in the awards: Christopher Rodley (Ngāti Koata), who is mapping the DNA architecture inside cells, researching how the 3D organisation of DNA in the cell nucleus affects the on/off switching of genes; and Jenna Gallie, who is investigating the evolutionary response of experimental populations to fluctuating environments.

The Advancing Human Health and Wellbeing category is sponsored by the Health Research Council of New Zealand and the award carries a grant of \$5000. The MacDiarmid Awards are presented by the Foundation for Research, Science and Technology.



A \$470,000 Philips CT scanner about to be put through its paces by Professors Elwyn Firth and Hugh Blair. The Computer Tomography scanner is the centrepiece of a purpose-built \$1.1 million facility instigated by Landcorp, which is Massey's partner in the venture. Landcorp's particular interest lies in assessing the extent of body fat in livestock, but the facility will be used for all manner of animals – the integrated table is large enough to accommodate cows, horses, and even smaller whales – and for teaching as well as research. Computer Tomography generates three-dimensional images from a large series of two dimensional X-ray images taken around a single axis of rotation. The facility was launched in April 2009.

## Accolades



Dr Hamish Anderson



Dr Grant Hannis



Professor Glyn Harper



Professor Paul Spoonley



Professor Mike Hendy



Associate Professor  
Dean Halford



Dr Barbara Holland



Professor Colin Holmes



Dr Mike Joy



Dr Heather Kavan



Norman Meehan



Professor Tom Nicholson



Professor Neil Pearce



Dr Paul Perry



Professor Mick Roberts



Dr Nick Roskrug



Professor Jacqueline  
Rowarth

**Dr Hamish Anderson**, a senior finance lecturer, is the first New Zealand university staff member to win the Australasian Pearson Accounting Finance Lecturer of the Year Award.

**Dr Grant Hannis** and **professors Glyn Harper** and **Paul Spoonley** have been awarded Fulbright Senior Scholar Awards to spend time in the US. Dr Hannis will investigate the depiction of Chinese gold miners in 19th century newspapers; Professor Harper will conduct research into New Zealand's WWII role in the battle of Cassino; and Professor Spoonley will research the cultural identities of first generation Latino people in San Francisco as a part of a larger project that includes Pasifika people in Auckland.

**Professor Mike Hendy** and **Associate Professor Dean Halford** have been appointed Officers of the New Zealand Order of Merit in the 2009 New Year's Honours list for services to mathematical biology and education, respectively. Professor Hendy, who specialises in mathematical biology, is the co-director of Massey's Allan Wilson Centre for Molecular Ecology and Evolution. Associate Professor Halford was head of the Department of Mathematics from 1995-97 and deputy head of the Institute of Fundamental Sciences from 1997 until his retirement in 2006.

**Dr Barbara Holland**, Institute of Fundamental Sciences and Allan Wilson Centre, has received the New Zealand Mathematical Society's Early Career Award for 2008. The award recognises "groundbreaking work in interpreting information of historical and biological importance in comparisons of genetic sequence data, and her pioneering development of phylogenetic networks that succeeded where simple optimisation models failed in identifying conflicts and in unmasking the more interesting biological evidence". In 2007 the award was made to Dr Catherine McCartin of Massey's School of Engineering and Advanced Technology.

**Professor Colin Holmes** has been awarded DairyNZ's Lifetime Achievement Award.

**Dr Mike Joy** has been awarded an Ecology in Action award by the New Zealand Ecological Society in recognition of his outstanding achievement in the practical application of ecology in New Zealand.

**Dr Heather Kavan** of the Department of Communication, Journalism and Marketing and **Norman Meehan**, a senior lecturer in the New Zealand School of Music, have been awarded National Tertiary Teaching Excellence Awards, each award carrying \$20,000 in accompanying funding.

**Professor Tom Nicholson** from the university's College of Education has been elected to the US-based Reading Hall of Fame. Nicholson is the only New Zealander among the 100 international academics represented in the hall.

**Professor Neil Pearce**, Director of the Centre for Public Health Research has assumed the presidency of the International Epidemiological Association.

**Dr Paul Perry** has been elected to the scientific advisory board of the World Values Survey Association. Dr Perry, a senior lecturer in the School of People, Environment and Planning, has been a principal investigator in the New Zealand study of values since 1985.

**Mick Roberts, Professor of Mathematical Biology** in the Institute of Information and Mathematical Sciences, has been elected to a Fellowship of the Royal Society.

Senior lecturer **Dr Nick Roskrug** has been appointed to the Environmental Risk Management Authority's Māori Advisory Group, Ngā Kaihautū Tikanga Taio.

Director of Massey Agriculture **Professor Jacqueline Rowarth** has been declared Federated Farmers first Agricultural Personality of the Year.



Individual



**Professor Anne Noble**

Anne Noble's indelible photographic imagery is known far beyond Massey's Wellington campus, where she is Professor of Fine Arts.

Her work is represented in gallery collections worldwide – notably in the *Musée du Quai Branley*, Paris; the Australian National Gallery; and the Queensland Art Gallery International Collection of Contemporary Art.

It has also been exhibited at Te Papa and all other major New Zealand museum collections.

From a 1982 exploration of the Whanganui River, to her graceful 1988 photo essay about the contemplative life of nuns, to pictures of her daughter Ruby showing off vividly coloured sweets and, in recent times, breathtaking desolate images of Antarctica, Professor Noble's work is wide ranging.

In a 2007 interview ahead of the exhibition opening for *Ruby's Room* in Paris, Professor Noble explained her photographic philosophy.

"I work at the university and I can tackle big subjects or lengthy research projects but in fact the little surprises that you find are best. I collect things, put them away and get them out and photograph them. Love letters, for example, and fragments that people keep."

In 2007 Professor Noble was the only international recipient of the US National Science Foundation Polar Programme. Professor Noble has been awarded six Creative New Zealand grants in the last 15 years and received Public Good Science Funding from the Ministry of Research, Science and Technology Science and Technology Promotion Fund in 2000.

That same year Professor Noble was given the honour of a retrospective exhibition and accompanying book reflecting on her photographic work over the previous 20 years. The exhibition *Anne Noble: States of Grace* toured New Zealand's main public art galleries for the next two years.

In 2003 she was awarded the Officer of the New Zealand Order of Merit for services to photography in New Zealand. The citation included mention of the Archive of Contemporary Culture, which she established at the National Library of New Zealand to archive social documentary projects undertaken in collaboration with honours students at Massey over the previous four years.

As research director for the College of Creative Arts, Professor Noble helped it secure a top ranking with the Performance-Based Research Fund, which measures the quality of academic research. In 2006 the university was rated the number one design institution in New Zealand. Professor Noble is also the recipient of this year's College of Creative Arts – Individual research award.

Individual



**Professor Peter Schwerdtfeger**

Fundamental aspects of chemistry in relation to quantum physics – such as the chemistry and physics of gold – have been the major research focus for Professor Peter Schwerdtfeger during his five years at Massey University, earning him three consecutive Marsden grants over the past three years – a unique achievement.

He is the recipient of the both the College of Science's Individual Award, and a Massey University Research Medal – Individual (Joint).

One of the professoriate of three at the Albany campus-based New Zealand Institute for Advanced Study, he has earned multiple accolades and prizes as one of the top-ranked physical scientists in the world.

In nominating him for the College of Science award, Distinguished Professor Gaven Martin said Professor Schwerdtfeger has an international reputation as a leading chemist unmatched in his field in New Zealand, and seldom matched in a global context.

"Achievements such as his election to Fellow of the Royal Society of New Zealand (1997), the award of Hector Medal for work of great scientific or technological merit (2001), the James Cook Fellowship (2001) and his exceptional citation rate, narrow him down to be among a very few select scientists in New Zealand."

German-born Professor Schwerdtfeger gained a degree as a chemicotechnical assistant at the Chemisches Institut in Stuttgart, Germany, in 1973, and a PhD in 1986 from the University of Stuttgart. He has held numerous positions as teaching and research fellow at universities in Germany, Australia and New Zealand, as well as Professor (and personal chair) at the University of Auckland and deputy director of its Institute of Fundamental Sciences prior to joining Massey.

His Marsden-funded projects include experimental and theoretical investigations of the nanostructures of gold for a better understanding of the quantum size effects in nanostructured materials, and understanding and modelling the behaviour of dynamic clusters of atoms and molecules in heavy metal clusters.

He has supervised a number of PhD students, and collaborates intensively with more than 30 research groups worldwide on many different topics ranging from computational inorganic and organic chemistry to materials science and high-resolution spectroscopy.

Professor Schwerdtfeger has been the recipient of four Marsden grants (2003, 2006, 2007 and 2008) totalling \$3 million.

### Early Career



#### Dr Leigh Signal

From its establishment in 2003, Dr Leigh Signal has been an integral part of Massey's Sleep/Wake Research Centre.

In that time she has been employed as a senior research officer as well the centre's associate director. Dr Signal's research interests include sleep, sleep inertia, sleep and respiration at moderate altitudes, fatigue and performance issues in the aviation industry (Dr Signal is a qualified commercial pilot and flight instructor), sleep during the perinatal period and maternal health.

Her research includes laboratory and field-based studies and she has a particular interest in the application of research findings to improve health and safety.

Dr Signal has been awarded more than \$3 million in research funding since joining Massey.

This includes a grant in June this year from the Health Research Council of New Zealand to study sleep in pregnancy

and postpartum, and the relationship with maternal health in 500 Māori and 500 non-Māori women. This grant followed funding awarded earlier by the Health Research Council on the same issue.

Other grants awarded included a Marsden Fast Start Award last January to continue investigating the time course and magnitude of sleep inertia, and research contracts with the Boeing Company for an international collaborative project examining the effects of commercial aircraft cabin pressure altitudes on sleep, respiratory physiology, and performance. These were conducted in hypobaric chambers in Tulsa and Vancouver.

"The large majority of projects that I am involved with are conducted as a collaborative effort," Dr Signal says. "Diverse teams can make projects challenging to organise and conduct, but my track record in undertaking this kind of work demonstrates my skills in this area.

"My intention is to continue to build on the international reputation I have for conducting high-quality research and to expand the areas of research I presently have underway," Dr Signal says.

She also shares her research knowledge through contributions to academic teaching, supervising graduate students and mentoring students and junior research staff at the Sleep/Wake Research Centre.

### Team



#### Volcanic Risk Solutions

The Volcanic Risk Solutions team carries out high-profile research on volcanic risk and volcanic geological issues throughout New Zealand, southwest Pacific and Asia.

Led by Associate Professor Shane Cronin, the 23 member multidisciplinary team has secured \$7.5 million in research funding since its inception in 2004.

In that time the team has published 80 journal articles and 12 book chapters, presented 18 keynote lectures to conferences around the world and delivered 231 conference papers.

It has supervised 14 masters/bachelor (hons) and six PhD students to completion and currently has four masters and nine PhD students.

Recent research highlights include work on the first probabilistic hazard forecast for Mount Taranaki and a unique calculation of geomorphic change induced by a volcanic flood at Mount Ruapehu.

The team was nominated by Institute of Natural Resources head Professor Peter Kemp, who says the team has all the credentials of an international standard research team.

"The team and its individual members are prolific producers of highly original and innovative research on volcanology and natural hazard management," he says. "They produce both exciting and fundamental scientific discoveries on volcanoes and lahars, and provide hands-on advice and practical tools for managing natural disasters caused by volcanoes."

College of Sciences Pro Vice-Chancellor Professor Robert Anderson says the team has developed a high-profile defining strength at the university.

"The team has brought credit and public recognition to the university through several appearances on national television, tens of radio interviews and over 100 newspaper articles," he says.

"The attraction of this research team as a destination for postgraduate study is represented by it starting 33 postgraduate research students in this area since 2004...attracting and training high-quality international PhD students from Switzerland, England, Germany, Colombia and the United States."

### Early Career



#### Matthias Lein

Helping plan and set up the university's first supercomputer, the Double-Helix, as part of a larger vision to introduce high-performance computing as an essential tool of research facilities is one Dr Matthias Lein's many contributions to promoting academic excellence at Massey.

Dr Lein is based at the Centre for Theoretical Chemistry and Physics at the New Zealand Institute for Advanced Study.

"As a researcher working at the interface between chemistry and physics I am personally devoted to interdisciplinary research and collaboration across the boundaries of traditional disciplines," he says.

He is currently part of an initiative to commission Helix3, which will be the largest super-computing facility at a University in New Zealand. His research group is currently Massey's largest user of Best-Grid, a grid computing initiative established by the Tertiary Education Commission.

"Matthias's research is deep and important," says Distinguished Professor Gaven Martin in support of his medal nomination. "He uses a variety of techniques (computational and theoretical) to

address serious questions of atomic structure developing new and innovative methods to test and explore fundamental theories."

Dr Lein completed his PhD in chemistry at Philipps Universität Marburg, Germany, and was an Honorary Research Fellow at the University of Auckland in 1999–2000, Visiting Scientist at Budapest Technical University, Hungary in 2003 and Marsden Postdoctoral Fellow at Massey's Institute of Fundamental Sciences in 2004–2006.

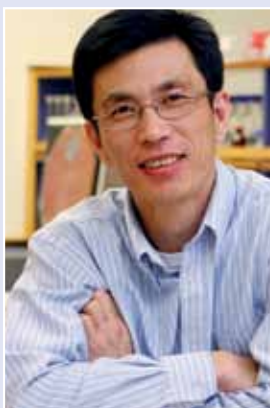
As well as serving on numerous academic boards and university administration committees, he has also been proactive in co-organising many international conferences and workshops in Europe and Australasia, including the 2006 New Zealand Institute of Chemistry conference in Rotorua, attended by over 300 people from more than 20 countries.

Widely published in a plethora of academic journals, including work on molecular parity published in *Physical Review Letters* – the most prestigious peer-reviewed journal in the field of physics – Dr Lein is also passionately committed to teaching.

"While traditionally academic success was measured by what and how much students learn – and elaborate assessment tools have been developed to measure these – the latest developments in tertiary education clearly show that academics need to become much more concerned with how students learn," he says.

He believes new technologies, such as interactive web-based teaching tools can complement traditional learning modes and augment deep learning.

### Early Career



#### Dr Aiqian Ye

Dr Aiqian Ye gained his PhD at Massey University in 2003 and subsequently began work at the Riddet Institute on the chemical and physical characteristics of food components. From 2005 to early 2008 he worked at the Fonterra Research Centre, where he investigated milk protein-based colloidal systems. During this time he filed three world patents and published four papers.

He then returned to the Riddet Institute as a Senior Research Officer. His research has broadened to investigate the behaviour of food structure during digestive processes and the work will establish a relationship between the physical properties of food components and nutrition. He is currently leading a major industry-sponsored research programme on structuring foods for health and is supervising three post-graduate students and several visiting researchers.

Dr Ye has rapidly established an international reputation among his peers and his work is increasingly being cited by other scholars. He is an extremely productive researcher,

having produced 35 scientific papers, four patents and four book chapters.

Recently Dr Ye was selected as a finalist in the Young Scientist Award 2009 by the American Chemical Society and presented his work in Washington DC in August. Dr Ye was one of five finalists and the only finalist from outside the United States.

The Riddet Institute's two directors describe Dr Ye's approach to science as "highly innovative" and his future prospects as "enormous".



### Supervisor



#### Professor Hugh Blair

Professor Hugh Blair is the recipient of both the College of Sciences Supervisor's Award and the Massey University Research Medal – Supervisor.

Throughout his 33 years at Massey, Professor Blair has supervised 39 successful postgraduate students, 28 completing masters degrees and 12 PhD graduates.

Professor Kevin Stafford from the Institute of Veterinary, Animal and Biomedical Sciences (IVABS), who nominated Professor Blair for the supervisor medal, said that Professor Blair worked hard to ensure students understood scientific rigour yet provided a skilful balance between supervisory guidance, respect for students' abilities and the cultivation of autonomy.

"Hugh Blair's understanding of this balance distinguishes him from lesser supervisors; his students are given the confidence to be

independent thinkers, responsible for their own destiny, personal qualities which are at the core of their future careers. It is for these reasons that his postgraduate student programme is so highly thought of nationally and internationally," says Professor Stafford.

Professor Blair, a Professor of animal science, is an acknowledged expert in animal genetics. After completing a BAgrSc (Hons) at Massey in 1976, he undertook his PhD Animal Science and graduated PhD in 1981. After a spell as a Postdoctoral Fellow at Cornell University, he returned to Massey in 1982 as a junior lecturer in sheep husbandry. In 1990 he achieved Associate Professor in the Department of Animal Science, and in 1998 became Professor of Animal Science. In 2009 he acted as head of the IVABS.

Professor Blair was director of postgraduate study at IVABS for many years, and is a principal investigator in the National Research Centre for Growth and Development. Professor Stafford says Professor Blair continues to develop links with other researchers, both in New Zealand and globally.

"His passion for research and his scientific rigour has also inspired a commitment to excellence in numerous young staff – some of whom will be future science leaders for this university."

### Vice-Chancellor's Awards for Teaching Excellence



**Norman Meehan**



**Adam Claassen**



**Sam Richardson**

#### **A jazz lecturer, a historian and an economics expert are this year's recipients of the Vice-Chancellor's Awards for Teaching Excellence.**

Norman Meehan, from the School of Music at Wellington, and Dr Adam Claassen, from the School of Social and Cultural Studies at Albany, have been awarded the Vice-Chancellor's Award for sustained commitment to teaching excellence.

Dr Claassen, a senior history lecturer, says his use of multi-media visual and audio material, breaking up lectures with group discussions and integrating personal anecdotes and stories by individuals from the past makes learning about history more enjoyable, concrete and interesting.

"There is something intrinsically thrilling when you know a student has caught onto something," he says. "It's a hot chocolate feeling – you've transferred knowledge, enthusiasm and intellectual stimulation and helped the student develop a toolbox of intellectual skills that they didn't have previously."

Mr Meehan, who teaches jazz history and analysis along with jazz composition and arranging, says the award was unexpected, given that he was employed to do something he had always loved doing. "My job is to play music to my students and then talk about it. How bad can that be? I'm so fortunate that I teach in something I care about. As Frank Zappa said 'music is the best' and you can't help feeling that somehow he's right."

The Vice-Chancellor's Award for Excellence in Teaching First-Year Students has gone to economics lecturer Sam Richardson, who teaches at Manawatu.

Mr Richardson says it is an exciting area to teach in, with many avenues for exploration. "Economics is truly everywhere – and we live it each and every day. Even though we may not realise it, every action we take has an economic dimension to it. I believe everyone who studies economics should learn about what makes people – individuals, businesses, government, in other words the economy – tick."





**The outlawing of the party pill drug BZP and P's growing disrepute may have had the effect of increasing the use of ecstasy.**

The latest iteration of the Illicit Drugs Monitoring System, conducted among frequent drug users each year, show a levelling out of methamphetamine (P) use and increases in ecstasy and – though it is still rare – cocaine use.

Lead researcher Dr Chris Wilkins (pictured) from Massey's Centre for Social and Health Outcomes Research and Evaluation says there has been a steady increase in ecstasy use since 2001.

“The ban on BZP may be encouraging more people to use ecstasy and this is an issue which we intend to investigate in detail over the next six weeks.”

Researchers also found that drug use and driving is at least as big a problem as alcohol and driving – and drug users who drive believe they are less likely to be detected when stopped by police than if they were under the influence of alcohol, says Dr Wilkins. *June 2009*

**There has been a sharp rise in the number of New Zealanders without religious affiliation.** In a recent survey, 40 per cent of respondents say they have no religious affiliation; 17 years ago the corresponding figure was 29 per cent.

Just over a third of New Zealanders describe themselves as religious.

Fifty-three per cent say they believe in God (although half of those say they have doubts), 20 per cent believe in some form of higher power and about third say they don't believe or don't know.

However, 60 per cent say they would prefer children to have religious education in state primary schools, with strongest support for teaching about all faiths.

Led by Professor Philip Gendall, researchers from the Department of Communication, Journalism and Marketing received responses from 1000 people as part of the International Social Survey Programme. *April 2009*

**Pseudoephedrine, a drug found in cold remedies and also used in the manufacture of methamphetamine, appears to do little for athletic performance.**

Dr Toby Mündel and Dr Steve Stannard of the Institute of Food, Nutrition and Human Health tested eight well-trained cyclists who performed two time trials in the laboratory. Ninety minutes before each trial they were given either a placebo or approximately three-times the usually prescribed dose of pseudoephedrine.

“Our results showed that pseudoephedrine did not have a noticeable effect on the athlete's performance,” says Dr Mündel.

The research is to be published in the *European Journal of Sport Science*. *June 2009*

**Agricultural workers – particularly women – have the highest incidence of leukaemia of all New Zealand occupation groups, probably because of their exposure to chemicals.**

This is one of the conclusions of research conducted by the Centre for Public Health Research.

The centre conducted an analysis of a study started in 2003-04, when researchers interviewed 225 cancer patients aged 25-75 and 471 randomly selected participants from the general population.

The analysis, led by Dr Dave McLean (pictured) found elevated leukaemia risk four or five times greater among market gardeners and nursery growers compared to the general population. Market farmers and crop growers, and field crop and vegetable growers, also all experienced varying degrees of elevated risk.

The study builds on research published by the centre last year, which showed those working in plant nurseries were four times more likely to develop non-hodgkin's lymphoma, while vegetable growers and those in general horticulture production have a two-fold risk of developing that disease. *June 2009*



**Increasing urbanisation and more intensive farming are killing New Zealand's freshwater fish species by degrading water quality, says the author of a report published by the Ministry for the Environment.**

Dr Mike Joy (pictured), a senior lecturer in the ecology group of the Institute of Natural Resources, reviewed 22,500 records of fish communities nationally and found they show significant decline over the past 40 years.

The most dramatic impacts are in waterways adjoining pastoral and urban sites. “These fish communities are like miners' canaries,” Dr Joy says. “They have a strong message for us – our freshwater ecosystems are in dire straits and more than half of our native freshwater fish species are classed as being at risk of extinction. *June 2009*

**Talking and laughing in class can sometimes be a good thing.**

Dr Bobbie Hunter and colleague Associate Professor Glenda Anthony have been working with year 7 and 8 Pasifika and Māori pupils at four schools in Waitakere and Manukau to find out if their maths performance and attitude improves when they work cooperatively in groups.

The results of their project – an Education Ministry teaching learning research initiative – have been better grades and greater levels of understanding. “They tell me it's harder and more challenging, but it's more fun. They really enjoy it now,” says Dr Hunter.

The findings mirror those of Professor Marta Civil from the University of Arizona's Department of Mathematics who has used similar group learning models among Hispanic and North American Indian pupils to improve maths performance. *July 2009*

## Findings

**Of the various forms of legalised gaming, electronic gaming machines, aka the pokies, seem to have the fewest redeeming features.**

Commissioned by the Ministry of Health, Massey's Centre for Social and Health Outcomes Research and Evaluation and Te Rōpū Whāriki, interviewed more than 7000 people from across the country for a major study into how gambling affects the well-being of people and their families.

Electronic gaming machines were used by four per cent of respondents in clubs, eight per cent in bars or pubs and eight per cent in the casino.

Playing gaming machines was found to be associated with self-reported poorer physical health and mental well-being. It also appeared to damage the way people

felt about their relationships with family and friends and the views they held about themselves, their overall quality of life, and their overall satisfaction with life. Other types of gambling, such as betting at the racetrack or TAB or playing poker, did not elicit the same negative feelings from respondents.

Māori and Pacific people were more likely to play gaming machines than other ethnic groups and there were significant associations between gambling participation and poorer self-rated quality of life in those groups.

The report, *Assessment of the Social and Economic Impacts of Gambling in New Zealand*, is available for download from the Ministry of Health website. December 2008

**A fifth of young New Zealand European children display asthma symptoms, a quarter of Pacific Island children and nearly a third of Māori, an international survey has found. And the disparities between children of different ethnicities appear to have widened over the past decade,** according to research published by Dr Lis Ellison-Loschmann, from the Centre for Public Health Research.

The survey was carried out as part of phase three of the International Study of Asthma and Allergies in Childhood, which canvasses more than a million children in more than 100 countries.

The study appears in the *International Journal of Tuberculosis and Lung Disease*. June 2009



Heather and Ivan Morison, *Journée des barricades*, Wellington 14 December 2008. Commissioned by Litmus Research Initiative, Massey University for One Day Sculpture. Photo: Stephen Rowe

# muscle, hair and skin

**Professor David Parry**, the winner of the 2008 Rutherford medal, talks to Malcolm Wood about his career spent exploring the structure of proteins.



**F**or someone who has just entered his retirement years – meaning a two-day working week in this case – Professor David Parry doesn't look his age. The 2008 Rutherford Medal winner is tall and whipper lean, and it is somehow right that as the world's authority on the structure of hair (or more particularly keratin, which is its basic constituent) he should himself sport a full head of the stuff. It's mostly grey admittedly, but then Parry knows professionally from his work with proteins that age will have its way.

But more of that later, for matters scientific are not top of Parry's mind just now. Rather, he is thinking about the talk he will give when he goes on tour for the Royal Society. Where the tour will take him, he hasn't been told quite yet, but it is likely to be small-town New Zealand: places where scientists on lecture tours are an uncommon event.

He's a bit apprehensive. These will be mixed audiences: some will be drawn to the hard science; others less so. So Parry is setting out to interleave his quite technical science with a more personal account of his own history and of how the world has changed around him in the half century since he began university study.

And it has changed, he muses, almost beyond recognition. Take information technology. Parry remembers the computer he worked with while doing his PhD at King's College in mid-sixties London, the Elliott 803 (a room-sized machine boasting 8k of memory). "It had green, red and blue lights and they all flashed on and off. The magnetic tapes whirled around and the reader chewed up our precious spools

of tape. This was a real computer and not the antiseptic ones we have today."

Or take international travel. His first postdoctoral fellowship with the CSIRO's Division of Protein Chemistry in Melbourne (where he met and married his wife and they had their first child) meant spending a month on the sea via the Suez Canal. His next bouts of extended travel were to Boston to work for the Children's Cancer Research Foundation and Harvard Biophysics Department, then on to Oxford via the QE2 to work for the Laboratory of Molecular Biophysics, and finally to Massey in 1973 to take up a lectureship in physics. The plane travel was not long-haul as we know it, but an extended series of less-than-three-hour hops.

As a boy, Parry could never have foreseen the shape his career would take. In his final school years he had planned to go to Oxford on a maths scholarship, but when his father relocated to London he hurriedly revised his plans. He made a late application to several London University Colleges and was accepted by King's College to study maths and physics, going on to graduate in 1963 with a job offer in hand: designing ship hulls for the British Scientific Civil Service.

But King's College intervened once more. New Zealand-born Maurice Wilkins (who had won the Nobel Prize for physiology or medicine the year before for his part in determining the structure of DNA) and his colleague Arthur Elliott were looking for someone to take on a PhD determining the

structure of synthetic proteins and polypeptides using the maths-and-physics heavy discipline of X-ray crystallography. Would Parry be interested? He would.

It was a career-determining choice. He had opted to become a molecular biophysicist, and at a time when breakthroughs such as the solution of the primary structural motifs in proteins (proposed in 1951 by Linus Pauling and colleagues) and the determination of the structure of DNA (described by Watson and Crick in 1953 drawing on the work of Wilkins and Franklin) were relatively recent and the field was largely untilled.

As his Royal Society audiences will learn, Parry swiftly began notching up achievements. Between completing his PhD and arriving at Massey, Parry participated in some seminal work. At Harvard he helped decrypt the structure of the tropomyosin, a cable-like muscle component, and at Oxford he collaborated in assembling the first-ever sequence of the protein collagen (subsequently explaining in an elegantly designed modelling experiment why the sequence led to the collagen-forming bands in the fibrils). He also arrived at the mechanism by which muscles are switched on and off.

The last of these alone would have been enough to make Parry's name.

At Massey Parry persisted with the line of research he had begun while at the CSIRO. There he had worked on wool proteins, now he would work with hair proteins. But call it wool or hair, it makes no difference, says Parry. In biochemical and structural terms the two

*Reprinted from MASSEY magazine, April 2009.*

are the same thing: a tough, resilient, outer layer that provides temperature regulation and protection from both the environment and predators.

All proteins are built from different combinations of about 20 amino acids. In the case of hair, the structure of keratin is based on the  $\alpha$ -helix. This resembles a spiral staircase with amino acids as runners. Two of these structures come together and wind around one another to form a coiled coil rather like a ship's rope.

One of Parry's achievements has been to establish that the basis of the coils is a set sequence of seven amino acids – a heptad – broken up by 'stutters', 'stammers' and 'skips', the terms applied when certain predictable numbers of amino acids are missing.

"The heptad repeat is an extremely common feature in a very large number of proteins, but it just wasn't recognised," says Parry.

This "delightful simplicity", as he puts it in one of his papers, means that one day soon it may be possible to bioengineer new forms of coiled coil proteins with biomedical and other applications.

What, then, is the relationship between the keratin in skin and the keratin in hair? At the base of the hair follicle, he explains, the structures of hair and the surrounding skin are virtually identical.

"But as the cells die the hair molecules rearrange themselves, disulphide bonds form, and the thing becomes very stiff and rigid," Parry explains.

These same disulphide bonds, which form many of the links between the coiled coils, are the reason why burning hair has that distinctive smell, and it is also these bonds that are rearranged when hair is permed.

As for what happens to proteins with age, the news is mostly bad. Parry has collaborated in investigations into the state of horse tendons as they age and has shown that the delicate collagen connective tissues known as fibrils undergo a distinctive change: "In an older horse the fibrils are very small; all the big ones have gone."

Age brings other unwanted changes too. Tissues, such as the skin, which were plump with lubricating water, become increasingly desiccated as we age, and most – not quite all, he says – of the cosmetic remedies on offer are little more than upmarket forms of grease.

Perhaps the strangest of Parry's projects has been an investigation of collagen in the cornea of the eye. For the cornea to be transparent, the collagen fibres must have the same diameter and be evenly spaced. But over the years researchers had produced results that showed the diameters of the fibrils varied widely across the species, a result Parry doubted. It must, he



The entire stock of rubber balls from Woolworths in Oxford – as Professor Parry puts it – is seen here as the base components of a model he and John Squire constructed to show the regulation of vertebrate skeletal muscle. The basic mechanism, described by them in 1973, remains undisputed.

thought, be an artefact produced by variations in methodology.

He talked to the veterinary department at the Auckland Zoo and soon strange packages began arriving.

"Every time an animal died – from natural causes I might say – they would post the eyes to us and we would extract the cornea."

He rattles off a Noah's ark of animals: "...salamander, possum, stoat, stingray, hippopotamus..."

"So we treated all these species in the same way and all, except the bony fish, had fibrils of the same size," he says with amused satisfaction.

"That was an easy piece of work, but quite fun – it is all fun."

Except when it isn't. In Parry's later career, as he increasingly took on responsibilities within the international science community, the amount of travel he had to do became a trial. In 1990 he was elected to the Council of the International Union for Pure and Applied Biophysics, serving for 12 years in roles including vice president and president. In 1999 he was elected to the executive board of the International Council for Science (ICSU) – science's equivalent of the United Nations – which is headquartered in Paris.

"Initially that meant only one or two meetings a year, but after three years I became vice president and the chair of one of the major subcommittees."

Six times a year Parry would set aside his duties as head of Massey's Institute of Fundamental Science to head for the most

unromantic return trip to the city of lights. "It really killed me: a day-and-a-half there, a two-day meeting, and then a day-and-a-half back. A miserable existence." At Massey a backlog of work and correspondence would await his return.

So while more golf, tramping, gardening and family time are on his list of aspirations, more travel isn't. For the most part it is far more convenient to collaborate electronically, and again Parry marvels at the way things have changed.

"When I came to New Zealand in '73 if you wanted to collaborate you literally had to write a letter to somebody and it would take a week to get there, and a week there and a week back. Then came faxes, then, at last, e-mails."

Parry is much sought after as a co-researcher, and not just because of his expertise, he admits.

Being 12 hours out of sync with Europe has its advantages – "I can work while they sleep," and, besides, there is another pragmatic line of reasoning: "I am not competing for same [nationally-based] pot of money that they are."

Over the years and in the course of compiling more than 200 published research papers (plus editing and co-authoring a number of books) Parry's tally of co-authors has topped 250.

"I have been collaborating with someone in Oxford and we just published a paper together.

"Coincidentally, I was at a big conference on intermediate filaments in Oxford later that year, so I got to meet him for the first time. Turns out he is about six foot eight and graduated from Otago."

How does he feel about the recognition of the importance of fundamental science in New Zealand? It has improved greatly, he says, with it now being more widely recognised by government that successful applied science could not exist without its vibrant sibling.

In his own case, his early work explaining how muscles are triggered has found application in such things as meat processing (electrical stimulation makes for more tender meat) and he has worked with an Auckland-based plastic surgeon to foster techniques to minimise scarring.

But acknowledging the place of fundamental science is not enough in itself. More funding is needed, particularly, he says, for that mainstay for New Zealand science – the Marsden Fund.

As for the Rutherford medal, he knew he had been put in for it, but as a first timer he didn't rate his chances.

"Most times you need to be there for quite a few years before you become a serious contender, and often you never get to the top of the pile at all." It must, he says, with genuinely unassuming self deprecation, have been an easy year. ■

# the joy of sects



Heather Kavan is fascinated by religious experience.  
She talks to Malcolm Wood.

**T**hough perhaps no saint, Heather Kavan has done her share of suffering for religion. For 11 months, Kavan, constitutionally not a morning person, rose before 6am to join a group of Falun Gong practitioners for half an hour of silent exercises.

Did she find transcendence? Not exactly. For Kavan, who is of slim build, a defining memory is of penetrating cold.

“I was stuck in the lotus position in a temperature below zero when I knew I just had to get my coat. And when I tried to stand up, I found I was paralysed from the waist down. So of course I went crashing down to the ground, and I crawled over to get my coat, and one of them looked at me and said, somewhat offhandedly, ‘If you had been meditating properly you wouldn’t have felt the cold.’”

It doesn’t help that the 6am exercise sessions seem to have gone into abeyance when Kavan stopped attending.

She suspects her presence was the impetus for the sessions all along.

Heather Kavan’s small, corner office on the Manawatu campus is surprisingly pleasant. Long and narrow, with two intersecting rows of windows, it feels a little like the bridge of a ship, and the view, while largely of concrete, is softened by Kavan’s thriving collection of indoor plants.

On the wall is her framed 2009 national award for sustained excellence in teaching, and, alongside, its tongue-in-cheek complement, a Pre-Raphaelite print entitled *The Accolade* and featuring a kneeling Prince Valiant-like figure in chain mail being knighted by white-robed, long haired damsel.

So far, so standard. While radiating more order and serenity than most, this is just another academic garret, and the books – Bill Bryson’s *Mother Tongue* and Lyn Truss’

*Eats Shoots and Leaves* – are those you would expect to find in the collection of someone who teaches speech writing and the art of writing.

What isn’t in evidence is Kavan’s alter ego: Kavan the investigator of religions, cults and ‘altered states’.

The room is bare of religious iconography, crystals, and uplifting homilies.

Yet here is a woman who professes to be, if anything, more comfortable in a revivalist meeting or meditation group than in the confines of academia.

And away from the university surrounds, Kavan’s clinical remove falls away. “Most of us can suspend reality for a temporary period when we go to a movie; I suspend it when I go to a religious meeting.” She shares the fervour of those around her.

Some things, she says, have to be experienced to be understood. »»

Take, for example, the case of Janet Moses, the mother of two who drowned during a marathon exorcism session. Were those who forced cold water on her to expel the demons guilty of manslaughter? A jury thought so.<sup>1</sup>

Kavan, who attended the six-week trial in the cause of research, is not so sure.

“The Moses case hinged on the consent issue. The judge advised the jury that if they believed that the accused had an honest belief that Janet Moses consented to the water being poured down her throat just before death, then they would have to find the defendants not guilty.

“The prosecutor argued, eloquently, – he should have been a writer – how can anyone say they thought she consented; they weren’t thinking at all; there was no thought involved – at least not towards the end. And it did ring true. They were so much in an altered state that they weren’t thinking.

“Similarly, what the defence said rang true, that at times Janet called the shots during the exorcism; she would say ‘the demon is here’ and the defendants would rush to expel it for her; she

believed she was possessed. They were trying to help her. They did have an honest belief she was consenting because she declined offers to take her away from the situation.”

There is no denying that the events surrounding Moses’ death were bizarre. Up to 50 people were present at any time in the small lounge where the exorcism was held. The windows were tightly sealed to prevent demons entering. The temperatures rose to “furnace-like” levels. The laundry – which held clothing contaminated by vomit – and the toilet beyond were declared off limits. The room was awash with water. People had taken to relieving themselves in a corner.

“It’s understandable that people who hadn’t experienced [anything like this] couldn’t comprehend the defendants’ responses,” says Kavan.

“Witness after witness testified that Janet had a strange look in her eyes and that was what convinced them that she was possessed: while there were other unusual behaviours, it was this very strange look in her eyes that everyone recalled. I’ve seen that look in people’s eyes, and it is frightening. I don’t interpret it as possession, but I can understand how someone else would.”

How then does Kavan propose to interpret the trial for the purposes of her research?

Her proposal to the presiding judge was that she apply the lens of collective entrapment, a subset of group think<sup>2</sup>, in which members escalate their commitment to a course of action even though it is obviously failing.

Now she is more inclined to interpret the events surrounding Janet Moses’ death in terms of trance or altered states.

She also finds herself interested in the issue of gender: in most exorcisms it is the woman who is exorcised, the man who is the exorcist.

“Usually that is because the exorcist sees women as easy targets, less likely to say ‘no,

Set out in print – or related to a jury – the events leading up to Janet Moses’ death in fact sound insane. In coldly rational terms, what was to stop someone opening the windows, stepping outside the door, asking for help, simply saying ‘enough’?

Those caught up in the events – even those who stood accused of her manslaughter – acknowledged that to an outsider how it all played out would seem incomprehensible.

Yet at times during the testimony, Kavan was seized by an almost overpowering sense of empathy: she wanted to approach the defendants and say, ‘I do understand’.

Similarly, many other religious phenomena can only truly be understood through direct experience.

“When the anti-cult people criticise cult members, I often think that they’ve never been near a cult leader. Because the big-name cult leaders, the gurus, emanate an energy: it’s magnetic, it’s addictive. People let down their guard, all rational thought goes out the window. It’s like falling in love.”

What is the lure for Kavan personally? Part

of it is that as a self-described child of the sixties and seventies she comes of a generation of spiritual seekers.

But there is also a certain in-the-moment thrill. “You can feel the adrenalin that goes around the room, the excitement, even if you’re a sceptic, the most mundane activity takes on an air of excitement.

“If I go into a room where people believe in spiritual entities, even a simple act like choosing where to sit takes on a whole new dynamic. I could inadvertently sit on a chair that someone believes an invisible entity is occupying. Every move is filled with adrenalin. There’s a whole game that goes on. It’s compelling.”

She enjoys the sense of uplift that revival meetings and meditation groups sometimes achieve. She likes the camaraderie, the moments of transcendence, and the “fantastic stories” they weave. In some groups, she says, the intimacy is closer than you would find in many families.

But unlike the true believers, Kavan does not believe there is only one true path to the divine.

Indeed, you could almost think of Kavan as a spiritual mystery shopper, sampling the range and setting out her insights in academic papers.”

“I often think that exorcisms are like a game of spiritual poker: it’s about bluff. Whoever can bluff the best wins. However, I don’t believe anyone was bluffing in the Moses case. The family were tragically inexperienced.”

what a load of rubbish’. But in this instance the people who were perceived as possessed were often those who fainted under the heat. So they were more likely to be female. The stronger males had a better chance of being able to physically endure.

“If you’re in a group and someone is checking out who has a demon, and they see you as the next target for an exorcism, there are really only a couple of ways of getting out of it. You can’t say, ‘no, I’m not possessed’, because that would just be evidence that you are. You could fake deliverance, which one of the witnesses in the Lee case<sup>3</sup> did: he went along with it, and at the first possible moment [he faked deliverance]. And of course the other way is to turn on someone else really quickly. ‘Yes, there it is. It’s just flown to you!’

“Whoever is quick-witted enough to put themselves in the position of the discernor [and say], ‘it’s on him’, or on her – usually it’s her – is the survivor.

“I often think that exorcisms are like a game of spiritual poker: it’s about bluff. Whoever can bluff the best wins. However, I don’t believe anyone was bluffing in the Moses case. The family were tragically inexperienced.”

It is time-consuming work. Often the face a group of believers presents to the outside world will be at odds with the behind-the-scenes reality.

“With a cult, particularly an extreme cult, you have to spend about six months with the organisation before you even discover the cult. Usually there is a fairly straight-forward-sounding religion, which is a front. And after six months you discover that there are other meetings.”

Even for the non-cult-like manifestations of religions, developing an understanding takes time.

To produce her research on glossolalia – aka speaking in tongues – Kavan spent over three years observing the practice in two very different religious groups<sup>4</sup> – a Pentecostal congregation and an apocalyptic millenarian yoga-based sect. For her paper on Falun Gong<sup>5</sup> there was the 11-month period of rising before daylight

to participate in 6 o’clock group exercises.

Her approach to Falun Gong was made when she discovered it was inviting academic institutions to conduct unbiased research.

Kavan immersed herself in her research topic, conducting ethnographic research (part of which was her 6am exercise attendance), analysing the writings of Falun Gong leader Li Hongzhi’s speeches and writings, and extensively consulting external courses.

To begin with, her sympathies lay firmly with Falun Gong, but as she became more knowledgeable a shift took place. Though the Falun Gong members she met were “humble and courageous”, Falun Gong itself was less attractive: it was adept at working the media to its advantage, was less than forthcoming about some of the less palatable aspects of its dogma, and was only too ready to bring defamation suits against anyone who published unfavourable material.

Is Falun Gong a cult? It certainly seems to display characteristics that are cult-like, writes Kavan: “an idolised charismatic leader who exploits people by letting them believe he – and it is usually a ‘he’ – is God’s mouthpiece; mind control techniques; an apocalyptic world view used to manipulate members; exclusivity (‘only our religion can save people’); alienation from society; and a view of members as superior to the rest of humanity.”

In her eclectic approach to religion, Kavan may be unusual, but she says the quest for ecstasy – to be outside of ourselves – is one of the most basic human drives.

By international yardsticks, New Zealand is highly secular, but, as seems to be

lose all scepticism, however strange the doctrines they are asked to believe.

“[People] get into the habit of suspending doubt for such long periods it becomes part of their personality; it becomes a way of living.”

Can the benefits be come by without the drawbacks? Imagine.

“One of the things I’ve been looking at, and other scholars have been searching for, is a way that people can have these amazing experiences without having a leader who will manipulate them.”

This is no longer so far fetched. With the neurological basis of religious experience being increasingly well understood, perhaps the day will come when drug- and guru-free

spiritual epiphanies will be available on demand.

“If people could have these experiences without being driven by someone else’s ideology and ego, that would be great,” says

Kavan. “There would be a lot less religious violence in the world.” ■

“What’s the old saying?” she jokes.

“I love Jesus; it’s his fan club I can’t stomach.”

embedded in the nature of being human, many of us hunger for something more.

In a recent survey, 30.5 per cent of New Zealanders agreed with the statement “I don’t follow a religion, but am a spiritual person interested in the sacred or the supernatural”<sup>6</sup>.

The trouble, says Kavan, comes when the spiritual experience people seek – “which is a state of higher consciousness” – becomes encumbered with other people’s ideas. “The person’s genuine experience becomes interpreted in terms of the group’s ideology, and the leader’s ego and dogmas and rules start dominating the experience.

“What’s the old saying?” she jokes. “I love Jesus; it’s his fan club I can’t stomach.”

And unlike Kavan, who will in the end return to her office to question and analyse every aspect of her experience, many people



1. The five people convicted of Janet Moses’s manslaughter were sentenced to a mix of community work and supervision, the latter including the options of counselling sessions and of Tikanga Māori and educational programmes.
2. A mode of thinking that people engage in when they are deeply involved in a cohesive in-group, when the members’ strivings for unanimity override their motivation to realistically appraise other courses of action.
3. The death of Janet Moses has a New Zealand precedent: in 2001 Korean immigrant Pastor Luke Lee was convicted of the manslaughter of Joanna Lee, who died during the course of being exorcised. In one of the stranger aspects of the case, following Joanna’s death, Pastor Lee and his congregation were convinced that Joanna would rise from the dead. While serving his sentence, Lee successfully mounted appeal based around the issue of consent. Having served his sentence, Lee was deported to Korea while awaiting retrial. Kavan, H. (2007, Aug.) The Korean Exorcist meets the New Zealand Justice System. *AEN Journal*. 2(2), 53-58
4. Kavan, H. (2004, May) Glossolalia and altered states in two New Zealand religious movements. *Journal of Contemporary Religion*, 19(2), 171-184
5. Kavan, H. (2008). Falun Gong and the Media: What can we believe? In E. Tilley (Ed.) *Power and Place: Refereed Proceedings of the Australian & New Zealand Communication Association Conference, Wellington*
6. The survey was conducted in 2008 by Massey’s Department of Communication, Journalism and Marketing as part of the International Social Survey Programme. 1000 responses were received and analysed. Of the respondents, 40 per cent said they had no religious affiliation, 53 per cent said they believed in God (though half admitted to doubts), and 57 per cent believed in life after death.



# tiger country

He's the Indiana Jones of the Department of Commerce, or so some say. The similarities between the Hollywood character and Massey University senior lecturer **Dr Brendan Moyle** are clear to see. Both university academics by profession – Jones in archaeology and Moyle in economics – their 'crusades' take them on exciting adventures in far flung destinations in pursuit of the bad guys. But while Jones' role is confined to the silver screen, Moyle's mission to save the tiger species from extinction is very real. It has come with its own perils as he works covertly in China to try to understand the complex black market in trade of tiger products. He has tracked smugglers' routes and is a rare breed of conservationist, studying the issue from an economic perspective in pursuit of a solution.

He speaks to Kathryn Farrow.

## Tell me about your different strategy for saving the tiger species?

I'm a conservationist but economics is my tool to understand how and why the illegal trade in tigers takes place. You cannot fight the black market unless you know how it operates and there has been no analysis of what drives demand, until now.

## How serious is the threat to tigers?

The wild tiger population is in deep trouble; there are only an estimated 3500 to 4000 left. When I started my research two-and-a-half years ago, we thought there were 4000 in India alone but 12 months later that had gone down to 1400 tigers. About 300 to 500 tigers a year are poached and the biggest single market is China. In Tibet, the skins are made into costumes (chupas) and the bone is in high demand across China as a traditional medicine to treat severe bone diseases.

## Surely poachers face the death penalty – why does this not deter them?

A poached tiger commands a very high price – up to US\$50,000 (NZ\$78,000) to an Asian smuggler. A lonely hunter who is offered US\$1500 (NZ\$2350) to shoot a tiger – a hundred times his annual salary – is not going to say no. The death penalty has been handed out but it is no deterrent; it has just made trade in illegal tiger products more secretive.

## How did your work with tigers come about?

I'd been working with crocodiles, parrots and butterflies. I was one of those people who stuck to the conservation of the underdogs because no

one gives you lavish amounts of money to help these species as they do with whales and tigers. But through my connections with International Union for Conservation of Nature (IUCN) I was asked by the Chinese authorities to look into why the hunting ban was not working.

## Why do you think the hunting ban has not been effective?

In 1973 there was an international ban on tiger poaching and in 1993 China imposed a domestic ban after pressure from the West. But tiger poaching hasn't been stigmatised, is badly enforced and the demand has not changed while supply has been constrained – pushing prices higher. You are wasting your time if you want to control the poaching with interdiction or education. There have been campaigns launched about the traditional Chinese medicine (TCM) shops but they only sell fakes. Tiger bones are highly prized in China for their perceived medicinal qualities and people will pay for this. They order the tigers knowing they are threatening the species and poachers will deliver despite the threat of the death penalty or 20 years in a Chinese prison. That, combined with the fact that poachers come from hunting cultures and resent government restrictions on hunting, paints a very complicated picture. If a wild tiger ate your children or grandchildren you'd have no hesitation in killing it.

## Have you always had an interest in wild animals?

As a child I was a member of Hamilton Junior Naturalist Club and I was always fascinated with false scorpions. My grandfather gave me a

book on New Zealand spiders by Ray Forster when I was 11. It was a hard cover book with colour photographs, which would have cost a bit in 1977. I think I am the only grandchild who still has their present from that year and now my children are using it. I had lizards, bugs and spiders in my room as a child. Nobody was really afraid of spiders then – well not boys anyway. They were just used to scare girls in the classroom. When it came to doing a degree, I studied a BSc in biology followed by an MSc at Waikato University with my master's thesis focusing on New Zealand's false scorpions and then I did a PhD in economics at Waikato. As time has gone on, I seem to have progressed to bigger, more scary animals!

## Your research in China was recently published in criminology journal *Global Crime*. What did it expose?

I found many myths about the illegal trade in tiger products – lots of stuff is made up by conservationists. To give us a chance of saving the species, we have to try to make sense of the black market and find out how it operates. The issue is about markets, not about zoology. The black market operates on networks that were established long before the ban.

## What are the myths?

I guess the first main myth is that there is one homogenous black market, when my research indicates it is actually geographically separate, with different product mixes and subspecies. Second, there is a misconception that tiger bone is marketed through the TCM shop network but it would be very stupid for smugglers to





“You are wasting your time if you want to control the poaching with interdiction or education.”

sell through the TCMs because it’s easy to leave a trail. My studies found that there were small conspiracies operating secretly outside formal markets. Third, my work shows that the bans from Convention on International Trade in Endangered Species (CITES) and the Chinese domestic ban have not reduced demand, as is commonly thought. High prices indicate that demand has been sustained, while supply has been constrained and most of the costs come from the distribution side, avoiding detection, not procurement of the tigers. Lastly, I found that tiger products are not widely available. During my three trips, the closest I have come to a tiger part is in a photograph. Fakes are very widely available but the real stuff is not. The market for fakes becomes confused with the market for real tiger parts.

**How did you carry out your research?**

Detecting poachers in reserves is difficult because of terrain, corruption and lack of resources, but I interviewed rangers and local people to learn how the market operates. They were happy to give me information. They think it is interesting that people want to know that stuff because they actually haven’t been asked before and these are the people with the knowledge. I was also one of the first people to gain access to Chinese arrest and interception data that has shown that gangs are very small.

**What dangers did you face tracking tiger poachers?**

I’ve tramped over many miles of unforgiving territory and been arrested and detained by the Chinese army. I’ve had to clear plenty of cockroaches out of my bed and I’ve had to talk my way out of situations when faced with people with guns. But my previous work researching crocodiles was more dangerous – try being in a swamp with a five-metre crocodile. Oh, and in Papua New Guinea I came back from the Highlands in a bullet-peppered landcruiser, but there are some things I don’t want my mother to know. My work is risky, but it’s risky in the same way a fireman has a risky job. I’ve fallen off a cliff face once. When you go into wilderness areas it is physically challenging. I’ve not stared death in the face through my conservation work – that only happens when I’m out cycling on Auckland’s roads.

**So, what is the solution to saving the tiger species?**

I’m not sure. I’ve been working with the Chinese wildlife authorities who are looking at using captive tigers to reopen the trade in tiger bones and skins. There are two very large tiger farms in China – one in Guilin in the Guangxi province and one in Harbin. It is hard to distinguish something that is a zoo from something that is a farm. They do the same thing – breed animals and show them to the public. The tiger farms don’t kill the animals for trade, because that is illegal. They are stockpiling bodies because tigers do die of natural causes.

**Isn’t tiger farming an extreme solution?**

Yes, it is controversial but we can’t carry on doing what we are doing – the death penalty isn’t working. People hate the idea of a tiger farm because they see tigers as cute and fuzzy. I am not thrilled by the idea of tiger farms but do not see a reason why we should play nice with the Asian criminals. I was approached to look into this by the wildlife authorities because I have come from a crocodile background as a member of the Crocodile Specialist Group, which is a worldwide network of biologists, wildlife managers, government officials, independent researchers, NGO representatives, farmers, traders, tanners, fashion leaders, and private companies actively involved in the conservation of the world’s 23 living species of alligators, crocodiles, caimans, and gharials in the wild. We managed to suppress poaching.

**So you’re from a Crocodile Dundee background....**

(Laughs) Yes, there are similarities! Both crocodiles and tigers are huge carnivores, can be turned into high value products and have been involved in human/animal conflict – hence they are hunted. Crocodiles can be farmed and tigers can be farmed; it is just not a popular solution. Farms cannot compete on price but can compete on quality. People do not want crap quality crocodile shoes or belts. Farms offer high quality skins with no scratches. They can also compete on volume. If people want to buy skins, farms can deliver that and these consumers are assisting crocodiles to survive. The danger is that the Chinese people may think that if you can buy it legally it must be fake. But this

may encourage some people to leave the black market and opt for legally sourced tiger skin and bone – and tigers are so scarce we have to look at this as an idea. It is not a popular solution and I’m not saying it is going to work but what we have got at the moment is not working.

**Where to from here?**

I’m hoping my work can leverage into a full research programme and finding out who is buying tiger bone for medicine. I never came close to a real tiger or tiger skin or bone during any of my trips. People who aren’t sick are buying the bone now just in case they get sick. It is not impossible for them to think tiger bone can help strengthen human bones because bone contains amino acids but obviously we cannot prove otherwise. We cannot do clinical trials unless it is on tiger bone that is illegally traded – because that is the only way. I want my paper to lead to more research into how the black market works and how Tibet might be different from China. The local culture there is to use tiger skins as costumes (chupas). Similarly, I’m hoping to look at the picture in India, where there are 1400 to 1500 tigers still in the wild. Wild tigers are sliding to the brink of extinction and we have to do something differently before it is too late.

**So, are you Massey University’s answer to Indiana Jones?**

If I am Indiana Jones, then I’m Indy with more mud and meetings and less gunfire – I’m also not afraid of snakes. ■





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“Here we have very nice soils, so we have to be very careful to apply the biochar properly.”

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# burnt offerings

By supplementing our soils with biochar we may be able to reap a multitude of benefits – more productive soils, less agricultural pollution and, best of all, a way of tackling climate change.

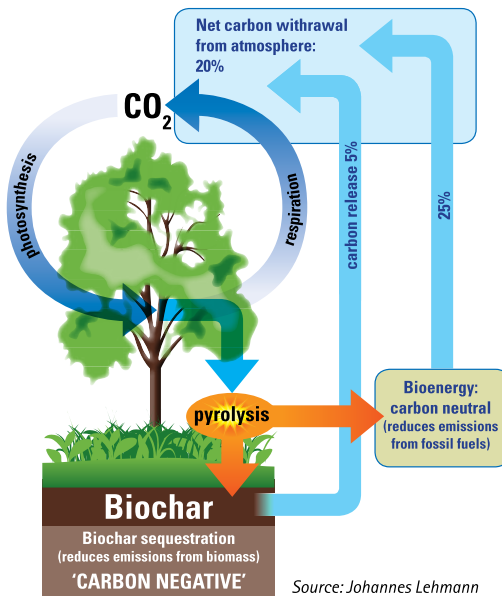
MAF-Associate Professor in Soil Science and Biochar **Marta Camps** talks to Malcolm Wood.

As many would-be farmers have found, the apparent fertility of tropical rainforest soils is a cruel trick. The forests may be lush, a riot of growth, but once cleared and cultivated, the land quickly becomes barren.

But there are exceptions. In the Amazon basin one group of soils – the terra-pretas – are astonishingly fertile. Taking their name from the Portuguese for ‘black earth’, the terra-pretas, first described in the 1860s, were for a long time a riddle. How had they come into being in this forested wilderness? Perhaps volcanic fallout was the answer, or could it be that the terra-pretas had their origin in ancient lake beds?

Only in the 1990s was a consensus reached. The ‘wilderness’ of the Amazon basin had, it turned out, up until briefly before the arrival of the European, been well peopled and husbanded for thousands of years. Terra-pretas was the legacy of indigenous land practices. It was anthropogenic – human-made.

Marta Camps, who took up her position as MAF-Associate Professor in Soil Science and Biochar in January 2009, knows about building soils. In recent years she has been based in Bilbao in the Basque country and worked in collaboration with the University of Santiago



Source: Johannes Lehmann

de Compostela. This is *la España húmeda*, ‘wet Spain’, its lushly green landscape similar to that of Ireland. But it is not without blemish. Bilbao’s industrial prosperity lies in part in the region’s history of iron mining.

Professor Camps brings up a series of images on her computer screen: first an abandoned open cast pit and tailings, the barren rock and earth too acidic to support plant growth; then that same landscape newly verdant with vegetation. Next, an arid, barren limestone plain; then that same plain carpeted in knee-high grass.

The difference lies in a thin layer of what is known in the trade as a technosol: a soil created in large part from materials made or extracted

from the earth by humans; components such as the sand, slag and iron oxides from foundries; the fly ash derived from biomass combustion; the shells from the seafood fisheries; and sewage sludge.

From these unpromising ingredients, Camps can deliver soils to order: acid or alkaline; well drained or water retaining.

It was while working on technosols and mine site remediation that Camps began to think about soil carbon.

“Some of the fly ashes we worked with had high charcoal. So then we started to study the properties of the charcoal.

“We started reading Johannes Lehmann.”

Lehmann, a soil scientist whose name has become synonymous with the biochar movement, had come across terra-pretas during a stint of living in the Amazon basin investigating depleted soils. Terra-pretas owes its fertility, as well as its colour, to a charcoal-like substance that somehow managed to persist in the soil for up to 7000 years – ever since indigenous tribes incorporated slash-and-char techniques in their agriculture. Terra-pretas is biochar in action.

It was the early 1990s: global warming and the likelihood that of its anthropogenic origins were causing increasing unease. Perhaps,



The Touro mine site in Galicia before after being rehabilitated using an artificial soil, a ‘technosol’. This rehabilitation was carried out as a collaboration between the *Universidad de Santiago de Compostela*, TEN and NEIKER.



Amazonian terra-pretas – an ‘anthrosol’ – a fertile, carbon-rich soil created by a human intervention: the use of char-and-burn over millennia.

Lehmann and others thought, one way of addressing climate-altering rise in atmospheric CO<sub>2</sub>, as well as realising a number of other substantial benefits, might be to learn to sequester it in the soil.

The attraction is easy to see. Pyrolysis, the technique used to produce biochar, is easy enough to understand. A feedstock – read anything from wood chips to chicken manure – is heated in an oxygen-depleted environment, driving off a syn-gas and leaving behind varying proportions of biochar and a black, viscous bio-oil. The syn-gas can be burned to power the process and generate surplus energy; the bio-oil can be refined to biodiesel; the biochar becomes a fertility-promoting soil amendment.

Here is a relatively simple small-scale technology that goes beyond simply reducing emissions. This process uncouples the terrestrial carbon cycle as it removes carbon from it in a form that can remain stable in soils for hundreds to thousands of years.

No wonder it has become one of the great white hopes for slowing climate change. But it is not quite as cut-and-dried as all that.

Before biochar moves from an attractive notion to a realistic approach to climate change mitigation a complex set of issues must be unpacked. They lie in three realms: Camp's specialist area, soil science and carbon sequestration in soils; pyrolysis technology; and the economics and incentives surrounding GHG mitigation strategies.

Oddly enough, one of the problems Camps faces could be New Zealand's temperate climate and fertile soils.

In places like Southern Spain and Australia, where vast areas of land are threatened by desertification, adding water-and-nutrient-retaining biochar to the soil may be an unmixed good.

"Australians are quite happy to spread biochar across Australia: it's dry and they don't have much organic matter, so there is no risk except for fire events."

In New Zealand's well-watered, temperate, fertile conditions, there is a risk that the unthinking addition of biochar could boost microbial activity to the extent that it promotes decomposition of native organic matter.

"Here we have very nice soils, so we have to be very careful to apply the biochar properly."

In a laboratory close by, Professor Camps shows me a simple pyrolysis plant and its products.

The pyrolysis plant is a five-litre sealed cylinder sitting behind a perspex screen in which feedstocks ranging from wood chips to animal wastes can be subjected to carbonisation; the biochar is a mass of dark, pellet-like material; the bio-oil is a murky black liquid.

This particular biochar has been sourced from Palmerston North sewage and has a number of interesting properties, says Camps. It is, for example, higher in nutrients, such as potassium, phosphorus and calcium, than most biochars and the mineral content confers a higher bulk density – meaning it is less likely to be blown away once applied. As it has a high ash content, it is being useful in addressing acid soils.

It is an object lesson that not all biochars are the same. Change the feedstock or type pyrolysis – the temperature and time – and quite different qualities result. A biochar produced from manure will be more nutrient-rich but less stable in the soil than one produced from wood. A wood-based biochar produced at a higher temperature will be more porous than one produced at lower temperature.

In this variability, and in the possibility of the pre-treatment of feedstocks and the post-treatment of biochar, lies the possibility of tailoring particular biochars to perform particular useful functions.

Take the problem of nitrates. Around 40 per cent of groundwater monitoring sites in New Zealand have levels of nitrate that are elevated above natural background levels, and one in 20 has levels hazardous to human health. Most of these unwanted nitrates derive from stock effluent rich in ammonium.

What good can biochar do? Activated biochar – charcoal treated to carry the right surface charge – is, it turns out, good at accumulating ammonium on its surfaces, a process called adsorption.

The possibilities? One is to use a biochar soil amendment as a filter to take up ammonium before it reaches the water table, another, to use a biochar already carrying a load of adsorbed ammonium – perhaps filtered from waste water – as a form of slow-release fertiliser.

Some of Camp's postgraduates are working on activating biochar to better adsorb ammonium, while others are conducting greenhouse trials to investigate its ability to boost fertility and condition the soil. The use of biochar as animal feed supplement is also an area of interest, especially if this becomes a feasible way to deliver biochar to soils.

It all sounds very exciting. But there is no escaping the fact that it is all, so far, very small scale. The biochar I have been shown might serve to fertilise a few window-box planters, not much more.

But the small-scale trials presage larger ones ahead. Another Massey staff member, Professor Clive Davies, is at work on a larger scale pyrolysis plant, and with the soon-to-be-appointed second MAF professor, whose mandate is pyrolysis plant and biochar engineering, matters should begin to move swiftly. ■

### The New Zealand Biochar Research Centre

The NZBRC began as a Ministry of Agriculture and Fisheries initiative. The ministry recognised that New Zealand had a particular and intractable problem: a substantial and growing part of New Zealand's greenhouse gas emissions (48.2 per cent of all greenhouse gas emissions in 2007) derived from agriculture and forestry.

Biochar, the ministry believed, could be one means of addressing this. Hence the creation of the MAF-funded Massey-hosted New Zealand Biochar Research Centre.

The NZBRC has three closely-linked

streams of research and development activities:

- soil science and biochar
- pyrolysis plant and biochar engineering
- biochar and greenhouse gas mitigation strategies.

The first major appointment is that of Marta Camps as MAF-Associate Professor in Soil Science and Biochar. A second professorial appointment centred around pyrolysis plant and biochar engineering is pending. An investigation of the economic and market issues surrounding biochar is being led by researcher Attilio Pigneri. ■



Honours student William Aitkenhead, Associate Professor Marta Camps and doctoral student Kiran Hina.



Professor Hazelton with PhD student Katharina Parry.

# Caught up in traffic

Professor Martin Hazelton  
talks to Malcolm Wood

**H**ere is a possibly infuriating mental exercise for the next time you are stuck in traffic: see if you can disconnect and see yourself, the roading system, the mass of machinery and people going nowhere fast, in a more abstract sense. Picture yourself rising above it all, assume a Wise’s-street-map view, and picture your car as just one among the many.

From this Olympian perspective you can see traffic less as a tangle of frustrated intentions and more as a physical phenomenon: a strange substance working through a complex circulatory system. Sometimes the substance is fluid- or gas-like, sometimes it is clotted, sometimes shockwaves ripple through it, as, back at ground level, driver reacts to driver reacts to driver.

Now think about how you design such a system to get each car to its destination as swiftly and efficiently as possible.

It is a problem that has engaged civil engineers, applied mathematicians, physicists (one of the better known traffic modelling systems was designed by Los Alamos, the people who brought you the atomic bomb) and a handful of statisticians, of whom Professor Martin Hazelton is one.

Hazelton, a clean-cut Englishman who has just landed a \$310,000 Marsden grant to look at transport network problems, began his career-long fascination with the subject early on: immediately after his doctorate he spent 18 months working with the transport studies unit at the University of Oxford.

What is it that appeals? The field, he says, produces some lovely quirky problems and it can be appealingly counterintuitive. For one thing, this is a realm in which the self interest of the individual – each trying to pick the quickest route – is not necessarily the best thing. In fact,

if you were to empower some all-seeing traffic controller to manage matters perfectly, people would reach their destinations much more quickly. Then there is Braess’ paradox: in some cases adding extra capacity – such as another road – to a network will actually slow it down.

So far, so academic, but of course the everyday costs of the inefficiencies in our roading and transport systems are very tangible – wasted fuel, emissions such as carbon dioxide, and knock-on effects throughout the economy to name but three – and since WWII traffic modelling has become an ever more important tool.

If a public agency wants to know what will happen when it builds a bypass, adds public transport, introduces congestion charging, or provides real-time traffic information via GPS and cell phone, then it makes sense to test the what-ifs virtually first.

And the latest modelling software is capable of embracing an astonishing level of detail. TRANSIMS, the Los Alamos product, promises agent-based simulation of the second-by-second movements of every person and every vehicle through the transportation network of a large metropolitan area.

Where, then, do the difficulties lie and what does a statistician bring to the table? The problem is not so much the level of detail, Hazelton says, as it is of calibration.

“Many transportation models are very good at forecasting the past. You can tweak all of your parameters until your model perfectly predicts what happened yesterday. But if you change one of the inputs just a little bit – say a few hundred people want to go to see a sports event – everything falls over. The models can be perfectly calibrated to reproduce the past and almost completely useless at predicting the future.”

In effect, trying to make these determinist models identical to the reality they are trying to represent – a map at the same scale as the landscape – is a futile endeavour, Hazelton says. Rather, there needs to be a shift away from the deceptive precision of ever more complex and determinist models towards one in which degrees of imprecision and uncertainty can be assigned values – and this is where being a statistician comes in.

“What we need is some well-founded methodology for calibrating the system, so that if we fail to perfectly reproduce reality then instead of saying ‘whoops, we got it wrong’, we say, ‘we always knew we had some random elements, and we can at least quantify how wrong we were likely to be’.

“And our forecasts aren’t going to be spot on either, but at least we are going to be pretty accurate.”

Pretty accurate would be an advance. If sometimes New Zealand’s record of traffic planning does not seem very distinguished, then others do no better. A 2005 study by Danish researchers looked at the traffic forecasting in transportation infrastructure projects, drawing on the data from 210 projects in 14 nations, their collective worth amounting to US\$58 billion. In a quarter of the roading projects the traffic forecasts were more than 40 per cent out. ■

GDP typically devoted to transportation by developed countries: between 5 and 12 per cent  
Global CO<sub>2</sub> emissions attributable to transport: 20 per cent.  
Cost of traffic congestion to the US economy in 2000:  
3.6 billion vehicle-hours of delay  
21.6 billion litres of wasted fuel  
US\$67.5 billion in lost productivity  
Estimated economic, health and environmental cost of traffic congestion to the New Zealand: in excess of NZ\$1 billion.





## the rebirth of plastic

They brought us beer, yogurt and bread. Now bacteria are fashioning plastic to order, and the applications, from biodegradable packaging to sophisticated medical diagnostic tools, are extraordinary.

**Professor Bernd Rehm** talks to Malcolm Wood.

If some alien archaeologist were to conduct an excavation on some future depopulated Earth, it is more than likely he would label our time the age of plastic.

In the layers of earth before the 1920s, plastic would be vanishingly rare. In the layers from the 1950s on it would be inescapable – partly because plastic is the cheap all-purpose miracle material of our time, and partly because almost all of the plastic we make – over 200 million tons of the stuff every year – is near immortal: it neither rusts nor rots.

Conventionally plastic is made in a series of energy-intensive industrial steps, beginning with breaking down feedstocks, generally oil or gas, into the short molecular units known as monomers, which are then reformed into polymers many thousands of units in length. Ethylene is linked into polyethylene for plastic bags (500 billion are discarded every year); vinylchloride into polyvinylchloride for hoses, flooring and electrical insulation; propylene into polypropylene for rope and carpet fibre. None of these molecules is found in nature, and indeed ‘plastic’ has become almost a synonym for unnatural. It need not be.

From an office shelf Professor Bernd Rehm brings down a cardboard box. It holds opaque bottles, tubes of crisp plastic flakes, and a palm-sized transparent rubbery lozenge. All of this is bioplastic, sourced not from petrochemicals but from bacteria, some of them hosted in the laboratories just down the corridor.

“One hundred per cent renewable,” he announces, holding up an opaque shampoo-sized bottle, then, picking up the shard of a similar bottle alongside it, one side of which is blasted away. “One hundred per cent biodegradable. In the compost it dissolves into CO<sub>2</sub> and water.”

For a product only now becoming available in commercial quantities, bacterially produced plastic has a history that stretches back a surprisingly long way. It begins in the 1920s with the work of French biochemist Maurice Lemoigne, who took a bacterium and isolated a solid material he identified as a polymer of 3-hydroxybutyric acid. Lemoigne and his coworkers published on this in 1926 and continued to report on studies of their polymer up until 1951, even casting it into a transparent film.

Yet the wider scientific community remained oblivious to Lemoigne’s work, which was published in relatively obscure French-language journals, and it was not until the late 1950s when poly-3-hydroxybutyrate (PHB) was simultaneously ‘rediscovered’ by microbiologists in Great Britain and the United States that a wave of research was triggered.

PHB, the bioplastic, Lemoigne had discovered, is a representative of a class of molecules called polyhydroxyalkanoates, or more succinctly PHAs.

His particular PHA had come from the Gram-positive bacterium *Bacillus megaterium*, but there could be any number of other

candidates, says Rehm. “Lots of bacterial genera, even the archaea, even the extremely halophilic [salt tolerant] archaea, can produce bioplastic.”

They do so in self interest, during times of nutrient limitation storing carbon and energy in the form of PHA – non-water soluble polymer compound – as a food and energy reserve. And they do so in quantity: given the



A bioplastic bottle before and after being composted.

right conditions, bacteria can produce around 80 per cent of their body mass by weight in the form of plastic granules.

The idea of turning to bacteria to commercially produce industrial quantities of plastic came early. The first project was launched by the W R Grace Company in 1960 only to be abandoned in 1962 because the particular polyester, PHB, was found to have poor thermal stability (the ability of a material to resist changes in physical shape or size as its temperature changes).

In 1980, ICI (Imperial Chemical Industries) launched a product development programme for a biodegradable thermoplastic trademarked as Biopol and produced by fermentation using the bacteria *Ralstonia eutropha*. Again, little came of it commercially. Biopol was too expensive to produce and lacked the qualities of its synthetic competitor polypropylene.

Yet interest never quite died away, and today, with microbes genetically engineered for the task, DuPont is manufacturing a bioplastic under the trademark Sorona and ADM another under the trademark Mirel.

As Rehm puts it, “there is a huge design space around bioplastic”.

“The *Pseudomonas* bacteria produce this more rubbery material,” he says, picking up the

plastic lozenge. “From *Ralstonia eutropha* you get this brittle plastic.” He brandishes a container of crisp-like plastic fragments.

Varying the nutrient mixes fed to a particular bacterial culture will result in varying plastic formulations. Then the plastics from different bacteria can be blended to manufacture a material with the desired qualities. If you want a plastic that is rigid or flexible, melts at a high or a low temperature, is more or less gas permeable, bacterially derived bioplastics will answer.

Bacterially-derived bioplastics are biodegradable, carbon neutral or even carbon negative, and reduce the world’s reliance on oil and gas. The sticking point? Price. Currently bioplastic comes in at almost five times the price of its petrochemical competitors.

For the moment, the best that can be hoped for is that bioplastics establish themselves as those niche markets where green credentials matter – where they form part of brand values.

But the story doesn’t end there. Rehm is looking at the tiny granules of bioplastic produced by bacteria not as a commodity product but as an opportunity at another scale entirely: the nano.

Consider the granules as objects in their own right. Each is 50 to 200nm in diameter

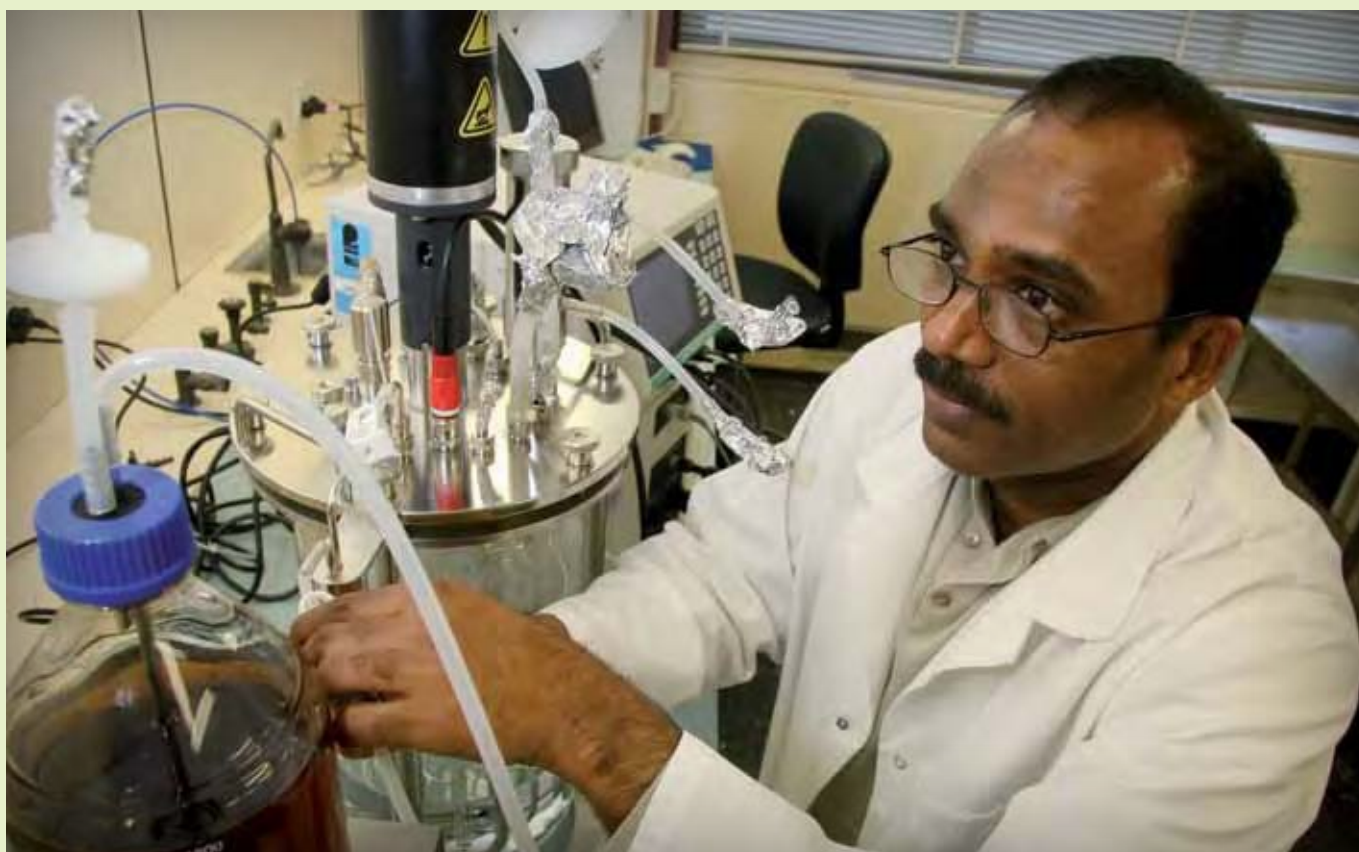
(a nanometre is one millionth of a millimeter) with a polyester core surrounded by mantle of attached proteins.

Rehm’s insight has been that with a sufficient understanding of the processes surrounding the formation of the granules you can engineer their make-up to perform any number of useful and ingenious functions.

Biobeads could be used to purify proteins, deliver drugs or diagnose illness. ■



A disk of raw plastic cast produced by *Pseudomonas*.



Post doctoral fellow Raj Palanisamy attends to bioreactor hosting a culture of bioplastic-producing bacteria.



## Building a biobead to order

To understand how to build a biobead, you have to understand the workings of the biochemical machinery that builds a plastic granule inside a bacterium in the first place.

In a series of reactions mediated by enzymes – complex proteins that catalyse reactions – the cell first creates monomers, the basic molecular units, which are then strung together into extended chains by a synthase enzyme.

Much of the work being carried out by Rehm's bioplastic research group springs from two key insights into the latter part of granule formation: first, that this synthase remains strongly attached to the surface of the granule it has helped create; and second, that it can be tampered with – long sequences within it play no part in the reaction and can, in theory, be replaced.

You might, for example, by cutting and pasting in the right genetic sequences, choose to anchor an antibody (to capture antigens or proteins) to the granule surface, or an antigen (to capture antibodies or stimulate the immune system), or an enzyme (to catalyse a reaction).

Similarly, three other classes of molecule that also bind to the surface of the PHA granule – PHA depolymerase and the structural proteins called phasins as well as regulator proteins – can also be genetically engineered to purpose.

Conventionally, attaching something such as an enzyme to a plastic bead would be done in an intricate series of chemical steps, as Rehm explains: "You need to form and purify the bead, you need to produce and purify the enzyme, and then you need to crosslink the enzyme to the bead with a chemical crosslinker – usually toxic – and even then the enzyme sits at the bead's surface at different orientations, because it is a random orientation process."

Rehm can accomplish all this in a single step, and with an unheard of precision and economy.

"We have accumulated quite a bit of knowledge on how to rationally design those hybrid genes."

In laboratories just across from Rehm's office, there is living and breathing proof of his assertion. Contained in isolation laboratories in a series of 10-litre bioreactors, genetically modified bacteria are producing biobeads to order.

Strangely enough, *Escherichia coli*, Rehm's favoured bacteria for the production of bioplastic beads, in nature lacks the molecular pathways to form PHA (it stores carbon and energy in the form of glycogen), so the genes for PHA must be patched in.

*E. coli*, explains Rehm, is accepted by the US Food and Drug Administration, is widely used to produce therapeutic custom proteins (insulin is produced using *E. coli*), and the absence of any PHA pathways, which might complicate things, is actually an advantage.

But *E. coli* is still not completely innocuous – the cells hold a toxic lipopolysaccharide – and a paper authored by Rehm's group setting out their success in producing biobeads for antibody purification using a strain of *Lactococcus lactis*, a bacterium used in cheese production, has recently been published in *Applied and Environmental Microbiology*.

Together with Massey's Enterprise Team, Rehm is exploring possible spin-offs. PolyBatics Ltd, a company intended to commercialise the bead technology, was launched in late September 2009. ■

## Why biobeads?

### Diagnostics

When an organism is exposed to a disease it generates specific antibodies. The antibodies lock onto the characteristic proteins or polysaccharides known as antigens that identify the disease-causing organism. Biobeads bioengineered to express certain antigens on their surface can be used to capture the antibodies from blood serum, so providing a diagnostic tool.

### Vaccines

Similarly, biobeads carrying disease-specific antigens on their surface can be used as vaccines to generate an immunity.

### Targeted drug delivery and imaging

A bead carrying an antibody on its surface will lock on to any tissue that displays the particular antigen the antibody matches. For example, the antigen might be a protein expressed by a tumour. In this instance the biobead could be engineered to carry more than one functionally useful molecule. It might, for example, carry a cancer-killing drug or a molecule containing an element, such as gold, that can be used in imaging.

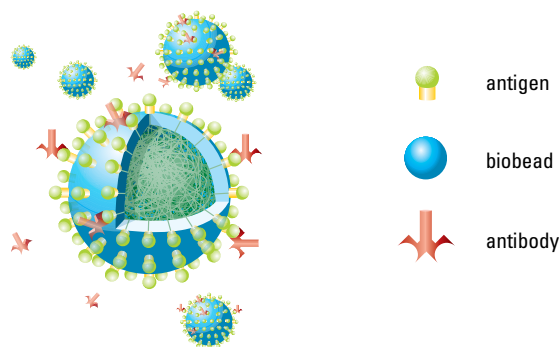
### Biocatalyst immobilisation

Rehm and his colleagues have successfully used biobeads to capture the enzyme beta galactosidase, which breaks down sugars such as lactose. A process they have recently developed for the bacterial production of a biobead with immobilised alpha-amylase, an industrial enzyme suitable for starch liquefaction and biofuel production, has been accepted for publication in *Applied and Environmental Microbiology*.

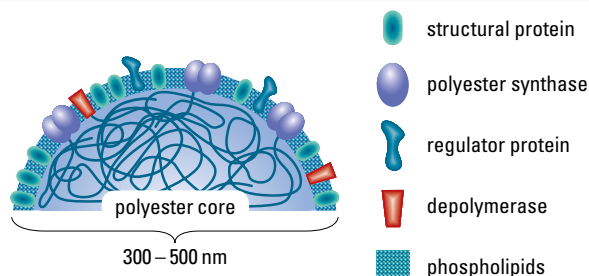
### Protein purification

Antibodies are usually purified from blood serum to allow diagnostic tests. Rehm and a coworker have developed a biobead displaying a binding domain for efficient antibody purification.

Biobeads engineered to carry an antigen on their surface are used to collect antibodies from blood serum either for purification or diagnosis.



Antigens anchored to a biobead are used to capture antigen-specific antibodies.



A PHA granule in cross section showing the surface proteins.

## Alginate

It lends body and texture to icecream, is an ingredient in heartburn remedies, and imparts fireproofing qualities to fabrics. Alginate, a viscous gum usually derived from brown seaweed, has many uses.

But the production of alginate is not restricted to seaweed alone: two microbial genera – *Pseudomonas* and *Azotobacter* – produce it as well.

*Azotobacter vinelandii*, a soil bacterium, encloses itself in a tough alginate cyst casing during times of stress. *Pseudomonas*, on the other hand, produces a slimy, pseudoplastic alginate to bind itself in dense, complex colonies called biofilms.

These different physical qualities are an expression of the varied make-up of the alginate itself, which is technically a copolymer, made up of two different molecular units that can appear in various orders and ratios.

*Pseudomonas* is much studied, principally because of one of its members, *P. aeruginosa* is a persistent and debilitating infection for cystic fibrosis sufferers.

In cystic fibrosis, explains Rehm, a mutation in one of the genes encoding a chloride channel impairs the secretion system. Clogged with a viscous mucous, the lungs become the ideal environment for *P. aeruginosa* which is inescapably ubiquitous but seldom causes disease in otherwise healthy individuals.

Once established in the lung, *P. aeruginosa* converts from being a free-living and ‘planktonic’ form to a settled community-living form that secretes large quantities of alginate. The alginate forms the structure of a biofilm that anchors to the lung surface, generating an immune response: the cells encountering the biofilm break apart releasing their DNA – another high-molecular-weight viscous compound – which crosslinks to the alginate and, together with the DNA from the breakdown of bacterial cells, becomes part of the biofilm matrix. Penetrating that matrix to deliver antibiotics is extraordinarily difficult, and the infection cannot be eliminated, only held in check.

Hence *P. aeruginosa* has been of particular interest to medical researchers.

But the potential uses of tailor-made



bacterial alginates produced by engineered bacteria could be useful in a host of applications. One that is being actively explored is the use of alginates in specialist medical applications, particularly encapsulation.

For his PhD thesis, Rehm worked on alginate production in *P. aeruginosa* and *A. vinelandii*. Supported by a Deutsche Forschungsgemeinschaft (DFG) fellowship, he spent time at the Unigen, Center for Molecular Biology at the Norwegian University of Science and Technology in Trondheim, Norway, where the seminal work on the alginate metabolic pathways had been done, forming an enduring working relationship with the alginate-research pioneer Svein Valla.



Dried bacterial alginate is a potentially useful biomaterial.

“The six months I spent in Norway were extremely productive. We had three papers in international journals,” says Rehm.

Rehm took one of the genes essential to the biosynthesis of alginate in *P. aeruginosa* and, with the help of the Norwegians, went looking for its equivalent in *Azotobacter*.

“After a few weeks we had it, and it turned out to be part of a cluster of 12 genes. It

enabled us to get the whole cluster [of genes involved in alginate biosynthesis].”

Coauthored and published in 1996 in the *Journal of Bacteriology*, the resulting paper was, says Rehm, “a bit of a triumph”.

Soon afterwards, now at the University of British Columbia on a postdoctoral scholarship, Rehm published his first single author paper, this time looking at a single alginate gene found in common in *P. aeruginosa* and *A. vinelandii*.

Rehm has continued to work on alginates, off and on, ever since. But, despite the genes involved having been identified, the mechanisms surrounding the polymerisation of alginate and its secretion into the environment outside the cell have proven extraordinarily complicated and resistant to easy explanation.

“Quite a few of the proteins [produced by the alginate-biosynthesis genes] are unique to alginate biosynthesis and their function is unknown.”

In fact, the genes encoding the enzymes involved in alginate synthesis also seem to be deeply entangled with and regulated by other complex networks within the cell.

“It is getting so complicated and exciting. We solve one little problem, and that comes with a number of follow-up questions.”

Recently, for example, Iain Hay, a PhD student in Rehm’s group, elucidated one of the necessary mechanisms for alginate synthesis in *P. aeruginosa*: a gene, MucR, produces an enzyme, PA1727, which in turn synthesises a messenger molecule, c-di-GMP, which binds to a particular membrane protein, Alg44. Discovering this pathway constitutes an important piece of work and has led to a published paper.

But it only advances knowledge so far. What exactly happens when c-di-GMP binds to the membrane protein? Unclear.

What of c-di-GMP’s companion molecules? “In *Pseudomonas aeruginosa* you can

find 38 enzymes involved in the synthesis and degradation of c-di-GMP. What are they all doing?” says Rehm, bemused.

Discouraged? Not a bit: he loves the intellectual challenge.

“Tomorrow those of us in the alginate research group will meet to discuss things, and it will be last week’s model, out the door, next model please.” ■

## A life in science

Professor Bernd Rehm is one of those rare individuals who come by their career ambitions early and pursue them undeviatingly. “At the age of 15 I knew that I wanted to study microbiology, I knew that I wanted to get my PhD, and I knew that I wanted to become a professor.”

He grew up in a rural area in central Germany as “a very free kid. There were no computers; we had to invent games”. In the woods and fields surrounding his small, ancient village he caught snakes and stoats. He became fascinated by nature, and, in his adolescence, took to reading the works of many of the pioneers in the life sciences.

But in setting his sights on becoming a professor, he would not have it easy. In Germany, reaching the rank of professor is perhaps more arduous than anywhere else in the world. The German diploma, the equivalent of a masterate, can take five-to-six years to achieve; the promotion, the equivalent of a PhD, another three-to-five years; and the habilitation, the qualification seen as a prerequisite for professorial appointments, another several years of

research, a thesis, a public lecture and an oral examination.

At 19 Rehm went to the Ruhr University of Bochum, over the years completing his undergraduate degree, his diploma, and his promotion there.

For his diploma thesis Rehm investigated the workings of the enzyme lipase in the bacterium *Pseudomonas aeruginosa*. For his promotion topic, he focused on the bacterial production of alginate, again using *P. aeruginosa*.

He followed this with a postdoctoral fellowship at the University of British

“At the age of 15 I knew that I wanted to study microbiology.”

Columbia, looking at some poorly understood aspects of an outer membrane protein of *P. aeruginosa* under the direction of Professor Bob Hancock. It was while in Vancouver that he and his wife had their first child and Rehm published his first academic paper as sole author.

Now he needed to find a suitable post in which to undertake his habilitation. One of his job applications came across the desk of Professor Alexander Steinbüchel at the University of Münster. Steinbüchel’s interest was in another class of biopolymers, the polyhydroxyalkanoates, aka bioplastics.

Steinbüchel offered Rehm an untenured position as a postdoctoral researcher. Under Steinbüchel’s mentorship, Rehm would be expected to further research into PHAs, but again he would have the liberty to pursue his personal research interest in alginates.

Over the next several years Rehm established a research programme around PHA biosynthesis with a niche focus on the key polymerisation enzyme, and notched up the requirements for his habilitation.

He was now a highly regarded 37-year-old university researcher and teacher with a string of degrees to his name and a wife and two children. Yet, because of the peculiarities of the German academic system, he had yet to hold a permanent job – and, with his habilitation completed and a further two years of employment at the University of Münster, the system again expected him to move on.

Massey was among the universities interested in him. After a midnight telephone interview, Rehm took up an invitation to visit the Manawatu campus where he made a well received presentation. Soon after his return to Germany – astonishingly soon to Rehm – he received the job offer. A tenured position was his if he wanted it.

After a Rehm family debate – his wife and children were for the adventure – he accepted.

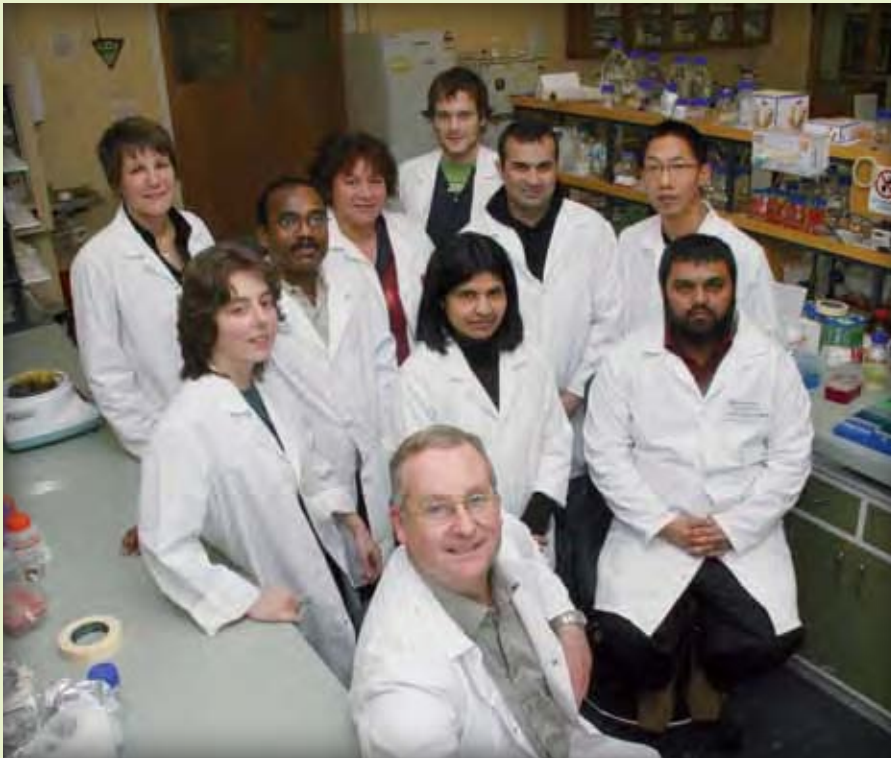
Rehm did more than simply bring his experience with him, he also brought a number of members of his established group and despite some delays with equipment, “after two months we were up to speed and the same year we were publishing”.

Rehm is now the principal investigator for three research groups, one investigating bacterial polyhydroxyalkanoates, another, bacterial biofilm formation, and a third, alginate biosynthesis.

His research has attracted a cosmopolitan group of masterate and doctoral students and postdoctoral fellows, their origins including India, Italy, New Zealand, Japan, and, of course, Germany.

Rehm takes delight in seeing his colleagues do well, particularly his doctoral students.

“If you are good in your first year of supervision, then they become more and



Professor Rehm, at front, with, from left: postdoctoral fellow Dr Katrin Gage, PhD student Anika Jahns, postdoctoral fellow Dr Raj Palanisamy, master’s student Jane Atwood, PhD student Iain Hay, postdoctoral fellow Dr Indira Rasiyah, PhD student Zahid-Ur Rehman, PGDipSc student Jason Lee, PhD student Aamir Ghafoor. Absent: PhD student Natalie Parlane, currently conducting vaccine trials in the Hopkirk Institute.

more independent. That's the fun part: you can see them become confident and produce interesting results."

And interesting results there have been. Seventeen papers have been published and currently four await publication.

How does the New Zealand research system appear to German eyes? Some things seem enviable. When the DFG funded his PhD studies he was required to present a summary of his data to a professorial committee every six months, with no certainty that his funding would be continued. "I tell my PhD students they are living in paradise getting a three-year funding period." His postgraduate students are allocated a lab bench each, an unheard of luxury in Germany. If there is a disappointment, it is that the group has yet to achieve Marsden Funding. After all, in Germany, much of his research was funded by the Marsden Fund-equivalent, the DFG

And how does he regard his career? "When I look back I wonder at [just] how dedicated I was," says Rehm, who now has two sons of his own and who does not want to burden them with parental expectations. Still, sometimes he can't help himself.

"So I am sometimes wondering what my sons are doing. I am asking them, 'so what would you like to be?'" ■



### In print

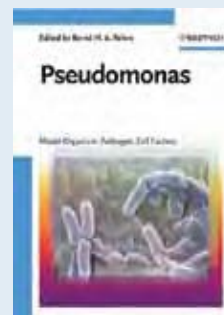
As well as having 110 scientific publications to his name and having been the sole editor of four comprehensive multi-authored reference books, Rehm sits on the editorial board of eight international scientific journals, is the editor-in-chief of *Current Proteomics* and the editor of the *Journal of Biomedicine and Biotechnology*.



#### **Microbial Bionanotechnology: Biological Self-Assembly Systems and Biopolymer-based Nanostructures**

Bernd H.A. Rehm (ed), Horizon Bioscience, 2006

Bionanotechnology is an emerging multidisciplinary field fusing nanotechnology with biology, but differing from nanotechnology in that rather than using a top-down approach to generate nano-sized building blocks, instead employs a bottom-up strategy harnessing nature's capacity to form molecular nanostructures.



#### **Pseudomonas: Model Organism, Pathogen, Cell Factory**

Bernd H.A. Rehm (ed), Wiley-VCH, 2008

*Pseudomonas* is one of the most important model organisms in applied microbiology and one of the most fascinating, according to Rehm, and many of its members have remarkable abilities. *P. auruginosa*, the representative he is most familiar with, can produce a number of interesting polymers, including cellulose, alginate, and PHA, while another species, *P. putida*, has shown a remarkable ability to degrade organic solvents and is being used in bioremediation.



#### **Microbial Production of Biopolymers and Polymer Precursors**

Bernd H.A. Rehm (ed), Caister Academic Press, 2009

A comprehensive and detailed account of the use of microorganisms for the production of the most important biopolymers and polymer precursors.



#### **Alginates: Biology and Applications**

Bernd H.A. Rehm (ed), SPVB, 2009

A broad overview of the state of art of alginate material properties, genetics and the molecular mechanisms underlying alginate biosynthesis as well as applications of tailor-made alginates in medicine, food and biotechnology.

# girls, maths, and classroom politics

Associate Professor **Margaret Walshaw** talks to Kereama Beal.



“... it isn’t just the teacher who sets the rules and regulations for the classroom, but the pupils themselves”

**B**eing aware of the effects of social positioning in the classroom is an important tool for understanding achievement in mathematics, particularly for girls, says education researcher Associate Professor Margaret Walshaw.

Walshaw is based within the School of Curriculum and Pedagogy in the College of Education and is co-director of the Centre of Excellence for Research in Mathematics Education. She has just

returned from a six-day conference in Greece involving some 700 delegates from 40 countries, where she presented a paper based on a Teaching and Learning Research Initiative project which focuses on teaching and learning secondary school mathematics.

“The more I think about the work that I and others do in mathematics education, the more I see how it is really driven by what we, ourselves understand,” Walshaw says.

“The theories that we hold dear to our hearts allow us to make sense of things and we derive a sense of self and purpose by the way we put the world in focus from the theories that we hold.”

Walshaw says those theories once included a belief that girls were deficient in mathematics and didn’t have the make-up to be proficient in the subject.

“I guess I felt a little uncomfortable and uneasy about how they were used to explain



the achievement of girls in mathematics,” she says.

“They were older theories, which have now moved to thinking about girls as being central to mathematics, so there’s been quite a turnaround.”

Historically, the older theories suggested that it wasn’t a woman’s place to become educated, which Walshaw says helped form the idea that women didn’t have the calibre to do mathematics.

“There was a movement around the 1970s in mathematics education where people were beginning to say ‘Hey this can’t be right – how can girls be deficient?’

“This led to people questioning what goes on in classrooms and how that might be used to explain why girls were not doing so well in mathematics.”

Walshaw says the researchers at that time looked at how often girls asked questions in the classroom and what they believed constituted a good mathematics student.

“Girls came back with the answer ‘good, kind, and helpful’ whereas the boys’ answers tended to focus on intelligence and ability. Girls’ work would be praised for being neat and tidy – but not necessarily good, or correct.

“This is an example of an idea or attitude operating in classrooms at that time that didn’t allow some girls to develop as well as they might in mathematics.

“The feeling was that maybe our classrooms weren’t conducive enough for girls to actually do well. It was found

that they asked fewer questions, so it then became an issue of finding ways for them to feel more comfortable to do so. This, I think, was the beginning of the turnaround.

“I believe that turnaround was useful because it allowed influential people to come and say that girls can do anything, and it made an improvement. It gave people a different perspective.”

But Walshaw says that while the more inclusive perspective was a positive change, it still didn’t explain enough about their mathematics achievement and the processes at work to position them in a social arrangement to encourage their success.

“Understanding the ways that girls do things is important, as is the way any single person views themselves in a social setting. How does their understanding of where they fit, influence their participation?”

“We certainly needed to move away from the theory that girls are deficient in mathematics, and the move towards girls being central was important to give them a position within mathematics. It allowed those in education to set goals for girls.

“We want to see girls doing well in their subject areas, at post-school education, and in their workplace. This theory has been really useful for society.

“Statistics in New Zealand show that young women are more likely than young men to undertake full-time or part-time study directly after leaving school, they’re more likely than young men to hold a post-school qualification, and more under-30 women than same age

men have graduated from university or hold a higher level qualification.”

Walshaw says, however, that detractors have said a “feminisation of education” has led to under-achievement in boys. “There has been the occasional backlash and criticism of feminist theories,” she says.

“In a sense, some people say that centralising girls has been detrimental for boys. It’s still obvious that people are concerned that boys are not doing well at school, but my focus has not been on boys as it has been on girls. To understand this better, you’d need a micro-analysis of the full classroom dynamics and inter-relationships within that classroom including both those between pupil and teacher, and those between the pupils themselves.

“My research has been built around ideas that try to unpack how people are positioned in society and my work is directly related to people in mathematics education. So I’m not as interested in the way people perform in mathematics, but I’m looking at a micro-level of what happens in classrooms to try and explain how they’re positioned in a social setting and how it might affect them.”

For a two-year Marsden study Walshaw looked closely at the inter-relationships in the classroom of different decile schools and found aspects of practice in the classroom that may not normally have been visible.

She used microphones attached to individual pupils at their desks to listen to their conversations, and then interviewed those students after the lesson.

“Many people assume that a lot of the conversations carried out in the classroom by the pupils themselves, are off-task conversations, but in fact the pupils would often relate what they were doing in their class work to their activities outside of the classroom in their own life.

“So in the times their conversations may have appeared to be off-task, they were actually making connections between the two environments, and contextualising what they were doing.

“The pupils were also very focused on their academic work, and a lot of brainstorming would happen too, which was an interesting aspect.”

Walshaw says that what was particularly interesting were the conversations that happened in a year-12 classroom between two girls who sat in front of two boys, all accelerated students studying mathematics at a higher level.

“It was a fascinating exchange that I didn’t fully understand until I interviewed the girls afterwards. In the girls’ view the boys were trying to distract them and get them into trouble, by kicking their chairs, and making them laugh – which was a no-no in this classroom.

“I saw a little of this happening, but the girl’s perception of this may have been escalated. But what’s important is the way they perceived what was going on and how it affected what they were doing.”

Walshaw says that one of the students in particular, who was prone to giggling, was significantly affected.

“The boys’ behaviour did prompt her to giggle in the class, which had the effect of creating a difficult relationship between her and the teacher.

“It was difficult for her to get beyond this, and as a result she didn’t feel she could do anything well enough for the teacher. Over a period of time, in some way this incident contributed to her disengaging with mathematics and deciding herself that she couldn’t do it, when, in fact, she was a gifted student.

“These are the sort of things you are able to pick up when you look at the relationships within the classroom in a very direct way.”

In a group interview, the girls had criticised the boys over their behaviour, but Walshaw found that they were even more critical of the other girls in the classroom, over seemingly minor things such as gestures or expressions that other girls may have made.

She examined how social and structural processes interact in the shaping of female subjectivities and looked at how girls monitored and categorised the behaviour of other pupils in the classroom.

“I developed the idea that it isn’t just the teacher who sets the rules and regulations for the classroom, but the pupils themselves.

“One interviewee said: ‘Well there’s this girl Judith, she’s like the craziest girl in the class. She acts sort of, okay, this is kind of mean but she acts sort of a little disabled and she writes a real lot.’

“What emerged from that is a view of the very political and strategic nature of classroom life, which we often don’t consider.”

Walshaw has used the work of French philosopher, sociologist and historian Michel Foucault to help her understand and explain what goes on within the social structure.

“That’s not to say Foucault’s theories can explain everything, but for my purposes I’ve found that his ideas about subjectivity, power and knowledge have been very useful.

“I’ve used his ideas in other aspects of my work as well,” Walshaw says. “Looking at individual pre-service teachers in the context of their practice in schools, I applied Foucault’s ideas of surveillance and regulation to try and understand how pre-service teachers are dealing with their time in schools.

“It’s a pretty critical time for them. They’re on trial in a sense. They are learning, in a real classroom that is somebody else’s, in a school they’re only at for a short time. They’re also working with a group of students they haven’t developed long-term relationships with.”

Walshaw says a lot of issues come to the surface during what are called practicums – where education students gain practical experience during placements in schools. She was able to do some research with those students to try to understand and explain why some have had difficult experiences.

She says many difficult situations arise from relationships and misunderstandings between the student and the teacher and one way to address that is to develop systems and processes that can iron out those misunderstandings.

“Teachers are busy people and a lot of what goes on in classrooms is not apparent,” Walshaw says. “It’s only when you have the luxury of a fine-tuned research investigation that you’re able to see what goes on.

“I became very emotionally attached, as I worked through the Marsden research, to what the girls were saying.

“The classroom is the teacher’s classroom and I feel very privileged to have the opportunity to look in-depth into classrooms. Very few people have such an opportunity.”

Walshaw has also collaborated with Associate Professor Glenda Anthony to write a Best Evidence Synthesis for the Ministry of Education in 2001, which involved locating and synthesising research reports on effective pedagogy in mathematics classrooms.

“This came about from concerns about low performance among some groups of pupils, and equity and diversity among pupils. It enables us to identify which practices in the classroom are effective for all groups of students.

“We had to look at ‘what, why, how, and under what conditions’ and find the links with effective teaching and positive pupil outcomes,” she says. “So although some reports may have identified teaching practices that are deemed to be effective, they didn’t show an influence on pupil outcomes, both academic and social.”

The study covered early-years right through to upper-secondary school mathematics, and identified 1100 references.

“We used 660 – finally – in our report,” Walshaw says.

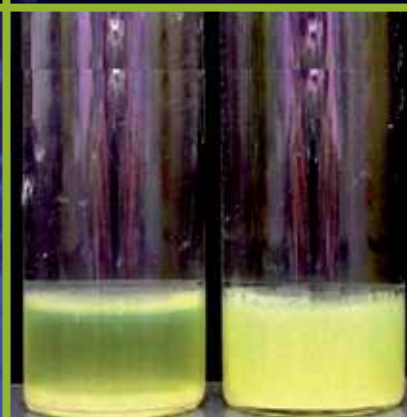
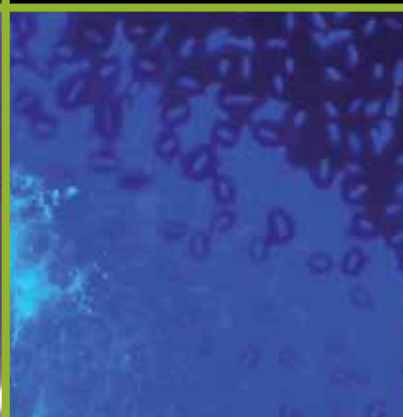
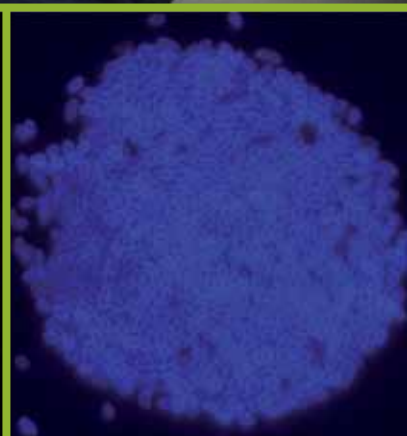
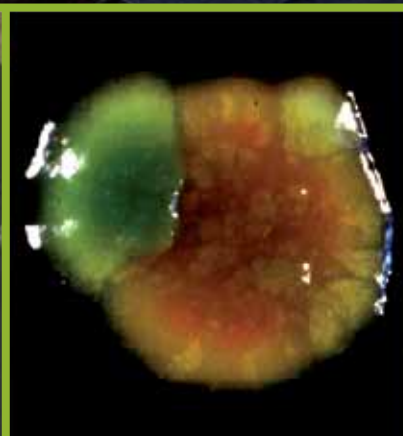
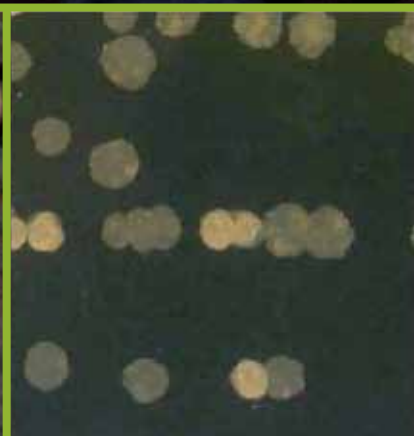
“We found a lot of literature that talks about education practices outside of the classroom. What the teacher does in the classroom is, in fact, greatly influenced by the school, the maths department, the parents and the wider community.

“Teaching in any classroom is not an isolated event.” ■

## Making sense of maths

With \$240,000 allocated from the Teaching and Learning Research Initiative fund, researchers from the School of Curriculum and Pedagogy have recently completed the data collection for a two-year project investigating the relationship between teaching and learning mathematics. The team of mathematics education researchers, led by Drs Walshaw and Anthony, worked in partnership with teachers from three secondary schools. The project represents New Zealand’s involvement in the International Learners’ Perspective Study.

The project leaders and their team Tim Burgess, Peter Rawlins and Anne Lawrence, closely examined how teaching interacts in a positive way with learning in Year-9 mathematics classes. They used video recordings of lessons and conducted numerous interviews with teachers and students with the aim to investigate the teaching/learning nexus in Year 9 New Zealand mathematics classrooms, with a commitment to identifying teachers’ and students’ constructed social and mathematical meanings. ■







A few millilitres of nutrient broth, a bacterium and a few days: these are all the ingredients needed to explore evolution at work. **Professor Paul Rainey** talks to Malcolm Wood about experimental evolution, Oxford, and his hopes for the New Zealand Institute for Advanced Study.

If Professor Paul Rainey can't quite understand why some people would deny the simple and powerful truth of evolution, he has good reason. The reality of evolution is such that it is all he can do to hold it in check.

At the New Zealand Institute for Advanced Study, this means that reference cultures of the model bacterium *Pseudomonas fluorescens* SBW25 have to be held in a glycol antifreeze solution at minus 80 degrees Celsius.

Released from suspended animation into the warm, hospitable world, they begin to feed and multiply, their numbers doubling once every 45 minutes or so, and as they do, evolution takes hold.

To a bacterium, a splash of fresh nutrient broth at the bottom of a vial is an unsettled vastness; every millilitre can be home to 1000 million cells. It is also a surprisingly varied place. There is the substrate of the glass; the oxygen-rich realm where the liquid meets the air; the liquid between with its gradients of light, nutrient and suspended gas. In each niche some bacteria will do better than others, leaving more descendants.

Heritability, variation, selection pressure: the necessary conditions for evolution have been met.

After a few days the bacteria that are taken from the test tube will be very different to those that went in.

Is evolution a reality? Just try to stop it.

Not that Rainey wants to. The frenetic pace of bacterial evolution allows him to develop

and test theoretical models for scenarios that might take millennia to play out at the more leisurely rates of reproduction seen in higher organisms. Here he can observe the processes that have given rise to life as we know it, in all of its glorious strangeness and diversity.

Rainey did not set out to become this – a geneticist exploring the workings of evolution using microbial populations. He began his undergraduate studies in science aspiring to a degree in forestry, thinking this would embrace his interests in science, research, biology and plants. But forestry, he soon enough discovered, was more about production and forest management. He switched to a BSc in botany, finishing his degree in the regulation three years without being particularly stirred by the experience.

But then he had other interests. As an undergraduate, Rainey had supported himself as a semi-professional jazz saxophonist. Two days after sitting his final exams, Rainey (an aficionado of such greats as Sonny Rollins and John Coltrane) was in London, giving himself over to the London jazz scene.

What brought him back to New Zealand after a year was his girlfriend, and what led him to abandon his bohemian existence, he says, was placating the fears of her parents.

Eventually he took a temporary job with a wholesale outlet for a dairy company; it morphed into a permanent position. "And I remember it dawning on me that this was quite a respectable job that I could stay in for the rest of my life, and I thought, 'Oh my God... I

had better get out of here.'"

So he did, completing first a masterate and then a PhD with the Department of Plant and Microbial Sciences at the University of Canterbury.

This time he was there because he wanted to be and he "enjoyed it tremendously".

For his PhD, he chose to look at the role of the bacterium *Pseudomonas putida* – *putida* deriving from the Latin for rot – in providing the stimulus that persuades the fungi *Agaricus bisporus* to produce its fruiting body, the common mushroom.

In turn, this led him to Cambridge University to take up an appointment as a postdoctoral research scientist in the then School of Botany, where this time he took *Pseudomonas tolaasii*, a bacterium that is no friend to the mushroom industry.

In fact, this is a bug many of us have unwittingly met. When the mushrooms at the back of the fridge become slimy and blotched, this is *Pseudomonas tolaasii* at work; to commercial mushroom farming the condition is known as brown spot disease.

Rainey addressed the biochemistry and molecular genetics of the toxin tolaasin, a detergent-like molecule that enables the microbe to establish colonies on the mushroom's otherwise water repellent surface.

His next appointment also dealt with a member of the *Pseudomonas* genus. The Institute of Virology and Environmental Microbiology in Oxford wanted someone to map the genome of *Pseudomonas fluorescens*, a plant-growth-promoting bacterium. »»

### Fast forward

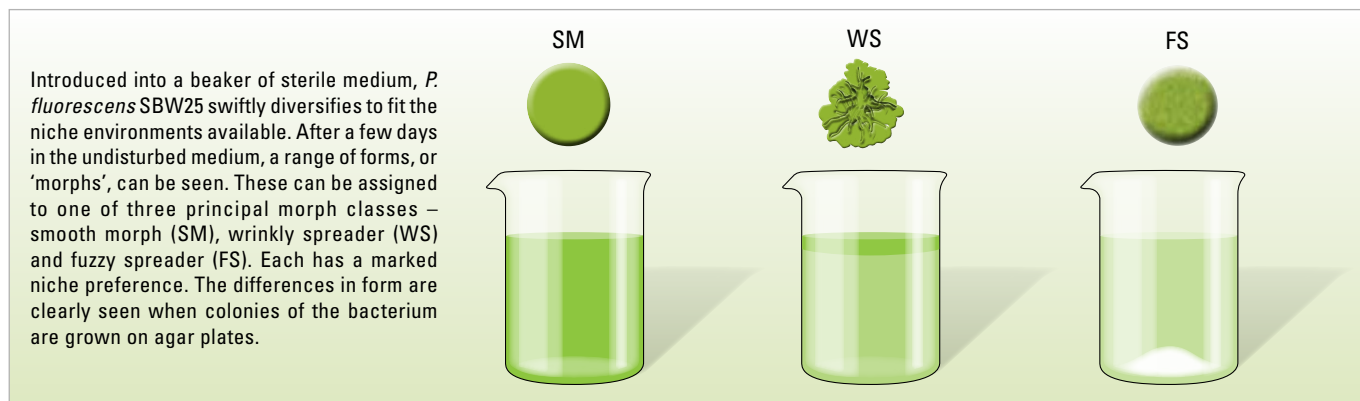
In the bacterial world evolution works swiftly. For the work published in their influential 1998 paper in *Nature*, Rainey and Travisano observed that in their cultures of *Pseudomonas fluorescens* raised in the undisturbed nutrient broth at the base of a glass vial “extensive morphological diversification” was apparent after just three days.

These morphologies – the physical forms – appeared to fall into three main groups, to which Rainey and Travisano gave shorthand names on the basis of appearance of the colonies formed on an agar culture.

From the surface of the broth came the ‘wrinkly spreader’ morph, matted together through the overproduction of a cellulose-

based polymer; on the glass surface, the ‘fuzzy spreader’; and in the liquid environment between the two, the ‘smooth morph’, which is closest to the ancestral form.

Rainey’s work, using *P. fluorescens* SBW25 has been used and elaborated by researchers many times since. The three niche specific genotypes – wrinkly spreaders, fuzzy



“Those were the days when people were releasing recombinant organisms into the environment. The idea was that if we had a map of the genome the bacteria could be released and if the genome was changing through time we would see that.”

*Pseudomonas putida* at Canterbury; *Pseudomonas tolaasi* at Cambridge; *Pseudomonas fluorescens* at Oxford.

What is it about *Pseudomonas*? “*Pseudomonas* is an interesting genera of bugs. They are brilliant opportunists, extraordinarily versatile, exploiting every available niche in the terrestrial environment. In the marine environment the equivalent is the vibrios, the choleras.”

Rainey’s work until this point may sound quite narrowly focused, but in fact from the days of his Canterbury PhD, he was fascinated by bacterial ecology and evolution, an interest initially encouraged by the evolutionary biologist Professor David Lloyd and members of Canterbury’s postgraduate community.

It had not been just the association of *P. putida* with mushroom production that interested Rainey. “I saw these bacteria do very interesting things. If you left them in tubes without shaking, what would come out after a few days or so would no longer resemble what went in the first place. It seemed quite magical at the time.”

This other strand of research became explicit at Oxford’s Institute of Virology and Environmental Microbiology, where

Rainey had the mandate to explore *P. fluorescens*’ population ecology and ecological divergence.

As a model organism for research, *P. fluorescens* has much to recommend it. It poses no risk to researchers and it is easy to identify. “The wonderful thing about *P. fluorescens* is that it produces a fluorescent pigment, and it is very pretty, very easy to see.”

The particular strain of *P. fluorescens* he used had been taken from a sugar beet, hence the first two letters of its acronym, SBW25.

At Oxford Rainey began the painstaking labour of mapping the *P. fluorescens* genome, slicing it into fragments – perhaps 130 in all – separating the fragments using electrophoresis, and then aligning overlapping sequences to arrive at the right order.<sup>1</sup>

In 1994, as his work wound to a close, and backed by Professors Richard Moxon at the University of Oxford and Rich Lenski of Michigan State University<sup>2</sup>, he applied to the Biotechnology and Biological Sciences Research Council (BBSRC) for an Advanced Research Fellowship to pursue research into bacterial ecology and evolution.

His success brought him five years of funding. He had no teaching obligations. He could go anywhere he liked in the United Kingdom to set up a research group.

But he and his wife liked Oxford. “I moved across the road to the Department of Plant Sciences.”

For an academic, Oxford is an easy place to like, and for Rainey it would be the setting

for a happy and highly productive decade. It was while here that he and Michael Travisano published the 1998 paper in *Nature* that established *P. fluorescens* and their typology of evolutionary variant as a way of exploring evolution in the laboratory.<sup>3</sup>

In 1997, while still holding his BBSRC fellowship, Rainey was appointed a stipendiary lecturer at Wadham College, founded in 1610, and a fellow of the all-graduate St Cross College, founded in the 1960s.

The appointments gave him entry to another world. With the Wadham College appointment in particular, Rainey could avail himself of all of the privileges afforded an Oxford don, many centred about the pleasures of the table.

“There would be sherry in the common room, several courses at the high table, then a move to the dessert room.” Rainey took on the onerous duties of running the college’s wine cellar.

From a certain standpoint, it all sounds very antique, very mockably *Brideshead Revisited*. Yet Oxford’s institutions make it what it is. Rainey remembers guest nights during which he might meet anyone “from the rear admiral to politicians to scholars from all over the world”. The colleges were like extended families, and extraordinarily hospitable to their own. It attracts and holds extraordinary people: Rainey remembers the likes of Richard Dawkins – whom he remembers as quite shy – Bill Hamilton, “the greatest evolutionary theorist since Darwin”,

spreaders and smooth morphs – are now part of the lexicon of the trade.

Yet, while the pattern is consistent, the genetic pathway, it seems, is not. Each time, the die is cast afresh.

This can be seen if samples of the same variant – perhaps wrinkly spreader – are taken from different cultures and subjected to the same selection pressures. Some will do well, some won't. Although they look the same, they have followed different genetic routes, conferring different levels of fitness.

The changes can also now be tabulated by comparing the new genotype against the ancestral form.

Rainey is now using *P. fluorescens* to address two of the last great problems in evolution: the origins of multicellularity, and the extent to which evolution is predictable.

In the course of life's four billion-year history on this planet there have been a number of events known as the major

evolutionary transitions. The leap from single cells to multicellularity is one of these – and the evidence is that this particular transition has happened not once, but a number of times.

But how so? Multicellularity, when seen from the standpoint of the individual single cell, is an odd deal to make.

Take Rainey's raft-like mats of wrinkly spreader cells. By overproducing cellulose at the cost of a small metabolic penalty they are able to stake out that enviable oxygen-rich territory at the water surface.

But better still from the evolutionary standpoint of the individual cell would be to freeload – hang out with the wrinkly spreaders, reaping the benefits of their oxygen-rich environment, without paying the price.

In the event, this is exactly what happens. The freeloaders proliferate, out-competing their apparently more public-spirited

neighbours, and sooner or later the mat sinks beneath their weight.

In a true multicellular organism the individual cells have made the supreme sacrifice, giving up capacity for autonomous replication. But how does one get there?

As Rainey has put it, "Mats must evolve to leave mat offspring, but mats cannot evolve to do this because they lack Darwinian individuality – the element essential for the evolution of group level traits, such as mat offspring. They lack the thing they need to evolve the thing they lack. Of course this is a nonsense."

His solution lies partly in a reconceptualisation of what is going on. Think of the mat as the multicellular vegetative stage and the cheat as the single-cell reproductive stage and you are partway towards a multicellular organism.

The remaining requirements? One would be that the switch between two forms is >>>



Bacteria are grown on agar and classified morphologically according to the form their colonies take.

and Bob May, chief scientific adviser to Tony Blair and past president of the Royal Society.

And in a world of corporatism, where administrators and politicians increasingly held sway over tertiary education, Oxford (along with Cambridge) remained an independent redoubt, run by the Congregation, Oxford's parliament of professors, tutors, fellows and administrators.

It is a formula that is envied and resented. Oxford and its institutions are at one and the same time seen as bastions of entrenched privilege and as, in many ways, an embodiment of academic excellence and societal engagement. Rainey's memory is of a "wonderfully privileged, highly stimulating, difficult to defend way of life. Anyone who has ever experienced it would hate to see it go."

So why return to New Zealand? When Rainey first moved to Britain it was with the intention of returning after a few years to take up a lecturer's position. But in the early 1990s the competition for positions in New Zealand was surprisingly fierce and after a time Rainey came to be increasingly reconciled to being where he was. His career advanced at a satisfying pace; he and his wife had a daughter; they bought their second house; Oxford and the British system offered him a degree of support that would be difficult to match.

But family connections – his own and his wife's – prevailed. When the Chair of Ecology and Evolution fell vacant at >>>

genetically programmed rather than reliant on one or other mutation.

Can such a shift occur naturally within the laboratory environment? Rainey thinks so. “It sounds fanciful, but it’s not impossible.”

The extent to which evolution is predictable is his other major interest. By predictable, he does not mean deterministic: the definition of evolution he is fondest of quoting – Richard Dawkins’ “the non random survival of randomly selected mutations” – precludes this.

However, it may be that at the molecular level evolution is being played with weighted dice.

“It is possible that natural selection has favoured certain – I will use the jargon term – ‘genetic architectures’, architectures that have evolved by natural selection, because let’s say they facilitate subsequent evolutionary change. Evolution may have favoured organisms that are evolvable.” ■

the University of Auckland Rainey was equivocal. “Oxford was a hard place to leave.” But his wife’s reaction was definite. “I mentioned it to Katrina and her eyes lit up.”

Rainey took up the chair in 2003 (Oxford also appointed him International Professor of Biology and Visiting Professor, Wadham College, in that same year), but he was never truly comfortable with the culture of his new employer, and when Professor Gaven Martin approached him about the possibility of a chair in the New Zealand Institute for Advanced Study he was receptive.

He took up the position in 2007.

What has it won him? Rainey sips a cup of espresso-strength plunger coffee; black birds are singing outside the window.

Through the door of his office I can see two postgraduate students in the alcove-like room across the hall, leaning in towards their computer monitors, conversing intently.

That is one of the prices of success. The New Zealand Institute for Advanced Study, launched in 2007, is outgrowing its premises. “We are chock-a-block.”

He seems generally happy. He is building a yacht at home. His saxophone has fallen by the way – “which is a bit of shame” – and he has returned to the piano; he favours Bach’s partitas, preludes and fugues, “and I go through stages of getting quite good on some”, he says wistfully.

He talks about the trip he is about to make to Monterey – Steinbeck country – to teach at a summer microbiology school (a

### Lessons from the laboratory

As the evolutionary scientist Stephen J. Gould once wrote, “On any possible, reasonable or fair criterion, bacteria are – and always have been – the dominant forms of life on earth.” But because we are large multicellular organisms ourselves, we are “accustomed to viewing phenomena of our scale – sizes measured in feet and ages in decades – as typical of nature”.

The disciplines of ecology and evolution began with multicellular organisms and that legacy is still with us, says Rainey.

“Someone wanting to do ecology and evolution would probably do zoology and plant sciences, they probably wouldn’t do microbiology. And someone doing microbiology, is unlikely to do any ecology or evolution.”

This is unfortunate. Particularly so because microbes and viruses reproduce

at such speed and so prolifically that they can out-evolve our measures against them.

Over the past half century humankind has in effect been conducting a large-scale uncontrolled experiment in drug resistance.

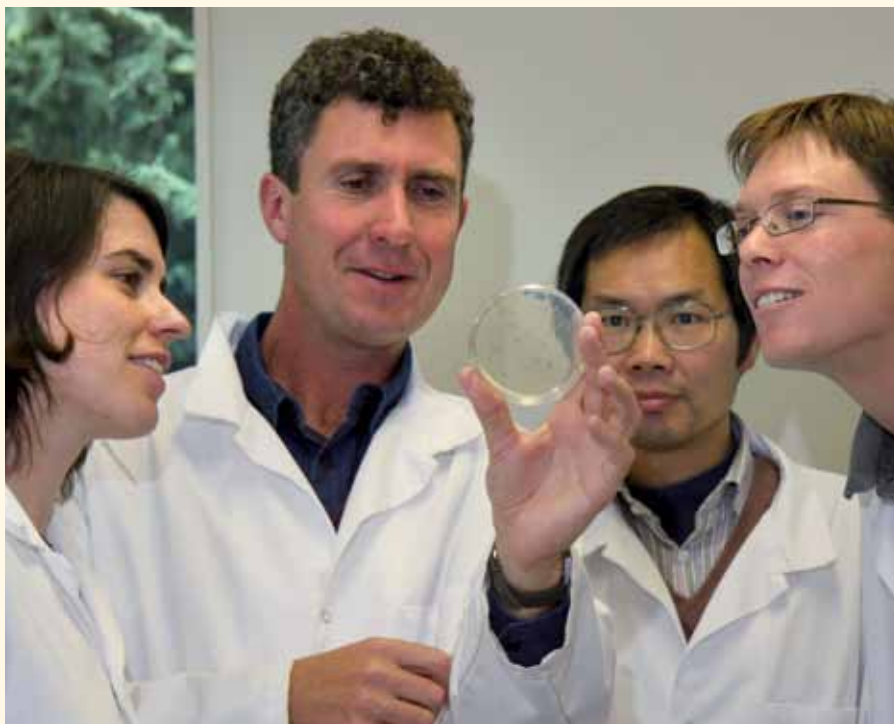
A legion of bacteria, including strains of *Mycobacterium tuberculosis*, staphylococci and salmonella, now exhibit multiple drug resistance.

How does this come about? In part because those administering the drugs – who are choosing the treatment intervals, dosages and drug combinations – are failing to take evolution into account.

*Pseudomonas aeruginosa*, an opportunistic pathogen in cystic fibrosis sufferers, is treated using antibiotics. Yet at one gathering of physicians Rainey was dismayed to discover that every physician has his or her rule-of-thumb, no two the same – surely a disaster in the making.

boot camp for postgraduates) at Stanford, where he is Visiting Professor. He talks about the feedback from the public lecture he delivered last year as part of Radio New Zealand’s Darwin year series. (His fluent exposition on the evolution of complex organisms is available as podcast – though acute self-consciousness holds him back from listening to it himself.) He talks about a trip he recently made to Norway, where

he delivered a lecture as part of the Darwin year celebrations and met Elizabeth Hambro, Charles Darwin’s great granddaughter; a professor he met while there is keen to spend a sabbatical year with the institute. He has no shortage of talented postgraduates wanting to work with him – one of the two postdoctoral researchers I can see in the room opposite is a mathematician newly arrived from the States.



From left: Sykle Nestmann, Professor Rainey, Dr Xue-Xian and Dr Jonathan Gauntlett.

Similarly, in the treatment of tumours – the body’s own cells gone rogue – the principles of evolution also apply. Every time an antitumour drug is given, a selection pressure is brought to bear and a *de facto* experiment in ecology and evolution is carried out.

“One of the worst things that can happen is an adaptive radiation within a tumour,” says Rainey.

In ecological terms, the administration of an antitumour drug can be seen as a disturbance event: it disrupts ecosystem productivity and influences diversity.

One inference to be made from theory is that in the case of an antitumour drug regime is that the drug should either be administered very frequently or very infrequently; it is in the middle ground that the greatest risks of drug resistance lie. ■

Massey, says Rainey, “has a nice touch”. “The research team here is fantastic. It’s a great culture, a great environment. I just hope we can grow it.”

Up until quite recent times it was regarded as *de rigueur* that any bright post-graduate would want to head off to big universities in Britain or the US – the OxforDs, Cambridges, Stanfords and Harvards – where the serious thinking took place.

The best New Zealand-based researchers could hope for was to ride along on the coat-tails of others. “[We think] we’re a small country, we don’t have a lot of money, we’ll just pick the cherries of the things that are done ‘out there’.”

It’s a mentality with which the normally temperate Rainey strenuously contests. The New Zealand Institute for Advanced Study is an initiative that shows that extraordinary work can happen where there is the will.

“We don’t think we can do it here? That’s bullshit!” ■

1. Rainey was able to draw on this early work to put a case for the sequencing of the *P. fluorescens* SBW27 genome. In 2009 the Sanger Institute completed the sequencing of the 6,722,540 base pairs and made it publicly available online.
2. In the late 1980s Lenski performed some of the seminal work in experimental evolution using *Escherichia coli* as his model bacterium.
3. Rainey, P.B. & Travisano, M. (1998) Adaptive radiation in a heterogeneous environment. *Nature* 394, 69-72

## The New Zealand Institute for Advanced Study

The New Zealand Institute for Advanced Study aspires to be one of the world’s leading centres for theoretical research and intellectual inquiry in the sciences. It exists to encourage and support fundamental scholarship – the original, often speculative thinking that produces advances in knowledge – and is characterised by interdisciplinary clusters of elite scholars with the ambition and capability to lead New Zealand’s cultivation and generation of knowledge



### Distinguished Professor Gaven Martin FRSNZ

*Research Interests: Mathematics*

Non-linear analysis, elliptic partial differential equations, Beltrami systems and geometric function theory, particularly as it interacts with conformal geometry, quasiconformal mappings and their generalisations. Applications in non-linear elasticity and materials science. Also low dimensional topology and geometry, particularly hyperbolic geometry, discrete groups and their associated universal constants, such as minimal co-volume, and relations between arithmetic and geometry.



### Professor Paul Rainey FRSNZ

*Research Interests: Ecology and Evolution.*

Evolutionary processes particularly, but not exclusively, evolution by natural selection. Our research is both theoretical and empirical and makes use of microbial populations in order to observe and dissect evolution in real time. A growing fascination is the evolutionary origins of multicellularity. Other interests include the ecological significance of diversity in natural microbial populations; evolutionary processes determining patterns of diversity in space and time; and the genetics and fitness consequences of traits that enhance ecological performance in populations of plant-colonising bacteria.



### Professor Peter Schwerdtfeger FRSNZ

*Research Interests: Theoretical Chemistry and Physics.*

Aspects of quantum chemistry and physics focused toward fundamental issues. Current research areas include: parity-violation in chiral molecules, relativistic effects, the chemistry of heavy and superheavy elements, simulation of metallic clusters, quantum-electrodynamic effects in atoms and molecules, solid state chemistry and physics including high-pressure materials, surface science, chemical evolution theory and the mathematical and philosophical aspects of quantum theory.



### Visiting Professor Victor Flambaum FAA

*Research interests: Physics*

Challenging problems in atomic, nuclear, elementary particle, solid state physics and astrophysics, in particular violation of the fundamental symmetries (parity, time invariance), test of the theories of Grand Unification of elementary particles and their interactions, search for spatial and temporal variation of the fundamental constants in the Universe from the Big Bang to the present time (such variation is predicted by theories unifying gravity with other interactions), many-body theory and high-precision atomic calculations, quantum chaos and statistical theory, high-temperature superconductivity and conductance quantisation.



# close your eyes

**Sarah-Jane Paine** is pregnant with her first child. Of all the physical and social adjustments the pregnancy has brought to her life, there is one change which she finds particularly fascinating: the sleep researcher is having trouble sleeping. Dr Paine is a post-doctoral fellow in Massey University's Sleep/Wake Research Centre. All her 31 years, she's been a good sleeper, easily slipping into seven to eight sound, uninterrupted hours of sleep each night. But she is now five months pregnant and that feeling of waking up well-rested and refreshed is just a lingering memory. "I'm now acutely aware of what it's like to suffer from disrupted sleep."

At least for Dr Paine, there is some value in the sleepless nights. They are giving her an insight into the frustration felt by the one in three New Zealanders who regularly struggle to fall asleep or stay asleep long enough to feel rested. Now she can fully understand why everyday New Zealanders are so intrigued by her field of study. Everyone sleeps; but hundreds of thousands of Kiwis battle their whole lives to achieve the deep and unbroken slumber Dr Paine used to enjoy.

**D**r Paine is of Tuhoe descent. One of five children, she was raised in Wairoa in Hawke's Bay, schooled at Nelson Girls' College, and studied anatomy at Otago University, where she gained an MSc in reproductive biology. In 2001, she started her academic career as a junior researcher at Massey's Sleep/Wake Research Centre. The centre is run by renowned international sleep expert Professor Philippa Gander, who has previously lectured at Harvard University and worked for NASA.

Dr Paine had no idea what sleep research was all about but quickly connected with the area of research that would become her speciality.

"I knew that I wanted to work in human research," Dr Paine says.

"And, we all sleep?"

Her immediate interest in the mysteries of sleep has been mirrored in the many people who, on finding out her area of expertise, launch into a discussion about their sleeping patterns and a barrage of questions about humans and sleep.

Is it natural for older people to lose the ability to sleep for several hours at a time? (Yes.) Do socio-economic factors affect the amount of sleep you get? (Yes.) What is the average amount of sleep most people have each night? (Seven hours and 24 minutes.)

"People are so interested in what we do here," Dr Paine says.

Nowhere has the public intrigue with sleep research been more evident than in the numbers clamouring to take part in barely-compensated,

weekend-long Sleep/Wake research.

Massey's Rime Isolation Facility is a rectangular room with three cubicles divided by thin relocatable walls. Each cubicle has a single bed, a television, a desk and a small, cheaply-framed, pastel-toned print hanging on the wall. Here, human guinea pigs volunteer to spend weekends reading books, watching telly, playing cards and waking at random times all through the night. Sometimes the volunteers are woken at regular intervals to sit at the small desks and perform multi-choice tests to see how brains function during periods of interrupted sleep. Sometimes they are just kept awake the whole night, then tested the next morning to assess the affects of grogginess and disorientation.

Until this year, there was no formal training around sleep in science or medicine. But Professor Gander has established the first undergraduate course in New Zealand dedicated to sleep and circadian science, and implications for safety, health, and well-being. There are 11 students enrolled on this 200-level, extramural Massey paper.

Dr Paine's salary is funded through a Health Research Council Eru Pomare Māori Health Fellowship. She's now moving into a new phase in her career; securing funding to get other researchers to work alongside her and helping to build teams within the Sleep/Wake Research Centre. She's attracted an impressive amount of funding to execute a range of projects, and says she is enjoying learning more about supervising projects of her own.

In the past she has researched morning people and night owls (both types used the weekend to catch up on lost sleep, although this was more pronounced among the night owls), the health consequences of insomnia, and the 24-hour circadian cycle and the people who, for reasons unknown, sleep and wake out of sync with the general population.

Now she's lined up research opportunities including a substantial study of 10,000 New Zealanders to see how many have sleep timing problems.

"In most people, the circadian clock is kept in sync by the rising and falling of the sun. But in some people, for reasons unknown, the clock gets out of sync."

This study will compare Māori and non-Māori. Māori are disproportionately represented in numbers suffering sleep problems, including obstructive sleep apnoea syndrome. Dr Paine's research is taking a fresh perspective on sleep disorders; while international researchers are still focusing on genetic disposition, she is considering societal factors, such as the high proportion of Māori involved in shift work and how this may correlate with the high incidence of sleep disorders.

"Shift work now is considered to be a type II carcinogen."

Dr Paine says those living in more deprived areas of NZ are more likely to have a sleeping problem. Is this because of other health problems, because of the stresses of unemployment, the physical toll of shift work, the number of people sharing your home? >>>



Dr Paine says she did not make a conscious decision to introduce a Māori focus to her research, but she had always hoped she could contribute to the Māori community through her life's work. She received an iwi scholarship to help with her education and she hopes to deliver reciprocity through her research.

"I'm Māori and that's part of who I am."

The Sleep/Wake Research Centre has collaborated with Māori health researchers who have taken a leading role in developing kaupapa Māori research techniques that are now being used as the blueprint for other areas of research. Dr Paine hopes to help build an environment which attracts and supports other Māori researchers and students.

"I feel really comfortable being a Māori scientist. I can do world-class, robust science that can be peer-reviewed by other scientists, but the way we do science at the Sleep/Wake Research centre also makes me feel comfortable as a Māori."

Professor Gander says Sarah-Jane has a vital role in sleep research in New Zealand, and is attracting growing international recognition for the calibre of her contribution to the field.

"Sarah-Jane is an outstanding young scientist who combines exceptional scientific rigour

with personal warmth and real commitment to the people she works with, whether research participants or colleagues. Her specific interests in the control of sleep timing and research ethics are framed by the need to reduce disparities in sleep health between Māori and non-Māori."

Dr Paine is interested in differences in sleep problems (including insomnia and Obstructive Sleep Apnoea) between Māori and non-Māori, and how the circadian clock influences sleep timing.

This work includes a focus on conditions such as Delayed Sleep Phase Syndrome, which is when some adults' body clocks stay tuned to the teenage-style night owl sleep patterns long after they've passed adolescence.

"In their late teens, early 20s, most people move out of that. But there are a group who will never move out of that delayed sleep phase. If they went to bed earlier, it'd be nearly impossible to go to sleep."

Most people find 3am to 5am the hardest time to be awake. The body is sleepiest when it's core body temperature is lowest.

What advice does she have for those who have trouble sleeping?

Watch your caffeine intake from midday

onwards. Don't go to sleep with the television or radio on. Sleep in a dark room with no noise. Get some exercise during the day, but not too close to bedtime. Get into a routine before bed; perhaps have a hot, milky drink, read quietly, then go to bed. Avoid heavy, spicy food or stimulants such as chocolate close to bedtime. Alcohol ruins the quality of your sleep. If you are struggling to get to sleep after 20 minutes or so (seven minutes is the average time it takes to fall asleep), get up, go somewhere quiet, and read until you feel sleepy and try again. Do not lie awake staring at the clock and growing frustrated.

Of course, it's one thing to know what works, quite another to practise those techniques.

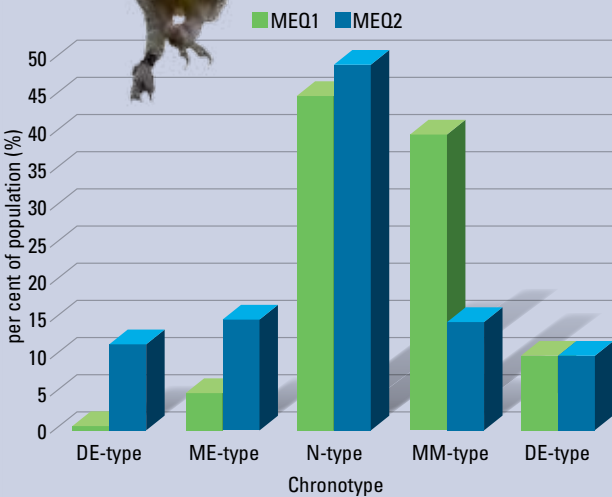
"I'd like to say I do take my own advice," Dr Paine laughs. "But I drink too much caffeine, have too many late nights and too many early starts."

One of Dr Paine's colleagues has just received a substantial grant to look into sleep patterns during pregnancy and following birth; an area of research Dr Paine says she had never given any consideration before she became pregnant.

And with her baby due to arrive around October, Dr Paine's close encounter with sleep deprivation may have only just begun. ■





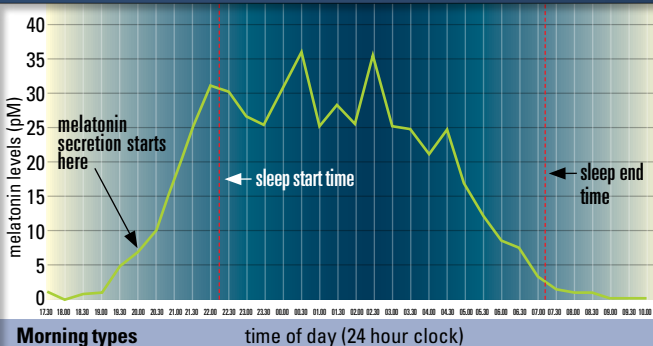


Weighted prevalence estimates of morningness/eveningness in the general population

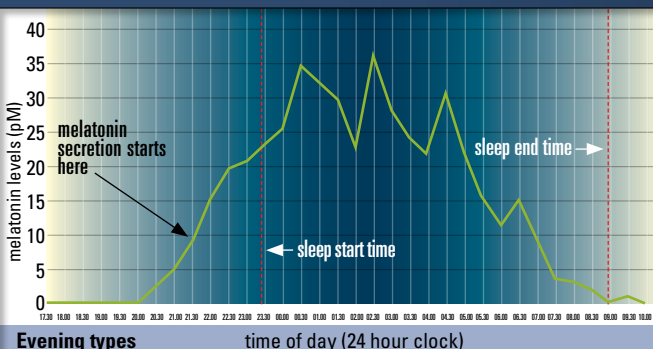
We all know about morning and evening people; the larks and the night owls. These are particular ‘chronotypes.’ Shown here is the range of chronotypes in a sample of the New Zealand population, roughly half-and-half Māori and non-Māori, who were sent a standardised questionnaire. The questionnaire returns were assessed according to two different sets of criteria, resulting in the green and blue bars. The categories are Definitely Evening-type, Mainly Evening-type, Normal-type, Mainly Morning-type, and Definitely Morning-type.

After controlling for ethnicity, sex and social deprivation, this study found

- people aged 30-34 years were more likely to be DE-type and less likely to be morning type (MM- or DM-type) compared with those aged 45-49 years
- the likelihood of being DM-type increased with age
- unemployed people were less likely to be MM-type compared to those not working nights.



Morning types



Evening types

The chronotype of a person is evident in the pattern in the biological rhythms associated with the hormone melatonin, here assessed in Massey’s sleep/wake laboratory. In a survey that was part of this particular study it was found that the morning types on average went to sleep at 10.14pm and woke 7.17am, while evening types went to sleep at 11.25pm and woke at 9.00am.

Dr Sarah-Jane Paine has researched the phenomenon of being a morning person or a night owl, the prevalence, risks and consequences of insomnia, and sleep across the circadian cycle (body rhythms aligned with the 24-hour clock). She is currently involved in five projects.

**Moe Tika, Moe Pai: Advancing Sleep Health in Aotearoa**  
 \$316,740, Health Research Council Eru Pomare Fellowship in Māori Health

This prestigious fellowship named after the late Professor Eru Pomare provides salary and training allowances for Dr Paine and research costs to the value of \$125,000.

**The Epidemiology of Circadian Rhythm Sleep Disorders**  
 \$125,000, Health Research Council

This project, which is actually part of the Eru Pomare Fellowship funding mentioned above, will provide the first information on the prevalence of the Circadian Rhythm Sleep Disorders in the general population of New Zealand. This type of sleep disorder is characterized by problems with the timing of sleep. This will examine what impact factors such as ethnicity, age, sex, shift work and socioeconomic deprivation have on these types of sleep disorders.

**Delayed Sleep Phase Syndrome in the General Population**  
 \$51,519, Lottery Health Committee

This grant will enable Dr Paine to investigate the sleep patterns and circadian rhythms of core body temperature and melatonin in a small group of people who self-identify as having delayed sleep phase syndrome. It will also provide some information on whether blue light therapy is a suitable treatment for these patients.

**Regulation of Sleep in the Circadian Biological Clock**  
 \$44,140, Lottery Health Commission

This grant will finance an upgrade to measuring tools used by the Sleep/Wake Research Centre. The Actiwatch technology is built around a measuring device that looks like a wrist watch. It is worn constantly by subjects in field studies, and used in laboratory settings. When worn in the lead-up to laboratory research, the devices provide information on a subject’s normal sleep/wake patterns, and monitor changes to those patterns during the study. The VitalSense technology will allow the Sleep/Wake Research Centre to monitor the 24-hour rhythm in core body temperature which is controlled by our internal biological clock. Research participants are asked to swallow a capsule (about the size of a large vitamin) and this relays temperature information to a small box worn near the body.

**Developing Sleep Services that Meet the Needs of Māori: A Feasibility Study**  
 \$145,561, Health Research Council

Dr Paine has helped build an understanding of the consequences poor sleep has on health, safety and wellbeing. This study will take stock of current services and include a literature review focusing on ethnic inequalities in sleep problems, particularly Obstructive Sleep Apnoea Syndrome in New Zealand. It will also consider potential primary care-level interventions that could improve Māori sleep health, as the basis of a potential larger project in the future which would analyse sleep health policy, purchasing, service development and evaluation.



# fire and ice

When the Mt Ruapehu crater lake dam broke in 2007, volcanologist Associate Professor Shane Cronin and his team were poised to go. He talks to Malcolm Wood.



It was a wet Sunday morning in Palmerston North in March of 2007 when the call Shane Cronin had been waiting on for three years came through. He was lucky to get it at all. His cellphone was playing up, but when, alerted by some sixth sense that the game was afoot, he switched batteries, it rang almost instantly.

High on Mt Ruapehu, at 11.20 that morning, during an intense rain storm, the wall of the crater lake had breached.

Trip wires and seismic sensors registered the initial non-eruptive collapse and at a remote sensing station seven kilometres away from the lake, the needles leapt on seismographs as a massive lahar, eight metres high at the peak of the initial wave, swept down the plunging catchment of the Whangaehu River.

In Palmerston North, Cronin and his colleagues moved at speed, with the coordinator of the team plan, Cronin's PhD student Jon Procter, making phone calls, assembling teams and vehicles, and throwing equipment together.

Within the hour, the pair and a contingent of 20 staff and students were rallying towards Ruapehu, with five teams assigned to agreed positions along the Whangaehu.

Shane Cronin grew up alongside the massive caldera of Lake Taupo with the volcanic cones of Ngāuruhoe and snow-capped Ruapehu part of the backdrop to daily life; Ngāuruhoe, he remembers, last erupted on his fifth birthday.

But don't suppose too much. Cronin's ambitions when he arrived at Massey in the late 1980s were not volcano-related. First he signed on for a year's study towards an industrial engineering degree, and, following that, he switched to a year of chemistry. But while he enjoyed both years – and the maths and chemistry has proved useful – neither subject grabbed him. Pragmatically, he thought industrial engineering would eventually mean working in a factory; chemistry would mean working in a lab. Cronin did not want to do either.

"Then one of my friends suggested earth sciences as a fill-in subject. I went along and was immediately hooked – primarily by the prospect of the travel and outdoors."

Cronin completed a BSc in Earth Science and then an honour's year in which he took the eruptive history of the lava domes of Mt Taranaki as the subject of his research project.

For his PhD he turned to the landscapes surrounding Ruapehu and Ngāuruhoe volcanoes, "looking at processes of volcanic activity, climate change, what rivers were doing...all the combined influences that had shaped that landscape".

What about volcanology proper? "I guess I was always looking at the active volcanology thing and thinking, 'Oh yes, that would be terribly nice to do, but that's kind of a fantasy. I can't really do that. I'll have to find some real job.'"

Then providence intervened. On September 18 1995, while Cronin laboured over his

thesis and skiers readied for the final run of the day, Ruapehu woke from a 50-year slumber, sending up a towering plume of ash, ejecting boulders, and sending a lahar down the Whangaehu river bed.

Cronin promptly suspended his PhD and took up a job working with Massey's Professor Vince Neall and a range of organisations, (including the ministries of Civil Defence, Health, Agriculture; fertiliser companies, and regional councils).

For the next 18 months he lived in the shadow of Ruapehu, heading home only at weekends – and even then decamping back if the mountain launched any surprises, as it was apt to do on weekends.

"Because I was right at the end of doing my PhD I kind of knew where that area of science was at. And we had the opportunities to do things that no one else had.

"Basically we got everything, every type of volcanic process. If it didn't happen one day, it would come the next. We would joke in the evenings about what we wanted to experience the next day, and to our delight we would often get just that."

Among the processes was an abundance of lahars. Some 35 passed down the bed of the Whangaehu. "We could go along and sample one as it went past, and then we would have a think and say 'Wouldn't it be good if we could sample here and there?'"

The most intriguing lahar was the first, a "really bizarre snowy flow", which they sampled extensively before the next lahar wiped out the evidence a day later. >>>

## Living within the lore



**M**t Taranaki, technically speaking, an andesite volcano, has an alter ego: it is a sorrowing lover. According to legend, Taranaki once lived on the volcanic plateau together with the other mountains only to unwisely fall for the beautiful hill of Pihanga, the wife of Tongariro. After a fiery battle Taranaki – in translation the ‘gliding peak’ – was banished and made his way to the coast, where he mourns his lost love.

The depiction of volcanoes as powerful, often battling personalities with their own loves and enmities is a feature of cultures around the world. Indeed, the story of Taranaki is uncannily mirrored in some of the traditions from the Pacific North West.

Cronin is fascinated by the way in which volcanism features in cultural lore. Sometimes the traditions can be seen as the embodiment of well-founded measures for living with volcanism. In Vanuatu, the Solomon Islands and Papua New Guinea, the signs that a volcanic event is nearing are set out in the traditions. For hazard management professionals, cultural

traditions like these represent a folk wisdom that can be both drawn on and augmented – and Cronin has co-authored work on just this subject (see Cronin, S.J., and Cashman, K., 2007: Volcanic oral traditions in hazard assessment and mitigation. Chapter 9 in Grattan, J., Torrence R. (eds) *Living under the shadow: The cultural impacts of volcanic eruptions*).

But the oral traditions also represent much more. For New Zealand’s tangata whenua the mountains of Taranaki, Ruapehu and Tongariro embody indissoluble ancestral links to the land and landscape and are located within a profoundly spiritual world view. When, for example, there was talk of breaching the crater lake wall to achieve a controlled release of the pending lahar, the iwi Ngāti Rangī expressed its absolute opposition: Ruapehu was a sacred mountain and natural processes should be allowed to follow their course.

Cronin is deeply interested in the way in which culture frames natural events. Within mainstream western culture a lahar is seen as principally a hazard, but there are other no less valid ways of conceptualising the event.

Nor are the world views necessarily incompatible. Cronin and his students have worked with Ngāti Rangī, using carbon dating and sediment cores to help the tribe compile a long term history of environmental events on their portion of the volcanic plateau. ■

## Now with fluoride



Ambrym volcano releases up to 1100 tonnes of fluorine as fluoride every day and between 14,000 and 20,000 tonnes of sulphur dioxide.

**I**f there is a flip side to the damage volcanic eruptions cause, it may be in the contributions they make to the fertility of volcanic soils.

When, in 1996, Ruapehu finished discharging lahars from its crater lake, it began erupting ash, which was swept by the prevailing winds over vast areas of the central and northern North Island. Cronin followed, mapping the distribution of where it fell.

The maps turned out to be of wide interest to farmers, fertiliser companies and health authorities. Massey’s Soil Science Department (now within the Institute of Natural Resources) analysed the ash content and issued a pamphlet for farmers explaining the implications. The ash carried with it fertility-promoting

» From that “one-day’s-worth of fantastic data” came Cronin’s first paper for the prestigious journal *Geology*.

For a humble PhD student this was a coup – and the paper aroused widespread interest, particularly in North America. Snow lahars, though understood to be potentially powerful destructive phenomena, were not well described.

One of the greatest volcanic tragedies known is the 1985 destruction of the township of Amero in Colombia, where 23,000 people perished during the night when a small snowy flow grew into a massive downstream lahar.

“My big point in the 1996 paper was that a very small amount of water can erode and entrain a huge amount of snow. Small floods can produce large and dangerous lahars very quickly, that also move incredibly quickly, far faster than their physical properties would indicate.”

By the time Ruapehu had subsided in 1996, Cronin was a fully fledged volcanologist with



Associate Professor Cronin in Vanuatu with local researchers. Douglas Charley, at second left, of the Vanuatu Department of Geology, Mining and Water Resources spent a year at Massey as an NZAid Research Fellow.

elements such as selenium, potassium and sulphur.

But, as some farmers discovered, not everything the ash brought was beneficial. Out on the Rangitikei plains, soon after ashfalls, a number of sheep and cattle died, and when Taupo veterinarian Don Shanks performed autopsies he found their guts contained masses of ash and their kidneys, pale and swollen, carried the signature of fluoride poisoning.

Fluoride is a Jekyll-and-Hyde ion: in small doses in drinking water (1 part per million or less) and in toothpaste it protects against tooth decay with no discernible ill effects; in greater concentrations it causes, progressively, dental fluorosis (1-4ppm), skeletal fluorosis (4-8ppm), and crippling skeletal fluorosis (8ppm plus).

Fortunately, fluoride, being highly reactive, is quickly bound by the soil, and most plants (the notable exception being the camellia family, of which tea is member) do not take up fluoride strongly. The risks lie in ash that is eaten when it covers pasture or when it contaminates drinking water. Around Ruapehu, the risk of fluorosis passed soon after the ashfalls did.

But in parts of Vanuatu, where high fluoride ashfalls are just one of those things and many homes rely on roof water, the health risks are substantial and ongoing.

The volcano of Ambrym on the island of the same name pushes out up to 1100 tonnes of fluoride every day.

Cronin began work on volcanic fluorosis as a human health issue in Vanuatu in 1999 on contract to the World Health Organisation. It was the first time the effects of chronic volcanic fluorosis had been documented in this part of the world – and they proved substantial.

On West Ambrym more than 250 children in the critical years for bone and teeth formation were surveyed by Cronin's student Rachel Allibone. Over half showed the diagnostic signs of moderate-to-severe dental fluorosis: chalky, discoloured and pitted teeth.

As at Ruapehu, the prevailing pattern of ashfall seems to dictate the incidence of fluorosis. In one instance, Cronin and his colleagues found a high incidence in an island 70km away from the source of contamination.

The long-term answer, says Cronin, lies in a shift to reticulated groundwater-based systems and ongoing environmental monitoring. ■



Well water being sampled. Generally fluoride is captured in the soil before it enters groundwater, and reticulated groundwater may be the best approach to preventing fluorosis.



A child's teeth shows evidence of severe fluorosis, including pitting, discolouration and chalkiness.



The process of participatory rural appraisal at work in hazard mapping on Savo in the Solomon Islands.

a publication record and a reputation for being one of the go-to people for the science of lahars.

He finished his thesis and began thinking about his career.

Cronin shifted to Fiji to take up a position within the United Nations Development Programme in their South Pacific Disaster Reduction Program office. Here his duties were twofold: investigating the volcanism of Fiji's third-largest island, Taveuni, and travelling the Pacific, "mostly to political hot spots like the Solomon Islands that no one else wanted to visit", conducting hazard education.

The novelty of Taveuni fascinated Cronin; it was totally unlike either Taranaki or Ruapehu, the volcanoes he knew best. Rather than being centred around one conduit, Taveuni was a distributed volcano system, like that of the Auckland field (see Big Bang Theories overleaf).

Hazard education, on the other hand, would send Cronin journeying around the Pacific ring of fire to some of the poorest, most isolated and least westernised locations on Earth.

Take the island of Savo, close by the Guadalcanal in the Solomon Islands. Just 6 kilometres in diameter and dominated by a 1500 metre cone and crater, Savo supports a coastal population of 3000 people when times are good – and no one when times are not.

In 1568 a Spanish mariner described the island being covered with "roads" of white carving down from the summit crater through the tropical jungle, and there are missionary accounts of further eruptions in the 1830s and 1840s and of intermittent activity into the 1880s.

But the oral traditions – or *kastom* stories – record hints of other events for which no literate observer was present, the most devastating being the so-called *toghavitu* »»

## Big bang theories

One day the Auckland volcano field will erupt again. The questions are when, where, and how severely?  
The best place to look for the answers: the South Korean island of Jeju.

To live in Auckland, is to live with volcanoes. All around is the evidence: the extinct cones of One Tree Hill, Mount Eden, and Mount Wellington; the craters of Lake Pupuke and the Panmure Basin; and, across the harbour, the iconic outline of Rangitoto, the Johnny-come-lately. If you were around 700 or so years ago at around the time of the Crusades – a geological blink of the eye – you could have watched as Rangitoto lit up the night sky, spewing forth lava and ash. In fact, people were there to bear witness: footprints have been found between the

layers of Rangitoto ash on the adjoining Mototapu Island.

In its 250,000 year existence the Auckland volcanic field has accumulated around 50 volcanoes. Will it host more eruptions? In geological time, count on it. But when, where and how big will the eruption be? These questions are less tractable.

One problem is the age of the field: a quarter of a million years old is too short a sampling time for good statistical inferences to be drawn. A second problem is the apparently haphazard manner in which new vents pop up,

making predicting when and where the next will do so at the frontier of hazards problems. The third major problem, says Cronin, is Rangitoto.

“[The Auckland volcanic field] pattered along producing all these little eruptions, and suddenly, wham, it produces Rangitoto.”

Rangitoto’s lava output is more than half the entire volume of the field, dwarfing, by a factor of up to 50-times, the next biggest cone, One Tree Hill, and the composition of its magma is very different to that of the numerous small basaltic cones. The magma



» eruption, which rendered the island uninhabitable for a period of years.

In the oral tradition, large rocks fell all over the island, red-hot pyroclastic flows, and mud and debris poured down the valleys, and either 7000 or 1007 people died (toghavitu can be translated in either way).

Savo remains active, and hazard planning needed to be set in place. But the people of Savo, with their own customs and language, were suspicious of the plans laid down for them in the far-away capital of Honiara, and, as Cronin found, the island itself was in the grip of unrest.

It fell to Cronin on behalf of the UNDP to be the mediator. He organised reciprocal visits: the Savoans to Honiara; the Honiarans

to Savo. He helped conduct village workshops which drew on the islanders’ own store of cultural knowledge – which Cronin found was considerable.

On Savo there were indigenous words for phenomena he knew in technical terms as lahars, ash eruptions and pyroclastic flows. There were areas that were tapu or *tambu* – “you don’t go here, you don’t go there, because it is dangerous” and areas of refuge.

Even the signs of a coming eruption are part of the lore. “They know the cyclicity. They know the signs in the crater: the vegetation begins to die or water starts ponding. They know that when your island shrinks, the coast erodes, you are ready for your next eruption.”<sup>1</sup>

1. One of the projects Cronin began during this period was a investigation of colossal explosive eruptions – eruptions large enough to disrupt the global climate and disperse ash as far distant as Antarctica – originating within an arc of volcanoes close by Tonga. Several of these eruptions have occurred in the past 6500 years. Currently Cronin is supervising two Macquarie University-based PhD students who are working on this topic. He is also currently a part of two community education programmes in the Solomon Islands.



Inspecting food crops on the island of Paama in Vanuatu after an ashfall from Lopevi volcano.

in the cones has come from deep in the crust relatively directly; Rangitoto's lava has taken its time on the way up.

What, then, are the best ways of working out what will happen? One is to examine the history of older volcanic fields that offer good analogies. For Auckland, a good proxy is the Korean Island of Jeju. Like Auckland's landscape, Jeju's is pepper-potted with small volcanoes, and, like Auckland, it has one volcano – Halla-san, a massive central cone the equivalent of many stacked Rangitoto volcanoes – that is notably different.

The similarities between the places do not stop there. Both have similar levels of infrastructure – “well maybe Jeju has better highways”, says Cronin – and both contain densely populated urban areas.

The differences? Age – the Jeju field is 850,000 years old (the most recent eruption happened 1000 years ago) – and the ready availability of data. Being without surface streams, Jeju is reliant on artesian water and bores have been sunk at numerous locations around the island, the resulting rock cores showing the island's eruptive history in great detail.

“Cores this big,” says Cronin, extending his arms as if to encircle a telephone pole.

Upwards of 5000 cores have been drilled around the island, some to depths of 600 metres plus, taking in the entire volcanic pile and the oceanic sediments beneath. What is more, the Koreans have proven willing to drill more strategically located cores at sites suggested by Cronin and his coworkers.

Cronin heads a consortium of researchers whose numbers include statisticians, economists, planners from Massey and Auckland universities, GNS Science, Kestrel »»



One day the Auckland volcano field will spring to life once more.



Morris Harrison of the Vanuatu Department of Geology and Mines looks on at explosions from the new island formed in Ambae's lake Vui in December 2005. Photo by Hannington Alatua

Cronin developed a long-term interest in the role of traditional knowledge and oral tradition in planning and education for volcanic hazards, as well as becoming, as he puts it, “a fervent convert to the Oxfam principles of participatory rural appraisal”, not just for volcanic events, but for most forms of natural disaster. “So I got into that for a few years, and we did this kind of work in the Solomons, Vanuatu, Fiji, Niue and Kiribati – so many different islands.”

Those links with the South Pacific remain intact, and even now Cronin is liable to run away, Indiana-Jones-like, to some remote island when something volcanologically interesting is happening.

And Cronin has other reasons to remember his time with the United Nations Development Programme.

While in Savo, Cronin was kidnapped and held for ransom. He was rescued, he remembers, by the intervention of a posse of armed, naked, body-painted warriors »»

» Group Ltd and Market Economics Ltd / New Zealand Centre for Ecological Economics. They are funded by the Foundation for Research, Science and Technology for \$966,000 over three years.

For their part, the Koreans – being Gyeongsang National University and the Jeju Special Self-Governing Province – have agreed to \$3.8 million in in-kind support over the life of the project, which officially began in April 2009. In fact, says Cronin, the Koreans are contributing considerably more than this, and, personally speaking,

they have proven extraordinarily generous and accommodating hosts.

Jeju takes great pride in its landscape – the island’s central volcano and its network of lava tubes form part of a UNESCO World Heritage site – and its distinctive culture. Cronin talks about the network of dry stone walls that crisscross the terrain, the Easter-Island-like ‘grandfather’ statues (a miniature sits on a window sill in his office), the island’s popularity among mainland Korean honeymooners, who often appear in matched dress (Jeju attracts around four million tourists annually), and the

seafood, for which Jeju is renowned. He runs through his Powerpoint show.

Then he pauses. The images are of a sequence of drill cores left at the side of a road. See? So many cores have been taken around Jeju that they can be casually abandoned. Can you believe it?

For a geologist used to inferring rock sequences from surface exposures this is extraordinary. Jeju – the Auckland volcanic field’s older sibling – stands to tell him and us so much.

Cronin is ebullient. “I feel like a kid in a candy shop.” ■



Members of the research team at Mount Eden, from left: Associate Professor Ian Smith, Auckland University; Dr Jan Lindsay, Auckland University; Dr Karoly Nemeth, Massey University; Associate Professor Shane Cronin, Massey University; Michele Daly, Kestrel Group Ltd; Greg Holland, Auckland Regional Council. Groups such as the Auckland Engineering Lifelines Group, the Auckland Regional Council, the Earthquake Commission and the Ministry of Civil Defence and Emergency Management are expected to draw on the research team’s findings when developing volcanic-risk management strategies.

» from a neighbouring village accompanied by the quick-thinking – and loudly cursing – Geordie colleague who had raised the alarm. Cronin (who, unbeknownst to his kidnappers, had been carrying the UNDP cash they wanted on his person) was left on the beach together with a large pig and baskets of yams and kumara as a conciliatory gesture.

It was while based in Fiji that Cronin caught dengue fever – to his frustration he was left bed-bound and could not view the cyclone then raging outside.

He became fluent in pidgin English and Bislama, the *lingua franca* of Vanuatu.

Then he shifted to Germany.

In Germany, as an Alexander von Humboldt Fellow based at the University of Kiel, his first task was to translate his supervising professor’s volcanism textbook into English. At the time, he spoke some German, but nowhere near enough. “I went in the deep end,” says the now



Lava being deposited on Hawaii’s Big Island in July 2003.

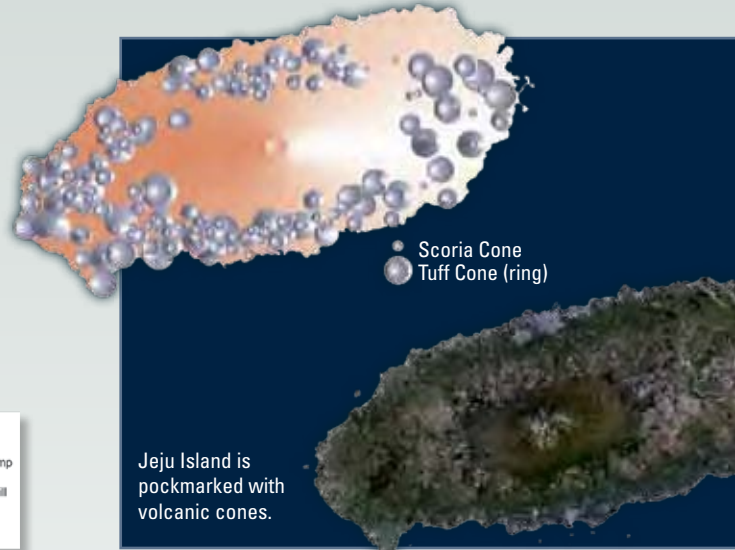




**The Auckland volcano field**

**Key**

- Volcano
- \* Obliterated volcano
- Ash, lapilli, tuff
- Lava, scoria
- Extent of volcanic deposits



Jeju Island is pockmarked with volcanic cones.



The central crater of Halla-san, Jeju Island's dominant volcano and its Rangitoto equivalent.

Photo: Christian Mehlführer

conversationally fluent Cronin.

Otherwise he was able to use his time in Europe to visit such well-known volcanic sites as the island of Gran Canaria and Iceland, where he helped a team of geochemists find the rock formations they wanted. “Like the Rangipo Desert [near Ruapehu], just bigger,” is his description of Iceland, and no challenge to someone used to inferring the geology of jungle-obscured landscapes.

What Germany taught him most importantly, he says, was the art of building a research group of coworkers, postdoctoral researchers and postgraduate students. It was knowledge he would draw on when he returned to Massey in 2003.<sup>3</sup> He had 18 months worth of funding. To sustain his work beyond that, he would bring in more.

He began work on a proposal to the Foundation for Research, Science and Technology for a six-year programme he

dubbed *Living with volcanic risk*, enlisting a team that had in its ranks economists, statisticians, Māori studies experts, geologists and soil scientists. Focusing on the most likely suspects, Ruapehu and Taranaki, he proposed to provide “probabilistic hazard forecasts and new risk management tools in order to reduce socioeconomic losses from volcanic events to New Zealand”.

It was a good proposal, but ambitious; in his heart of hearts, Cronin thought the prospect of funding was slight.

The phone call that set him right came through when Cronin was standing on the summit of Ngāuruhoe .

“You got it.”  
 “How much?”  
 “You got it.”

The project had been allocated \$4,248,000 for 2004–2009 from the Public Good Science and Technology Fund.

Cronin soon had another project in mind. His career had effectively begun with the lahars of 1996. In late 2004 the crater lake was overfull and another major lahar seemed imminent. This time Cronin wanted to be poised to document every aspect of its behaviour and consequences.

Together with Vern Manville of GNS Science, Cronin successfully bid for a \$720,000 three-year Marsden Fund Project.

Cronin knew that the existing state of lahar science was inadequate. Numerical models existed around which real world

3. Volcanic Risk Solutions, the Massey-based multidisciplinary centre for applied volcanic hazard and risk management research, now numbers more than 20 staff, 13 based at Massey, the remainder at other New Zealand, Australian, German, British and US universities. Postgraduate placements with the centre are highly sought after.

## Going downhill fast

**W**hen a volcano has the right combination of height and latitude to sustain glaciers and permanent snowfields, this brings a new menace: snow-rich lahars. Lahars – rapidly flowing mixtures of rock debris, mud and water – are in themselves a cause of destruction and loss of life. Add snow, and they gather volume and acquire new physical characteristics. And because, as Cronin puts it, snow-rich lahars “happen in places you can’t get to generally” and are hard to identify in the geological record, first-hand studies arouse great interest.

The Ruapehu lahar of 2007 has been a goldmine of data. Among Cronin’s findings have been the amount of snow a lahar can entrain – 60 parts snow for one part of crater lake water on the upper slopes of Ruapehu – and the frightening speed at which the lahar can move while in this semi-solid phase, lubricated by a layer of water at its base.

The 1996 lahar that made Cronin’s name had ratios of snow to crater water of 3000 to one.

Downstream, Cronin’s research has revealed a more nuanced picture of how lahars behave. For example, a lahar can consist of

a number of distinct phases carrying varying amounts of sediment; pulses of material can travel along the lahar’s length, sometimes separating out, sometimes overtaking one another; the model for sediment deposition is not simply drag-and-drop – throughout its length the lahar will be dynamically picking up and depositing material (a process Cronin and co-workers have computer modelled with some success).

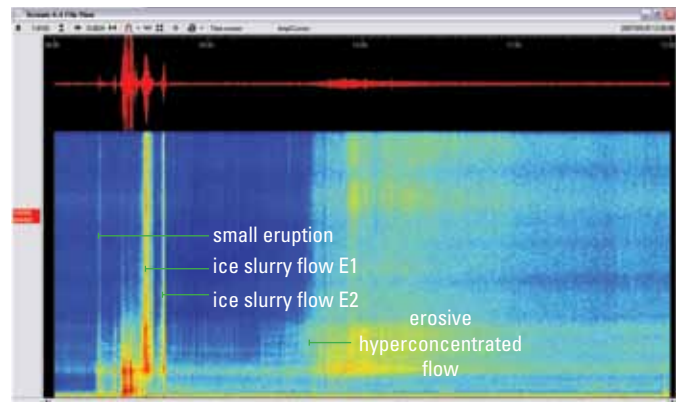
Snow-and-ice lahars are a real and present hazard. In North America’s Cascade mountain range, Mt Rainier and Mt St Helens have generated snow-and-ice lahars, and many other volcanoes in the range are good candidates.

Globally, the worst lahar-related disaster of recent times occurred in 1985 when a relatively small snow-and-ice lahar from the volcano Nevado del Ruiz Colombia created a mud flow that engulfed the town of Armero, causing 23,000 deaths.

Cronin’s findings have been incorporated into the Ruapehu early warning system. ■



The summit of Ruapehu showing, at left, the breach of the crater lake, the source of ice slurry flow E2, and, at right, the source of ice slurry E1.



A seismograph reading shows the eruption and two ice slurry flows. One of the lessons Cronin has taken from the 2007 lahar is how useful seismograph readings can be in giving a measure of the volume of sediment passing by.

» decisions could be based, but they were based on over-simplistic assumptions.

Using a light plane and LiDAR (Light Direction And Ranging), the upper 62 kilometres of catchment surrounding the anticipated path of the lahar would be overflowed and mapped to a resolution of 10cm. Pore- and load-pressure cells would be embedded in the bedrock of the river bed to measure the height and pressure of the overlying flow. Seismographs would be sited alongside the Whangaehu catchment to measure the noise and ground vibration caused by the moving slurry of water and rocks.

But Ruapehu was fickle. Summer on summer, the crater lake rose to the point where a lahar seemed near, then subsided.

“We got sick of waiting. We had three years of the Marsden fund to have this lahar and time was ticking by and it wasn’t coming. So we started working in Indonesia.”

The volcanoes he chose were Semeru and Merapi in Java, both of which have been erupting almost continuously since 1967; every wet season they unleash lahar after lahar down their slopes.

These volcanoes were the test bed for the Ruapehu instrumentation (cabled instruments, for example, were swiftly destroyed) and the site of a close-ish call.

Cronin was somewhere on the upper slopes of Merapi when the volcano disgorged a pyroclastic flow, which he heard and felt in the heavy mist but could not see.

For someone who is the father of two children and consequently puts himself in the class of volcanologists who are “less enthusiastic about lowering themselves into red hot craters and are more enthusiastic about developing remote sensing techniques” that was close enough.

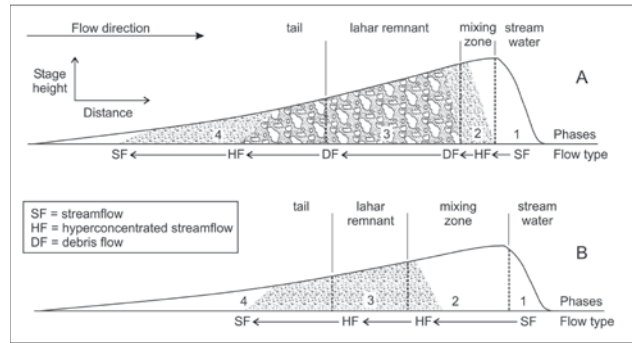
When Ruapehu let loose with its lahar in 2007 Cronin and his team were ready. As the front of the lahar passed down the



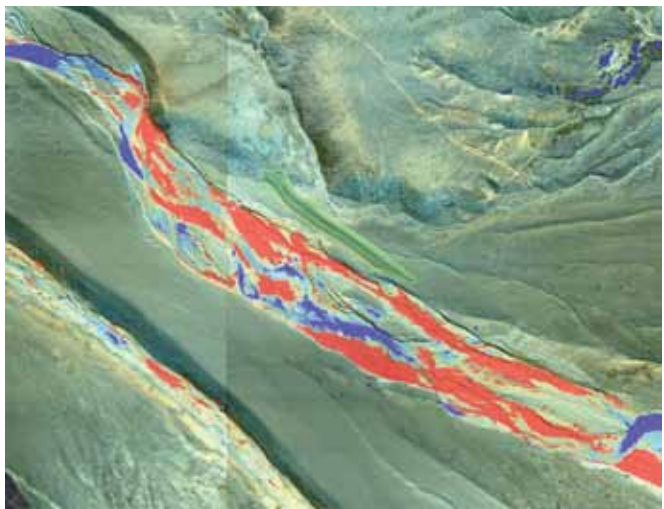
3500 people were evacuated during the eruption crisis on Ambae, Vanuatu, in 2005–2006. Cronin and Dr Karoly Nemeth helped the authorities manage the crisis and are heavily involved in research to improve volcanic crisis response around the South West Pacific.



The two snow slurry slides took with them 180,000 cubic metres of snowpack.



Model for Ruapehu lahar interaction with stream flow.



In the upper river bed of the Whangaehu the red areas show where material has been deposited, the blue areas where material has been entrained. The image combines before and after LiDAR mapping.



Having combined with the water of the Whangaehu River, the 2007 lahar sweeps towards the sea. On December 24 1953 a Whangaehu lahar washed away a span of the railway bridge at Tangiwai. Minutes later an overnight express train plunged from the bridge, with the loss of 151 lives.



Lava lake at the Marum crater on the island of Ambrym in Vanuatu.

Whangaehu River he and his team were there to observe, and the instrumentation, fine tuned in Indonesia, worked well. Later, he would overfly the path of the lahar, with a visiting UK student who happened also to be a hobby pilot.

From a one-day event the team gathered enough data to sustain five years of academic papers.

Few New Zealanders have much idea of how much disruption and destruction even a moderate scale eruption could wreak. Ruapehu's eruptions in 1995 and 1996 were spectacular and certainly a cause of serious inconvenience, but in the scale of what might have been they did not amount to much.

We should count our good fortune. Certainly Taranaki is behaving in a way that is out of character: a volcano that has erupted on average once every 90 years – sometimes violently – has been quiet for two centuries.



## Bang, bubble or fizz?

For the project *Living with volcanic risk*, Cronin and his team have focused on the scenarios likely to arise from eruptions of Ruapehu, Ngāuruhoe and Taranaki.

Of these, Taranaki is the wild card. Cronin knows the mountain well: since spending his BSc honours year investigating the lava domes – intact and remnant – that encase its summit he has spent many months with students and co-workers on its slopes.

The domes – mound shaped protrusions of highly viscous lava formed over time – seldom remain intact; once in a geological while, vast, hot, block-and-ash flows roar down the sides of Taranaki, inundating areas many kilometres out onto the surrounding plains.

These cataclysmic flows will often be preceded, in a kind of clearing-of-the-throat way, by small explosive pumice eruptions.

Then there is the remaining item in Taranaki's repertoire: large explosive pumice eruptions, the last of which was in 1655.

In short, Taranaki is quite capable of serving up “bang, bubble or fizz”, as Cronin puts it.

How will Taranaki behave in the future? Probably in much the same way that it has in the

past – a past that is set out in layer on layer of volcanic sediments and deposits.

Close by the mountain, each eruption stands some chance of wiping out the evidence of its predecessors, so Cronin and his PhD graduate Michael Turner have developed eruption chronologies by moving some 25 kilometres distant and turning to cores taken from lake-bed sediments. In one four-metre core, representing the course of 8500 years, the pair have found evidence for 103 eruptions.

Taranaki erupts so often that Cronin's colleague Associate Professor Mark Bebbington has calculated the rough chances

of Taranaki erupting in any 50-year period as approaching 50/50.

But what types of eruption do the ash layers represent? For a while it was difficult to distinguish between lava dome and pumice eruptions until Turner, in an inspired moment, looked at the oxidation of the iron content: dome eruption ash deposits are less oxidised than those from pumice eruptions.

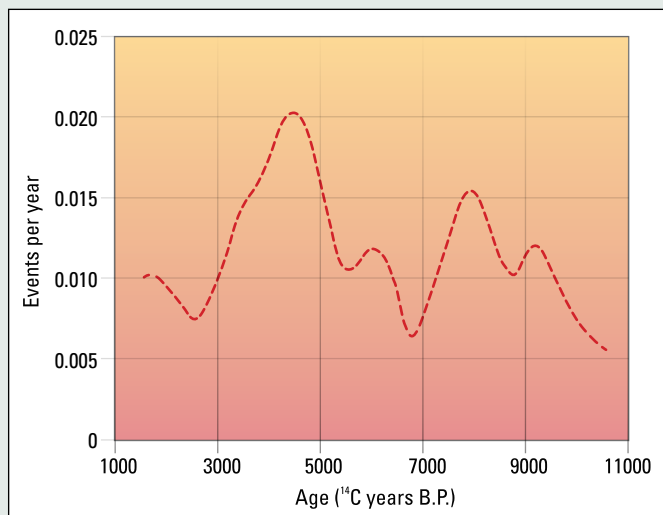
Then there are other indicators – investigated and identified by a succession of Cronin's graduate students – that tell of the type of magma that has fuelled an eruption. These include the forms of the minerals feldspar and hornblende.

By separating out the kinds of eruption and the sources of magma, Bebbington, Cronin and Turner have identified certain periodic cycles.

The eruption pattern, for example, is generally one of small explosive pumice eruptions leading to lava flows and dome building and finally a period of repose sometimes accompanied by the release of gases, before the cycle repeats.

Similarly, the recharge of magma beneath the mountain is cyclic.

Combining what they know about the cyclicity of eruptions and magma recharging enables the group to set the odds in a much



Overall time-smoothed eruption rate for Mt Taranaki. M. Bebbington

» Cronin knows what happens when volcanos behave badly. In fact, he is the sometime South Pacific correspondent at large for one of two e-mail bulletins that go out weekly to volcanologists worldwide.

He brings one up on screen. In Indonesia, Rinjani Volcano on the island of Lombok is sending ash plumes to a height of 4km. Sangay in Ecuador is erupting, as is Sarychev Peak on the Kuril Islands and Chaiten in Southern Chile. Sixteen different conspicuously active volcanoes are listed.

Today New Zealand is absent. It won't be always. ■



Dr Anke Zernack has worked on debris avalanche flows from Mt Taranaki.



German postgraduate Anja Möbis is working on Tongariro's and Ruapehu's volcanic deposits.

more sophisticated month-by-month way.

Taranaki has been napping for an unusually long time, but the group can say that at the present point in the cycle it appears that the chances of the mountain erupting are, if anything, diminishing – though at some point in future they will begin to rise again.

If an eruption is in the offing, Taranaki is likely to let us know. As fresh reservoirs of magma intrude beneath the mountain there will

be earthquakes, slips from around the summit and episodes of vent clearing.

One of the possibilities, a lava-dome eruption, could continue for many years or decades.

What any renewed activity at Taranaki or Ruapehu or Ngāuruhoe might mean for us is the other major component of the *Living with Volcanic Risk* project.

Cronin and his colleagues, particularly Garry McDonald of the New Zealand

Centre for Ecological Economics and Market Economics Ltd, and Professor Anton Meister (Applied Economics), have conducted a number of sectoral analyses and regional analyses projecting the economic loss for various eruptive scenarios.

Even a relatively small ash eruption would severely disrupt energy distribution, agriculture and air travel. ■



The summit of Mt Taranaki and lake core sediments showing ash layers.



Dr Emma Doyle with postgraduate research student Susan Cole. Cole, who hails from Britain, is working on the internal dynamics of lahars.



Research Officer Dr Gert Lube, Associate Professor Shane Cronin and research Officer Dr Jon Proctor.



## digging into the past

**Professor Susan Mumm** talks to Jennifer Little.

*Reprinted from DefiningNZ, August 2009.*

**K**nowing how to castrate and dock lambs hasn't proven a particularly useful skill in adult life for Canadian historian Susan Mumm. Nor has knowing how to demurely exit a sports car while sporting a mini-skirt, or how to peel a variety of fruit with a knife and fork – the skills conferred by a Georgia finishing school.

But her early experiences may have influenced the direction of her academic work: following the lives of women constrained by the social, economic and religious mores of their time.

Mumm, 48, the university's new Pro Vice-Chancellor of the College of Humanities and Social Sciences, has written widely on the international trafficking of women in the 19th century as well as about the brothels, convents and hospitals of the Victorian-era.

She grew up in the 1960s, one of six siblings on her parents' Saskatchewan farm. It was a simple life – “no indoor toilet, no appliances like washing machines” – but not without its attractions. “I ran wild and unsupervised across huge acreage. I had freedom that children of today can't imagine.”

Her parents, struggling farmers, who had left school at age 12, were avid readers and valued education. But certain things were assumed: “We were not the sort of people who go to university, not the likes of us – that was the message.”

Mumm left the farm at age 15 to board at a “crazy” school run by British ex-missionaries near Moose Jaw. She says the education was good but although her teachers noted her intellect, no one suggested she take it further.

After a brief and incongruous stint at finishing school she returned to Canada, where she accompanied a friend who had enrolled in an economics night class at the University of Saskatchewan but was afraid to go onto the campus alone.

Mumm had an epiphany while standing in the campus bookstore. “I felt very intimidated but I stood around listening to what people were saying and watching them, and I had this blinding revelation. These people didn't look any smarter than me, they didn't sound any smarter than me. I thought about it for a few minutes and said to myself ‘maybe I'm smart enough to go to university.’”

She enrolled in a double bachelor in English and history and, after a fretful first six

weeks, the feedback from her first set of essays confirmed she was indeed in the right place. Then, purely because other courses were full, she walked into a lecture on the condition of women in the 19th century for a paper on British social history.

“The lecture spoke to me. I could immediately see my mothers and sisters and, although their legal standing was different, many of the conditions of their lives were exactly the same.”

From this she learned that the past has a resonance that profoundly affects the present and, on a personal level, that university can be a “transformative” experience.

She won a Commonwealth scholarship to study at the University of Sussex before beginning her academic career as an Assistant Professor at York University in Toronto. A decade at the Open University in England and two years at Mount Saint Vincent University in Halifax, Nova Scotia as Dean of Arts and Science followed.

She has focused her research on “women who find cracks of opportunity in a world

### ... you can't be a historian without thinking about the roots of our society ...

of constraint”, delving into the lives of those who lived and worked in convents, brothels and charitable women's organisations.

She has published three books – *Religion Today: A Reader* (Ashgate Press/Open University 2002), *All Saints Sisters of the Poor: An Anglican Community in the Nineteenth Century* (Brewster & Boydell 2001), *Stolen Daughters, Virgin Mothers: Anglican Sisterhoods in Victorian Britain* (Leicester University Press 1999) – and edited the 19th century volume of *The Greenwood Encyclopedia of Love, Courtship and Sexuality through History* (Greenwood 2008).

Her numerous published articles include *Making Space, Taking Space: Spatial Discomfort, Gender and Victorian Religion* (Project Canterbury 2007), in which she investigates the extraordinary (to modern perceptions) controversy surrounding the establishment of 90 communities for women in the Church of England between 1845 and 1900. Convents were depicted by authorities as “indescribably hellish prisons” and “dens of infamy” during a time when the notion of a separate space where women could gather

was scorned, and convent and confessional pornography flourished.

Mumm, who served on a British government committee for the suppression of people trafficking, is proud to say an article she wrote on 19th century white slavery and its modern manifestations, which was re-published in the *Independent* newspaper, has transformed lives.

A man contacted her after reading the article and, on her recommendation, left his fortune to Anti-Slavery International, a charity and lobby group. “Probably hundreds of children have been released from enslavement as a result.”

Modern people-trafficking is driven by the same basic forces as it was in the 19th century, she says. “If you take poverty, restricted choices, a desire for a better life and quite a high level of naivety regarding promises of marriage or a better job somewhere else – these are the weapons. Desperate people take a gamble; they have nothing to lose.”

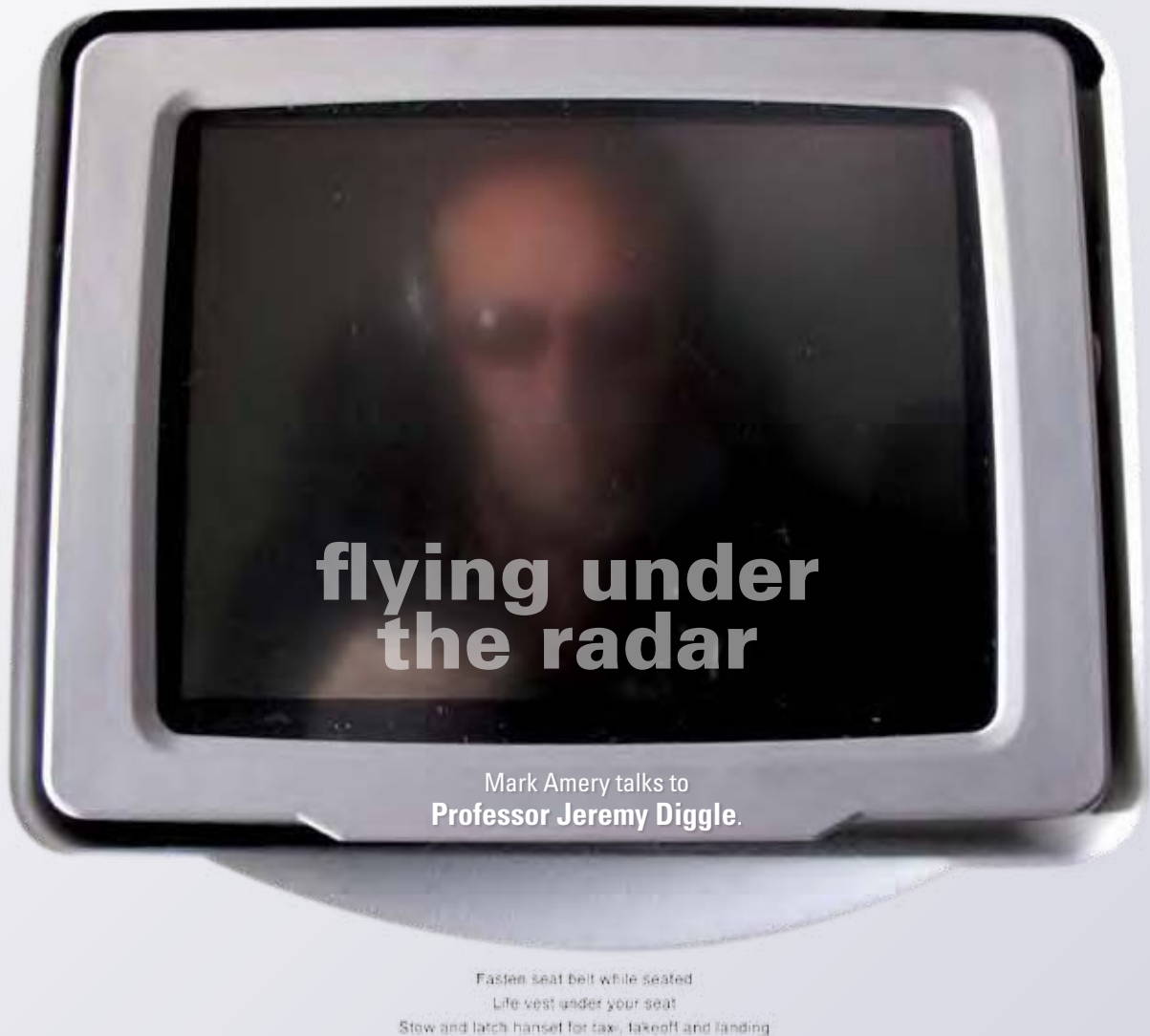
She is currently three years into researching a book on the history of the Young Women's Christian Association in Britain and the Commonwealth from 1855-1920, an organisation that grew out of need. “There was a real lack of space in urban areas for women

to stay. The YWCA took off like a rocket, with more than a million members by 1900.” It provided accommodation and security for otherwise vulnerable single female immigrants arriving for new jobs in port cities around the Commonwealth. She says she is the first person since 1906 to have been given unfettered access to the organisation's comprehensive archives in Coventry.

Mumm, married with two adult sons who live in Canada, joined Massey in February. She describes herself as “a women's historian” rather than a feminist one. “I'm certainly a feminist in my own life and opinions. But I have to try not to impose my views on the people I study.”

When not immersed in research and overseeing the college's 364 academic staff, 9200 students, nine schools and six centres across three campuses, she loves reading murder mysteries and gardening.

“I love to dig. In Western society, which was agrarian for centuries, you can't be a historian without thinking about the roots of our society and how many other spades have gone through the soil.” ■



**T**hose who can't paint, teach – this has to be one of the most blatantly incorrect adages around. Indeed, a quick scan of the tertiary art school landscape in New Zealand shows it to be populated by some of our most celebrated artists.

The strength of Massey's young art school in Wellington is inextricably linked to the talent and high profile of many of its artist-teachers. For sure, acclaimed artists are a marketing dream in pulling in students, but they also provide an example to those they are teaching. Only an artist can truly empathise with what another artist is going through.

Yet being well-known doesn't hold a candle to teaching experience. A case in point is the man at the head of the School of Fine Arts at Massey – British painter and teacher Jeremy Diggle.

Diggle has decades of experience as a teacher, yet as a practising artist for more than 30 years he's a self-proclaimed enigma. Like the secret successor to the American Stealth aircraft, the

Aurora, which Diggle once painted, he's happy flying under the radar, quietly exploring ideas in different spaces with different technology, with little concern for public profile.

"I'm very much an anonymous artist, by choice," says Diggle. "A lot of my works are in a sense secret projects. A lot of people I meet for the first time in institutions say, 'but you don't do anything...!'"

"I mean, many people know me in the UK, but from the very earliest time when I was at art school I've had an objective to be completely out of the commercial gallery scene, and be anti-exhibition. I'd show work, but not necessarily in a conventional way."

Put it this way: not only has Diggle never had an art dealer (traditionally the hallmark of being an established professional artist), he has never sold a work of art – even though he began as a painter. That might seem unconventional in modernist terms, but it will ring strongly with contemporary artists coming through whose practice also doesn't easily fit in the art market. Diggle's practice reminds you

that the dealer art gallery is a relatively modern capitalist concept, with art having a far longer lineage in the public domain.

"It goes hand-in-hand with the fact that I refused to go into the housing market. It's a sort of bonkers socialist principle: no property ownership whatever. I mean, I have some friends' work, which is gifted or exchanged. But really good art, as far as I'm concerned, should be in public ownership."

An image capture of Diggle's art practice and research areas at any one time suggests a rich and fractured – nay, eccentric – content, reflective of Diggle's interest in experimenting with visual language in order to create complex narratives. The hypertext structure of the online world suits him well; his adventurous, inquisitive mind ensures his world is one under perpetual reconstruction.

From reenacting the Apollo 11 moonwalk to studying the painting techniques of Vermeer, Diggle's work as an artist and researcher defies easy classification. "I suppose I'm deeply anarchic," he comments to me at one point. Yet







BAe Harrier burial, Capel Swan, Pembrokeshire, September 15th 2004. A hole in the ground. Diggle



BAe jump jet burial documentation, *Bloomberg 2004*

on consideration there are very strong threads running through his art and research work.

Diggle’s international reputation rests with being at the vanguard of using new technologies, from video in the 1970s to holography and multimedia. Ultimately, however, he says he is most interested in how we tell stories or construct narratives. Most recently he has returned to painting (the medium he originally trained in at St Martins School of Art and The Royal College of Art), recognising it as the most sophisticated human visual language of them all.

“I’ve always had a competency in working with or developing technology, but at the end of the day they’re vehicles for the same old communication. I’m interested in the same questions, like ‘How do you still tell this story?’ Of what it is to be human, to have emotion, or whatever it is. To have insight, a vision of some kind – how do you share that through the oldest form, one older than our language even?”

Diggle also gets excited on this topic in connection to teaching.

“Stop thinking about impact. Stop thinking about your manufacture. Stop thinking about the fact that you don’t have the skills to deliver this. Stop thinking about who’s going to deliver it for you. Start with: what is it? What does it say? In real time and space? And is it worth saying? Is there something you can say which is about more than about the self, for God’s sake? Can you objectivise? If you’re going to work with a strong subject or content, can you work out an objective and get some distance to it?”

Diggle is interested in the construction of myth and stories around art, and has often put this into practice. This means, for this writer at least, it can be a little difficult being sure whether all of Diggle’s past projects existed or not.

“I became interested in false documentation, so that what you do after the event is you construct something; even about a work that may not ever have existed. You give it plausibility or credence by playing the game of documentation. I met an artist several years ago who came up to me and said ‘I really like your work’ and I was thinking, ‘It never existed!’”

Diggle’s interest in how stories are constructed has left him feeling that many contemporary artists rely too heavily on documentation – that the photographs of a performance or action become more important than the actual art.

“A lot of my work has no existence whatsoever in terms of documentation; it happened. So there’s no evidence. I think it undermines the performance. Why perform if you’re going to document it? It’s a live action.

“Most performance artists conceive the documentation as fundamentally more important than the event itself. It’s like some kind of evidence for the ego rather than a direct communication with the audience at the time. I believe in having a script, but as to the performance itself, you’ve got to be there.

“Most good art is actually a performance. It’s either a record of a performance, an enquiry through performance, or it’s a performance itself. The odd piece of documentation is an evidence trail for funding councils, but actually you can’t replicate it.”

Perhaps the most audacious of Diggle’s experimentations with documentation, storytelling and audience was an action in the 1980s at the height of the Cold War. He buried a section of a Harrier jump jet in the Welsh countryside, in a fake construction of a military silo. Yet whether the action was real or not is something I have to take his word for – documentation can lie.

Diggle was interested in how news of the story might trickle out and, given military spy surveillance at the time, to whom.

“I created a lot of work about militarisation, and I did this burial of this aircraft which I told no-one about – except I had a few pub conversations to ensure it became a bit of an urban myth that there was this buried aircraft in Wales. Then in about 2004 some curator got in touch with me and said, “Did you bury an aircraft in Wales? Have you got any documentation?” Eventually I said I’d make some documentation if they wanted me to, so I ended up making some which ended up in this fairly big show about obscure artist interventions.”

Actions like this and the fact Diggle doesn’t crave a big public profile don’t mean audience isn’t important to art, he says. His work is often an exploration of how an audience is essential to an artwork – just in ways you might not always expect.

“Art without an audience is therapy – or just some strange psychological behaviour. The work I make is for an audience, but it’s about what the audience brings to it rather than what they get – it’s not about the presence of the artist. I’ve been very anti the whole cult of personality of the artist. The art literally has to stand and communicate without someone stood there all clever explaining or subtitling it.

“Even when I do a painting I do so with an understanding that it has a tiny audience. The whole thing about painting is that you have to go to the painting to see it, rather than a reproduction. A painting is a reflective experience, usually on a one-to-one basis. You may be painting for an audience of 1000 people in your lifetime with that one image. Even if you’re talking mass exhibitions, it’s tiny.

“So paintings are about a very particular relationship in time, and they’re also about the longevity and complexity of ideas and how they can change over time. What you put down in a painting or in any work of art should ultimately develop and mature and take on varying interpretations depending on the time.”

Diggle still does performance works. This year he’s been finding desolate country spots to do reconstructions of the Apollo 11 moon-landing, investigating the sequence of 133 photographs taken on that famous moonwalk.

“I take the photographs in the same sequence in an attempt to try and understand what it is to arrive in such a place for a very short period of time.

“I did do half of a moonwalk live to a conference, but they didn’t know what they were watching. What I was talking about to them was the act of rephotographing, a classic interest of photographers. The audience were actually witnessing me talking about the rephotography of the moon photographs during the process of me actually, in the auditorium, re-enacting part of the original actual moon walk, and taking some of the photographs as part of the original action. I do stuff like that which enables me to then create narratives.”

This may sound slightly mad, but on closer consideration Diggle’s actions are quite rational experiential explorations of the way we construct stories about our world through the lens of technology. Much of what we treat as memory is the image of it made for documentation (photographs and film); and this documentation was constructed from a particular perspective.

The first moon landing was one of the most broadcast events, featuring some of the most enduring visual images of the last century. Yet it’s also the most inaccessible to actually experience, with the photograph a stand-in for that experience.

“I’m trying to understand the relationship to the mother vehicle, the lunar lander – understand the physical operation of space, the scale. Coming to a realisation of things like the absolute terror, because when you physically reenact you realise for instance three quarters of the time they were in touching distance of the lunar module.”

Diggle is interested that most of the photographs were taken by Neil Armstrong, and yet he’s seen as the protagonist. The photographer becomes the subject – as if we insert him into the pictures. In Diggle’s reconstructions (which he plans to publish) he gets the Buzz Aldrin stand-in to take the photographs – to show us what we never see.

“So if Buzz Aldrin has a camera, what did he see? I’m not dressed up in the gear or anything, this is just two guys on a beach in the middle of nowhere! It’s the construction of narrative I’m interested in.”

The Apollo missions didn’t occur in feature-length movie packages. The world witnessed events unfold over several days. Diggle is interested in how art and stories operate over time (as the Harrier jump jet work more than indicates).

A Diggle narrative project in 2007 tried to create a fictional story in real-time employing a particularly interesting form of false documentation: the Apollo mission ‘insurance covers’.

“When the Apollo astronauts went into space they couldn’t get life insurance, so what they did as crew was get 100 first day stamp covers made for the mission, signed them, had them stamped and locked them with the mission controller to give to their wives to sell in the event of their non-return. These are known as insurance covers and are immensely valuable.”

Diggle put together an exhibition for the Exeter international arts festival, of purportedly signed insurance covers. For the opening he got a data projector and web link set up, and commenced a daily blog by a fictional character called Harold Warnerford who was obsessed with the mission. Warnerford in real time started trading the signatures of the astronauts on eBay, and slowly started to dismantle the credibility of the objects in the exhibition as a consequence.

“That piece of work was an experiment in creating stories in the moment. It was an experiment in the space between oral narrative and writing. I was interested in this transition from the oral narrative tradition to hypertext narrative.”

Diggle has just had an oral transcript from another project published: a description he made live at a conference in the UK of going to philosopher Ludwig Wittgenstein’s hut in Norway – though he’s never actually been there.

Friends gave him a fragment from the hut and made a stereoViewmaster set (the device for viewing 3D images on paper discs that became popular as a toy in the 1970s) of images of the trip to the hut. At the conference he looked at the series of images for the first

| Moon walk, 2009



| Aldrin to my Armstrong  
Apollo 11 Moon walk, 2009



| portrait of Howard Warnerford, 2007  
www.apoll8.info





| pearl with eyes closed, 2007



| portrait of the artist as mirror, 2007

time through a Viewmaster (so his eyes were immersed in the experience the whole time) describing the journey aloud from what he was looking at.

In this way Diggle explored the experience of going somewhere for the first time through documentary technology, while also expressing his interest in Wittgenstein's belief in language as woven into the fabric of life experience.

"It was also a way of trying to describe what I did understand of Wittgenstein, about the meaning of things in the world. The complexity of making meaning and defining meaning through precise words; and about the relativities of being there. Optically I went to the hut for the first time..."

All of these projects Diggle has conducted as an artist, but as an academic he also engages in pure research work. Engaging his interest in technology and narrative, a recent research project has been an exploration into understanding 17th century Dutch painter Vermeer's painting.

"I decided to get a studio five years ago to paint, and Vermeer has always fascinated me. I was setting the studio up to do some painting and I realised one day when I sat in the studio I'd actually constructed this entire tableau that could be Vermeer's studio. The table was in the right place, the curtains were in the right place, the light. So I decided to do a project trying to understand Vermeer's painting technique."

Just as Diggle explored the role of technology in the documentation of the moon-landing, he set out to look at the technology Vermeer employed.

Vermeer has been dubbed the 'first photographer' for his attention to photographic technique. For more than 100 years it has been

widely speculated that to achieve the detail he did, Vermeer employed camera obscura (in which, like a pinhole camera, light from a scene passes through a hole and strikes a surface where it is reproduced upside down).

Diggle's hunch was that this was nonsense. He took a lot of photographs with different lenses reconstructing the light, and employed camera obscura to try to nail what technology he was using.

"Despite the fact that Vermeer lived practically next door to a guy called von Leeuwenhoek, who was the world's leading lens maker and basically invented the microscope, the technology of the camera can only be a 20th century superimposition. At that time he wouldn't have taken that technological approach."

In the 1650s to 1660s, says Diggle, there was a big change in the precision of Vermeer's painting, and with it comes a change in viewing angle – from standing to sitting – and a much more photographic rendering of tonality and consistency of light. Diggle kept looking at the paintings for clues, and then he noticed the miniatures of paintings that had started appearing in the paintings' background (Vermeer was also an art dealer). Vermeer was dealing with miniaturist techniques, and the Dutch artists were now making works for small interiors.

"I think he had the aspiration that his paintings would be like fixed mirrors on the wall, so what he was painting was the mirror of the room. So that when people were in the room it's like they had a mirror with an image in there. He needed that level of accuracy."

Diggle came to the conclusion that Vermeer, in fact, started using a mirror to get a fixed point of view, which also allowed him to

control the intensity of light with a curtain, while painting in a slightly darker space.

"It becomes like copying a miniature. It reduces and moulds tonality and colour in a very subtle way. I actually think he then realised that he could use glass as a reflective surface, to allow him to fix his eye on one precise point to keep it stable while transcribing. Putting the canvas behind the glass he could see the image reflected in the glass and see the canvas at the same time. You can work incredibly accurately by seeing the image and the canvas – so you see the image onto the canvas. I think if he used a drawing device he used a piece of glass."

Diggle even thinks Vermeer may have employed a mirror or glass above his head, reflecting the image onto another sheet of glass through which he drew.

"When it comes to his masterpiece *The Art of Painting* he does one thing that probably no other artist has done in the history of self portraiture. He's painted himself with his back to the canvas, and I think he's actually saying something. He's saying, 'I paint with my back to the subject'.

Diggle's interest in Vermeer has also been personal. After 15 years Diggle has himself returned to painting.

"With Vermeer I was interested in the artist, the studio and the model; their relationship. Also, being a middle-aged artist myself confronting a return to painting I was really fascinated with what it was to be a painter. The realisation that it's an identity I suppose. You get to a certain point in your life when you think 'yes, actually, I'm a painter, that's what I do best!'

"I also have a great belief in painting as still having a fundamentally important contribution to make conceptually. I think it is the most conceptual medium, because of the reflective

quality of handmade illusion. The embodiment of knowledge through the language – which is a form of text – is a very, very complex level of conceptual meaning that you can put into a painting.

“Also the viewer has to come to it. It cannot be disseminated in any other way. You have to stand in front of it, not a replica or reproduction of it. There is no substitute for the depth of communication between one person and another by the mark. There’s something extraordinary about that. It’s like hearing the human voice, hearing someone who can really sing. It’s a direct interaction at the highest intellectual level. I get such a great hit from looking at really good painting.”

Diggle is currently navigating his way back into painting in terms of style – reinventing the language for himself. Having worked in a wide range of different styles he speaks of exploring the ‘level of language’ to use – for

him the balance between naturalism and the abstract. He’s fascinated by how painting is never meant to be photographic, but always presents a ‘plastic natural’.

“For instance in a triptych I’m painting, in the background I’m painting a Rogier van der Weyden, *Witness of the Crucifixion*, but I don’t just want to paint a copy of the van der Weyden, it’s got to be *the* van der Weyden. So how do you paint that, at that distance, in the picture? Because it’s not a slightly out-of-focus photorealism, and it’s not meant to be the copy. Yet I’ve painted a horse in front of it, which has got to be a horse. It’s not meant to be photo-real horse, it’s meant to be a naturalistic horse. If anything, the whole triptych has to be more like a van der Weyden!”

Diggle originally stopped painting on the day of the assassination of Olof Palme, the Swedish Prime Minister, in 1986, just before Palme was about to broker a Palestinian and

Israeli peace deal. Diggle had been completing a series of paintings about terrorism using Renaissance baptism images and when his hero was assassinated he lost faith in the effect a painting could have politically in the world.

“When I was in my early 20s I was highly politicised. I was struggling between wanting to take direct physical action and being a pacifist. There isn’t a violent bone in my body, yet the logic of terrorism seemed appropriate: the Red Army Faction, Baader Meinhof, all that sort of stuff. So I had this internal debate, and then I thought ‘Well I’m a painter I’ll paint it’. So I painted angry paintings of terrorist acts and tried to skirt the line between fascistic terrorism and left terrorism. I realised, with a little bit of distance and maturity, they’re both the same thing, they’re both fascistic.

“So I was having this debate and then Olof Palme got shot and he was a really, really good bloke, and I looked at these paintings and there was a real moment of ‘what’s the point?’”

Painting again, he’s started on a series of what he calls religious paintings employing some familiar narrative devices, such as the stations of the cross.

“I’ve decided to tackle some of the great religious themes as an absolute atheist. I look on religiosity as a kind of mental illness. At its highest level it’s about philosophy but at a base level it’s bonkers. Underneath, however, are some interesting narratives and I’m interested in engaging with those narratives with the audience who can read them. A lot of the great art from my culture is Christian art.”

Again, Diggle is interested in story.

“It’s a thing that is much more deeply rooted than even religion. Religion constructs itself around the human desire for story. And there are very common themes to stories. I’m quite interested in the individual interpretations. I’m interested in human suffering, which is epitomised by certain things that are in the Bible. The canon of religious paintings represent forms of deliverance. »»



| Vermeer study, 2007

“I’m interested in the power of narrative to affect people’s lives. The power of story. Not to proselytise some belief or political viewpoint, but simply the necessity of stories to make meaning, to experience the moment, whatever it is. Really, I never write anything. I tell stories and I enact stories. So a lot of my performative work is the telling of narratives.”

It’s as modern a notion to think of art as divorced from story as it is to place it in the neutral space of a gallery.

“It’s why I’m looking at the church. I’m interested in the fact that there’s this repository of narrative. The narrative has its 2000-year tradition of oral delivery within church context.”

Diggle’s interest in aural tradition must surely connect with his passion for teaching – its performance, its time-basis – but that love also comes with it a questioning spirit.

“I’ve devoted most of my life to teaching because I fundamentally believe there is enormous power in teaching, but I have seen a lot of bad practice, in various institutions over the years, which is to do with young potential being diverted by false information, false ideas of structure.”

Diggle, for example, follows the familiar model that tertiary students should, at a base level, be taught to make, to paint and to draw as basic language.

“It’s like in music, you expect students to get a grip on the basic craft. I think one of the problems with art education at the moment is that it doesn’t fully address those things.

“That’s not old fashioned – in fact I actually think it’s quite radical to teach an understanding of material. To teach levels of concentration that kids don’t have – which is why you teach drawing. A lot of people who are teaching have forgotten, or were never taught, or lost interest in the language. How do you continue to make art if you don’t have a language? I think artists should have a base set of skills with languages, with abilities.”

He also labels insane the idea that education should principally be pushing students to find their own distinct language or voice.

“At undergraduate level you should be equipping them with basic and advanced knowledge of language – the stuff to make with – and an understanding of the context of history and the range of things you can say and do. Without that you can’t push the boundaries anyway.

“I see people trying to be radical painters who don’t know one end of the paintbrush from another. You can’t challenge the academy or the canon unless you’ve got those basic fundamental skills. And they’re things you can learn; they’re not an innate talent. It’s taking that and having

something to say which is the other part of the education.

“Having your own language based on a knowledge of the discipline enforced through practice is an incredibly rare thing. It’s like the difference between being Eric Clapton and a good ‘pub’ guitarist. One of them has the touch and one of them doesn’t. It doesn’t mean one is right, but it does mean that one is significantly better than the other.

“I just long for the passion in kids’ eyes when they practise with a disciplined knowledge. You get it occasionally, but there’s an awful lot of playing at it. It’s become rather easy to not have to engage. There are so many sweeties in the toolbox, it’s possible to construct something to have apparent meaning. It’s very hard to make something that has meaning.”

Likewise Diggle along with many artist/academics has found the current requirements of an alignment between art practice and academic research problematic – and this is coming from a former Dean of Research at England’s University of Plymouth.

“When you consider art work as academic research – certainly as far as the science research model goes – it doesn’t fit at all well. There has been a lot of debate and work around definitions. It has taken many years to arrive at criteria and rules for research assessment that are generally agreed upon and accepted.

“Within the College of Creative Arts I’m co-director of research, so my job is to make sure everybody is research compliant, research audited, etcetera. My own practice is sometimes difficult to define in terms of the research definitions and I find it just as hard as anyone to describe my practice within the accepted

### Good art is not always good research, as good research is not always good art.

framework of definitions. I research stuff, I generate new knowledge, as well as producing artwork. As a result, my research doesn’t always produce aesthetic objects, but I always try to enquire into ideas through the language of painting and sculpture, or whatever it is. There is often an internal conflict between art making and research – they rarely align simply. Good art is not always good research, as good research is not always good art.

“For myself I think most art practice is an intuitive enquiry through a kind of refined craft language. It involves something hard to define, dare I say a kind of magic. Art is not necessarily trying to discover something new. It’s probably more to do with reflecting the human condition, something that is deeply emotional or deeply rooted in the psyche. The artist may be trying to understand it but it doesn’t

generate new knowledge although it often manifests itself as insight. I can say with my hand on my heart that Picasso wasn’t researching, he was making art. He was pumping adrenalin and hormones and he was partaking in a very ancient continuative dance, of feeling in the world and trying to make some sense.

“I have two positions about the relationship between art and research which conflict totally. On the one hand, as an artist, I think the connection with research corrupts art deeply. I think a lot of us capitulate to the idea of research because it generates careers and it generates a relatively sustainable stability of practice. I think a lot of people produce stuff for an exercise and an audit rather than more reflective and problematic work they may have made over a much longer period. It’s a set of rules imposed from outside by politicians in order to analyse, assess and distribute income – to create a competition where competition wasn’t required.

“My alternate position and the one to which I adhere as an academic is that it has focused artists and designers within academia and given us a set of guidelines, which have effectively enabled the translation of knowledge through a system of accountability and audit, that has made us stop and communicate more clearly about what we do. It will be interesting to look back in the future and get a true measure of the impact of the research environment upon art practice within the art schools.”

Outspoken, Diggle would also have no truck with the adage those who can’t make art, teach.

“I don’t think you can teach it unless you’ve got a practice. It doesn’t have to be a stellar practice, it just has to be an engagement. If you’re talking to a student about their work, it’s pretty useful to have a current experience, because it never gets any easier – getting the material to behave as it should.

“I think the difficulty with the visual arts is that unless you’re actually engaged in doing it, you actually don’t understand what the students are doing. You can’t empathise. It all becomes a head exercise.” ■

auto portrait with fragment of Wittgenstein’s hut, 2009





## inside the head

Between 2000 and 3000 New Zealanders suffer moderate to severe traumatic brain injury (TBI) annually.

At the forefront of dealing with the challenges TBI presents to the injured and those around them is neuropsychologist **Professor Janet Leathem**. She talks to Malcolm Wood.

**W**hen it comes down to it, this is the core of our being: a 1.5 kilogram mass of tofu-consistency fatty tissue. All of our thoughts and dreams, our behaviours and aptitudes, are contained here in an organ that is prey to the same ills as all flesh, that ages, that is all too easily damaged. And when it is injured, the damage is done to our very being.

In her career Professor Janet Leathem has assessed and counselled hundreds of people whose lives have been forever changed by traumatic brain injury.

Has it made her hyperalert to the risks of TBI in daily life? Not quite. But when her children send her links to video of their snowboarding exploits – almost, but not quite, landing it over large drops – well, ... she shakes her head at the bombproof self assurance of the young.

And sometimes it intrudes on her enjoyment of rugby. “I did see Leon Macdonald get a terrible knock once, and I thought, ‘oh, get him off’.”

Leathem first met brain injury (TBI) and its consequences as a young woman not long out of school working at the Kimberley Centre outside Levin. The centre – now closed – provided residential care to intellectually disabled, often emotionally disturbed children. Leathem worked there during her years of study for first a BA at Massey and then a BA honours at Victoria, over university breaks.

On graduating she began work at Wellington Hospital as an assistant psychologist: remarkably then a sole charge position.

“I was lucky. I often did psychological assessment work in the neurology and neurosurgery departments and was allowed to go into theatre. I saw all sorts of procedures. That sort of access doesn’t happen now, but it was very valuable.”

It also presented her with the raw material for research, and within a few years, while continuing to work full time, she had completed a masterate and begun casting around for a PhD topic.

In these days before MRI and CT scans, the only non-invasive way of detecting brain lesions was to use contrast agents and X-rays. It was an imperfect solution – the sometimes risky techniques gave the patient massive headaches, and in the end the images were often unclear.

Could psychological testing be an alternative? It was well known that particular lesions led to particular cognitive deficits. Perhaps, ran a strain of thought, if you could measure the deficit you could deduce the cause.

Leathem set out to find whether a particular measure of neuropsychological functioning based on the work of the Russian neuroanatomist Luria might be the answer.

“I saw 150 people with various localised brain lesions at Wellington Hospital.” Her findings: “As everyone knows now, when the neurologists and neurosurgeons were unclear, so were the psychologists with their test kits, and when everybody else was clear so were we. Thank goodness for CT and MRI scanning.”

In 1984 Leathem left Wellington Hospital to take time out for family life on a farm

just outside Levin, and when she returned to working life in 1987 it was to Massey’s newly launched psychology clinic on the Manawatu campus. Leathem, the clinic’s director, ran a clinical programme, saw clients, taught neuropsychology, and trained students to become clinical psychologists.

Strangely enough, Leathem was at this point best known as an expert on phobias; she had appeared in documentaries on national television and was occasionally sought out by the media for comment.

But her emphasis changed as ACC began referring traumatic brain injury clients to the Massey clinic for neuropsychological assessment, and rehabilitation.

When she shifted to Wellington in 2001 to reprise her Palmerston North role at a new psychology clinic on Massey’s latest campus, her work description went with her.

It has been estimated that in New Zealand there are between 2000 to 3000 cases of moderate to severe TBI annually. They include children who have fallen from bicycles or balconies, young men (men are statistically more likely to suffer TBI) who have been in road accidents, workers, who had over the years been exposed to neurotoxic industrial chemicals, and sports players.

One area of research that Leathem looked at with PhD student Sally Wills was high school rugby, where the pressure for the star player to turn out and make the school look good can lead to dangerous practices. >>>

“I have known of kids who have continued to play in spite of multiple concussions. If you have recently been concussed you are a sitting duck, you can't react quickly. It's a case of the more concussions you have had, the more you are likely to have.”

Wills looked at the associations between the incidence of concussions and such things as the phase of play and elapsed time, and she canvassed the players' thoughts about concussion and, as an indicative practice, the wearing of mouthguards.

One finding: the mouthguards were occasionally passed from player to player to enable the one who had forgotten his to pass the check. “They are just so staunch, these rugby players, they just want to play.”

At the professional level the codes are well aware of the need to minimise and manage the risks associated with concussion.

For a while the Wellington clinic undertook neuropsychological assessment of the Hurricanes (establishing a baseline for each individual for any future assessment necessitated by concussion), and Leathem has vivid memories of Tana Umaga visiting the campus and attracting a star-struck gaggle of students: “The girls even followed him into the toilets.”

What happens to a person who suffers a head injury and is suspected of suffering from a traumatic brain injury? First a medical examination is carried out to see if there is damage to the central nervous system: among the give-aways being problems with limb movement, coordination, or tracking an object with the eyes.

Then comes a more fine-grained neuropsychological assessment: a selection of formal standardised tests of such things as memory, attention and vigilance, language function, and visuospatial ability.

Finally, there is the matter of addressing the injury and its consequences. How do you

approach rebuilding the life of someone who has a brain injury?

Despite her many other commitments, Leathem maintains a caseload of patients as a Wellington-based consultant clinical psychologist. The first thing to do, says Leathem, is be sure that the person acknowledges the nature of what has happened to them.

“Some people will deny their condition because they have a problem accepting it. Others are honestly unaware of their condition. They think they can do anything, even when their test results and their relatives say, ‘oh no you can't’. You have to develop ways of showing them kindly that they can't do the things they were accustomed to.”

Then she and her subject work together to work out ways of compensating for the practical difficulties presented by the impairments using the abilities that remain intact.

This isn't easy. Not only have people often lost the sense of insight that might let them address their problems themselves by applying a consistent logic, but TBI is

often accompanied by an array of other interpersonal and emotional problems: common are such things as tendency to speak without thinking, an apparent self-centredness, lethargy, irritability, depression, and anxiety.

Some of the most common difficulties are those surrounding memory: memory problems will affect up to 80 per cent of TBI survivors.

But they are not insurmountable. Alarms, diaries, post-it notes and new technologies can help people negotiate memory impairments. Leathem has found a camera-equipped cellphone can serve as a useful *aide memoire*.

Need to remember something? Take a snap for future reference. Doctoral student Corne Mackie demonstrated in her research with Leathem that people can compensate well for their memory difficulties by using mobile phones to remind them when and how to do things.

The research into the use of mobile phone technology is being continued in



Heide-Marie Strauss, Professor Janet Leathem, Kiri Luther and Gunnar Scheibner

### Senior moments

Like most Western nations, New Zealand has an aging population profile, with the first of the baby boomers – the generation born between 1947 and 1966 – now nearing their retirement years. And as the population ages, so the concern grows with separating out the normal cognitive wear and tear of ageing from the mild cognitive impairment that may mark the onset of pathological conditions like Alzheimer's. But conducting and analysing a full-scale battery of tests is time consuming and expensive, so usually

a 10-to-30 minute test is first administered as a screen.

The most widely used of these is the Mini Mental State Exam, in which a series of simple questions are put: name the day of the week; count backwards from 100 by subtracting 7s; follow a simple written command... The problem is that the MMSE, developed in the early 1970s back before the arrival of sophisticated brain imaging and fine diagnosis, is a relatively indiscriminating.

Leathem and her doctoral student Heide Strauss are interested in two more nuanced

instruments: Addenbrooke's Cognitive Examination (ACE-R) and the Montreal Cognitive Assessment (MoCA).

“We think the MoCA is the best in terms of the length of time it takes to administer and the information that the neurologists, psychiatrists, neuropsychologists, neuropsychiatrists, geriatricians need.”

Leathem's postgraduate student Heide-Marie Strauss is looking at how well the results of the tests correlate with one another and with clinical diagnoses.





collaboration with Duncan Babbage – a technology enthusiast himself, never without his iPhone.

Often people have these accidents when they are young, says Leatham, and the psychologist-as-counsellor can mean that someone stays in employment or – one of the most important factors in a favourable prognosis – maintains a stable long-term relationship.

Leatham understands how difficult it can be for the partner. “Suddenly they are the one who has to work, has to be the grown-up, has to do the finances. They have lost their intimacy and lost the person they married, their partner. If they can get some of that back, then they might stay together.”

Take a simple chore like hanging out the washing. “The wife will say, ‘he’s home all day, the least he could do is hang the washing out.’ But you have to understand that the reason he doesn’t hang the washing out is because he doesn’t actually think of it. It’s not wilful, he just doesn’t have that auto-checker thing going that says ‘is there anything else that I could be doing?’

“If someone rings him or texts and says, hang the washing out he’ll think, ‘Oh, I’ll do that.’”

Helping people through their difficulties, she says, is one of the most satisfying parts of her job.

Do people often try to game the system by feigning disability in order to dupe ACC or private insurers? Some do, says Leatham, who has served on various ACC advisory bodies since the mid 1990s. But their chances are not good. As well as the psychologist’s own instinct for ham acting and inconsistency, there are formal tests available that use statistical inference to reliably test if someone is feigning. Nonetheless, the issues surrounding ‘malingering’ and its detection, says Leatham, are complex.

“There is a huge group of people whose injuries are not of a magnitude that would prevent them going back into employment yet they continue to lead the restricted lives of invalids – people who aren’t doing as well as might be expected.”

“They are in a sort of no-man’s land. They have got used to being on ACC, and they may have hit an age where things are more difficult anyway. Going back to their previous work may be impossible, but doing something new is difficult – and a comedown as well. If you have

got used to thinking of yourself as disabled, it’s powerful, difficult to shift. These people believe they are doing their best. They just can’t cope with their altered future.”

An altered future that, to one degree or other, awaits us all. As we age, various of our cognitive functions decline. Our ability to retrieve names or facts, our reaction speeds, our ability to process information: all these fall away with the normal processes of ageing in just the same way that hair greys or skin wrinkles.

But normal ageing does not equate to the pathologies of age, such as Alzheimer’s disease. In fact, says Leatham, middle-aged and older New Zealanders are at risk of being needlessly bothered, of becoming the ‘worried well’ if they mistakenly view the difficulties that constitute a normal part of aging as being part of the slippery slope towards dementia.

“In the olden days people of my age probably weren’t still working or multitasking as we do today. If you catastrophise, you might think, I can’t do this job any more, I am past it.”

But when formally tested, many people, though no longer displaying the abilities they had when younger, are found to have no more problem than others in their age group, and typically when problems are identified, they are less significant than people think and can be worked around.

“Gunnar Scheibner, a doctoral student, and I are about to run a series of groups for people who are normally functioning, except that they have noticed more difficulty with memory. We say this is normal, this is why, and this is what you do about it. People will be probably astounded to learn that they are not alone, and I think we’ll will have a lot of fun.” ■

### Reassessing ECT

Never mind that as practised today it may have little in common with its depictions in *One Flew Over the Cuckoo’s Nest* or the works of Janet Frame, electroconvulsive therapy (ECT) is something most of us recoil from. Nonetheless, it remains an available treatment of last resort. The reason: “When it works, it saves lives,” says Leatham. “Would I want it for someone I love? If they were catatonic, or so depressed they couldn’t do anything and likely to self harm and no medication could help, yes I would. ECT just turns them around.”

One consequences of the ECT backlash is that despite it still being used – with informed consent, under anaesthetic, and generally with brief-pulse current – there has been little recent cognitive research into its effects, such as those on memory.

Leatham’s postgraduate student Kiri Luther is working with Wellington hospital to follow the cognitive effects of ECT, assessing patients before, part way through, and after treatment, with follow-up assessments after three months, six months and a year.



Postgraduate student Kiri Luther is researching the cognitive effects of ECT.



Senior lecturer Duncan Babbage and Professor Leatham have a record of collaborations going back many years. Currently the two are working together on several projects focused on neuropsychological rehabilitation, one of which explores cell phones as memory aids.



## Torture and its after-effects

Lalman Rai spent 11 months as a political prisoner sleeping on the cement floor of a Bhutanese jail, his feet in chains, his wrists in cuffs. He now lives in suburban Christchurch.

He is one of the approximately 2000 refugees – 750 of them by quota – who settle in New Zealand every year.

They come from Bhutan, war-torn Afghanistan, junta-ruled Myanmar, the failed nation state of Somalia, bringing personal histories of dislocation and tragedy on a scale most of us would have difficulty comprehending.

But postgraduate student Bahrie Veliu might. Now working towards a Diploma in Clinical Psychology, Veliu lived through the trauma of Kosovo and in the years since has worked with refugees in Indonesia.

Veliu has chosen for her dissertation subject the neuropsychological sequela of torture and for her sample population has turned for help to Refugees as Survivors (RAS Wellington).

What constitutes torture? The World Medical Association defines it as the

... deliberate, systematic, or wanton infliction of physical or mental suffering... to force another person to yield information, to make a confession, or for any other reason.

Is being shackled night after night to a concrete floor, as Lalman Rai was, torture? Under this definition, certainly. And many refugees have suffered worse. Experiences of torture are common among refugees, as are its consequences: most predictably post traumatic stress disorder (PTSD), a condition which has been much studied, but also traumatic brain injury (TBI) sustained during torture.

These are conditions it would be useful to distinguish from one another, as the treatments are different. But a number of factors make this difficult. The refugees do not carry medical records with them, and if they have suffered a traumatic brain injury they may not remember the event having taken place. “After a traumatic brain injury, memory loss of the immediately preceding events is common, and, indeed, if you can’t remember what happened to you, that is probably quite good,” says Leathem, who, together with Professor Nigel Long, is supervising Veliu.

(In fact, Leathem explains, there is an ongoing argument as to whether these unremembered events – the horror of the approaching train or the attacker – can in fact cause PTSD.)

So how do you separate out the overlapping effects of PTSD and brain injury while allowing for the variations in culture, education, language and literacy among a disparate group of people?

Veliu and Leathem are working on putting together test instruments – in multiple translations – and protocols that will allow psychologists to make that discrimination.

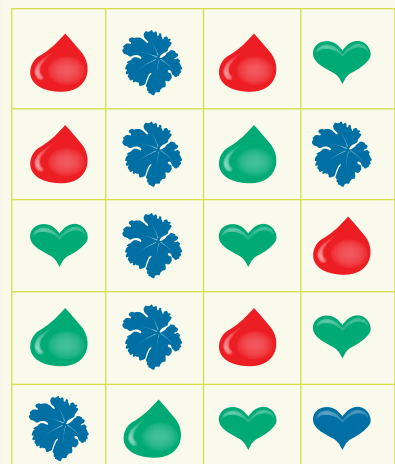
At writing, nine refugees have been interviewed, and already the project is raising other questions that warrant exploration.

What is the best way for psychologists to work with interpreters, for example. “Most of the neuropsychological literature is about working with Native Americans or Spanish-speaking people, whereas we are generally working with people who are speaking Arabic and Burmese.”

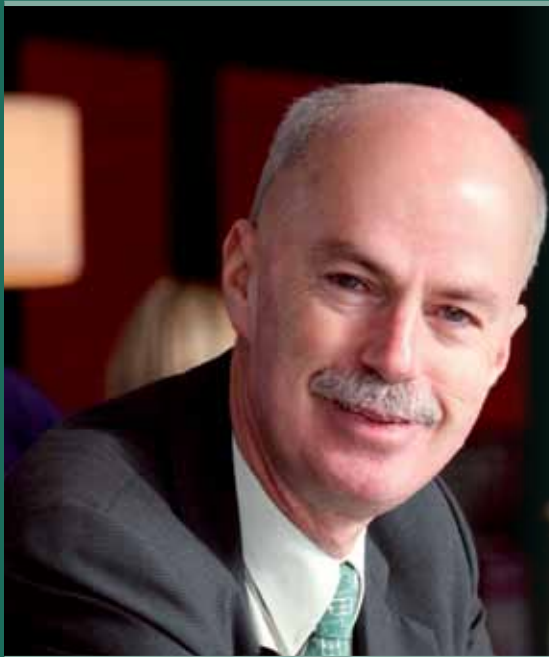
New Zealand has a text-based culture, with near universal literacy. In our source refugee nations this is not the case. In Somalia, for example, just one in four women over the age of 15 can read and write. This presents problems for text-based tests of cognition.

The Stroop test, for example, is a means of assessing cognitive control: measuring how well you are able to check yourself in circumstances where the most natural response is the wrong one. You are asked to respond to the colour you see and disregard the word you read. But the Stroop test depends on the subject being accustomed to reading. Veliu and Leathem are working on purely visual variation on the test using well-understood symbols and their colour associations – blue for a water droplet, green for a leaf, red for a heart – rather than words.

red white green brown  
green red brown white  
white brown green red  
red white green brown  
brown green white red  
white brown red green  
green white brown red  
red brown green white



Postgraduate student Bahrie Veliu is working on test instruments to distinguish PTSD from brain injury among refugees.



## due credit

You've probably seen his name in the business pages.

Malcolm Wood talks to **David Tripe**,

Director of Massey's

Center for Banking Studies.

There is a term David Tripe is fond of using these days when people ask about the origins of the global financial crisis. It is 'disaster myopia', the very human tendency to severely underestimate risk. It comes, he tells me, from a paper coauthored by Richard Herring, a former visiting scholar at the Reserve Bank. Herring, Tripe recalls, was fond of ending his talks to local audiences with the snide comment, "but of course the bankers tell us that this time it is different, there won't be a problem, nothing can go wrong".

Nothing can go wrong.

During his career Tripe has seen many shifts and ructions within the banking world. He joined the industry in the 1970s with an honour's degree in economics just as international exchange rates were being floated and the banks were making their first forays into foreign exchange trading, "some making quite spectacular losses by the standards of the day". Later he would watch with growing disbelief the behaviour of the markets in the lead-in to the 1987 crash. "There were people lending money on the smell of the smell of an oily rag. When you saw it being done, you thought, 'well this is a recipe for disaster' and, of course, it was."

He witnessed too the aftermath of the crash: the reluctance of banks to lend for commercial property development – an inherently risky activity, he says – and the fateful rise, in response, of private finance companies set up by commercial property developers.

But he also saw good things happen, particularly as the banking system was deregulated. "In the mid '80s you had to queue to get to a lender to get a mortgage for a house and you needed four or five mortgages and all the rest of it. By the mid '90s it was so much easier for the consumer."

By the time he departed the commercial banking world to join Massey's Institute of Banking Studies in 1994, he had developed an utter fascination with the industry he had entered for no better reason than "it paid better than a government job".

It shows. In conversation over a cappuccino in Wellington Library's Clark's café he leans slightly forward, talking with enthusiasm, explaining and expanding.

If a banking expert can be locally famous, then Tripe is that expert. Newspaper reporters seek him out; their coverage of the current crisis is punctuated with Tripe's typically matter-of-fact commentary. So I have been curious to meet him, if only to see what happens when banker turns academic.

Impressions? I can imagine he must be a compelling lecturer on the Manawatu campus, but he also has the sort of besuited well-groomed presence that might equally be at home in Wellington's policy-making circles or the boardrooms of Auckland, which is where most of the banks are locally headquartered.

But there are individual touches as well: his jazz-instrument-themed tie – though he tells me his inclinations are more classical – and the pocket watch he pulls out white-rabbitishly to consult once or twice.

Just as the 1987 sharemarket crash was, in retrospect, clearly predictable, he tells me, this time round the signs that a financial bubble was building were evident long before it burst. The flood of cheap credit, the comfortable belief that property could only rise in value, the herd behaviour – all of these were signs the market was riding for a fall, says Tripe, who has made no secret of his views over the past few years.

Indeed, he wasn't the only one to express doubts. But the industries whose self-interest was tied up with the rise in property and pushing out cheap credit were not interested in naysayers.

"There were a lot of people who had a commitment to it as a one-way bet, because if it was a one-way bet it was going to make them rich, or it gave them a job, because they sold services to the people who bought houses."

In New Zealand a smaller-scale reckoning came with the collapse of a number of finance companies, beginning in May 2006, while internationally the first significant signs that all was not well – the beginnings of the catastrophe – came with the August 2007 announcement by BNP Paribas, a commercial bank in France, that it could not fairly value the underlying assets in three funds as a result of exposure to US subprime mortgage markets. Like many other major banks, Paribas had unwittingly taken on so-called toxic debt in the form of the bundled and securitised packages of mortgages called Collateral Debt Obligations (CDOs).

These in themselves are a useful financial instrument, according to Tripe.

“CDOs were established to address the problem that when you bought a pool of mortgages you didn’t know when you were going to get your cashflow. With a CDO you would know when you would get your cashflow – say within two-to-four years or four-to-eight years – and in principle that is a good thing for investors.”

Similarly, a financial instrument some journalists have taken to describing as a weapon of mass financial destruction, the Credit Default Swap, is far more useful than not. “Suppose you are a bank wanting to make a large loan to the New Zealand government but you don’t necessarily want that much [risk] exposure to the New Zealand government on your books. What you do is make the loan then sell off parts of the exposure. Not having too much of a credit concentration with any particular borrower is just prudent.”

Where the fault lies, he says, is not with the instruments, but with how they have been used: the push to sell mortgages to people who could not afford them; the misleadingly secure ratings given to CDOs that were anything but; the rush to onsell those CDOs to institutions around the world; the overlay of financial complexity; and the miscalculation of risk. He comes back to disaster myopia. Those outside-chance events – the ones so unlikely no allowance is made for them – do happen, and much more often than the models allow for.

So what happens now in our patch? New Zealand’s small open economy faces some very serious problems. Although the exchange rate may offer some buffer, the overall demand for our products is still likely to decline as global demand diminishes; credit has already become more difficult to come by; and the downturn will cast an unforgiving light on the New Zealand economy’s fundamental problem: the nation has been consistently spending beyond its means, making up the difference with debt.

For a number of years New Zealand has been running a current account deficit of between 8 and 10 per cent of GDP (Gross Domestic Product), accumulating a net international debt that stood at \$165.9 billion at the end of September 2008.

Paradoxically that brings with it some reassurance, he says – overseas investors are to some extent hostage to New Zealand’s economic success – and some risks.

“Of that \$160- or \$170-billion odd of foreign indebtedness, banks have net foreign indebtedness in New Zealand dollars, or hedged in New Zealand dollars, of around \$110 billion,” explains Tripe. “So they have a very big chunk of it, which means someone somewhere else in the world is holding net New Zealand dollar positions that have been falling in value as the value of the New Zealand dollar has declined. There is a real concern that they will get uncomfortable with that and want to exit their New Zealand dollar positions, and that could cause a dramatic decline in the value of the currency.”

However, Tripe is reasonably comfortable that the local – read Australian – banks, although leveraged (“they all meet the standard capital rules of 8 per cent equity, but in practical dollar terms when the risks are unweighted we are effectively looking at between 5 and 8 per cent”), will accommodate the changing environment.

“When it comes to the crunch, I am not of the view that the banks are going to lose huge amounts of money. Most of their lending is secured with loans for housing and loans on small businesses, and most people will have been sensible in their borrowing, and the banks have some margin. Even if someone loses their job and housing falls by 20 per cent, in many cases the house can be sold without a loss, and even where there are losses, some of these will be insured.”

He is less sanguine about what will happen to the New Zealand economy generally. “To

spend at the level of our income we are going to have to reduce the proportion of the nation’s income being spent on retail and housing by 8 to 10 per cent. That means some excess capacity that is going to have to be drafted into some other use, which means that current levels of employment are nowhere near what they are going to reach. The official government figures seem to be unduly optimistic.”

Nor is the world soon going to be back to what it was anytime soon. Although Tripe is resistant to the idea of being classified ideologically, in general he favours free market solutions over the alternatives and he is no fan of nationally owned banks, which tend, he says, towards inflexibility.

Yet for the foreseeable future a number of landmark international banks will now have major government stakeholdings.

“The French took the best part of 20 years to unnationalise the banks that they nationalised in the early ’80s – and they took up most of the market’s appetite and capacity for buying banks. When you have the US and the UK and the Europeans all trying to denationalise banks [in the same period], that is going to take lot more.”

The blanket retail bank deposit guarantee schemes now in place in many countries also disquiet him. However necessary, these schemes introduce ‘moral hazard’: with the government carrying the risk there is less reason for financial institutions to act with proper prudence.

Will the crisis mean that banking qualifications now become more sought after within an industry whose upper echelons – it emerges – are largely full of people who have come in from other disciplines?

Tripe isn’t sure. There has, in the past, been a tendency for the banks to see themselves as all-knowing and no one has held them to account – bank customers seldom ask their bankers about their qualifications.

Perhaps, he says, they should. ■

### Changing the face of banking?

One of the more interesting phenomena in recent years has been the arrival of the NZPost-owned Kiwibank, which launched in June 2002 and, as of September 30 2008 had slightly more than 2 per cent of the New Zealand market share but more than 10 per cent of the New Zealand customer base. \*

But is the playing field level? In December 2008, former BNZ chairman Kerry McDonald suggested that the over-the-counter business in PostBank branches was being used to cross-subsidise the banking business.

Tripe does find aspects of Kiwibank’s business model “a bit challenging”, making it almost impossible to determine how well it is doing. “Kiwibank’s cost structure is way higher than the other banks. It has a bigger branch network and assets that are a tenth of the size of the bigger banks. The costs allocated to Kiwibank by NZPost should be those of the additional banking activities of the branch. But how do we test that? We can’t.”

He also wonders about the long-term future of a bank that relies on having a

costly physical presence in any community of some size. “If we look 20 years ahead are banks going to want branch networks as large as they have now? The answer is no. The only functions you need now are to deposit small business takings and to open an account. In Australia some of the information brokering for opening new accounts has been brokered to AustraliaPost, but they can do that because AustraliaPost isn’t a banking competitor.”

\* Combined with the TSB and SBS, this brings total New Zealand-owned share of the banking market to between 3.5 per cent and 4 per cent.



## as long as you've got your health

**Associate Professor Christine Stephens** tells Malcolm Wood about what public health campaigns can and can't do.

**Y**ou began your working life working with the victims of trauma using individual approaches. What happened?

When I started teaching health promotion I used more traditional psychological models, ones very focused on individual behaviours. But after a while, based on my personal experience, that of my colleagues, and the literature, I came to see that one-to-one therapy could only do so much and I started looking at the broader social life of people and their health and their choices.

Why the switch in emphasis?

I think it came from accepting how strongly we are influenced by our families, our friends and our workmates. Our eating habits are likely to be those we were brought up with. If members of our immediate family smoke, then we are that much more likely to smoke ourselves. If our social group measures our worth by how much beer we can drink in one night, then our chances of drinking in moderation are much slimmer, no matter how strong our resolution is. The social setting is key.

So a television campaign that, say, simply exhorts us to get our 30 minutes of exercise may not do that much good?

It won't work particularly well for you if the people you associate with are physically

inactive. You need social support. And it won't work well if the physical environment isn't right.

Take someone who lives in an outer suburb. They may have to rise early to drive or catch public transport to get to work, and by the time

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“When we go to get a hamburger, what we think is ‘yum’, or ‘my friend’s having a hamburger’, or ‘my kids want to go to Macdonalds’. We aren’t thinking, ‘ahem, I might get heart disease twenty years in the future’.”

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they get home it is late in the evening. Will a television campaign change matters? Maybe, as they lie on their couch watching television after getting home from work and looking after the kids, they will think, ‘well, that looks like a good idea, throwing balls about joyfully’. But in practical terms, when are they going to get to do that?

Another problem with the sorts of health promotion that tell us to do what is good for us is that a lot of time people aren't thinking about their health benefits in the future. The people who promulgate these messages are assuming that if they establish a link between how people

behave now and their health at some time in the future, people will change their behaviours. But usually our actions do not take place with this sort of future outcome in mind. When we go to get a hamburger, what we think is “yum”, or “my friend’s having a hamburger”, or “my

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kids want to go to McDonald’s”. We aren't thinking, “ahem, I might get heart disease 20 years in the future”.

It is often easier to have a campaign than to change people's environments. It can be an easy way out.

In fact, sometimes, you say, the finger-wagging approach can be counterproductive.

It can be harmful to stigmatise people because of conditions that have to do with their social circumstances. If you make people feel bad about their diet or exercise habits and it is

difficult for them to make changes, then all you are doing is putting pressure on them and making them feel unworthy. People who are overweight often find themselves the subject of moral judgments: they are overweight, therefore they are eating badly, therefore they have no self will.

There's no harm in giving people information – telling them this is how to eat healthily or warning that cigarette smoking will damage their health or ultimately kill them – but if you are making people feel psychologically unwell, then they aren't going to get physically well.

You also cite studies that show people will rebel against messages that are overly strident.

There has been research done showing that gay men have stopped using condoms as a form of resistance. In fact, condom use in general is a good example of how the health information delivered in a quite clinical way in the classroom fails to connect with the way people actually use condoms, which is social.

You use smoking as an example of how changes to the environment – taxation, limits on advertising, bans on smoking in public places – can change the incidence of the behaviour.

Smoking has been a great success story and I think it is generally understood that most of the effect of the antismoking work has come from changes to the environment. But then making rules around smoking is easy, because smoking is only bad for you – the case for rules is quite simple and clear-cut. You can't really carry that approach into other areas. People may talk about fat taxes, but we need to eat, whereas we don't need to smoke.

The antismoking message is one of those things that the middle classes took up with enthusiasm, but we still have what are called 'recalcitrant' smokers. And who are they? They are more likely to be poor people, people operating under stress.

After reading your book, it seems to me that by far the best way of achieving a long and healthy life is to have the right socioeconomic status.

Yes, the research demonstrates this over and over again. There's a study of the British civil service that shows that executives and administrators live longer than clerks and

cleaners. There's a Swedish study showing that people who hold doctorates live longer than people with masterates and they live longer than people who have bachelor's degrees. There is even a study that shows that Oscar winners live longer on average than the runner-ups. These are all eccentrically memorable examples that show that it works at higher status as well as between rich and poor.

But this is also something I see in my day-to-day working life. In the study of the New Zealand's ageing population I am involved in, we can show the same graded correlations between health and such things as income, level of educational qualification and ethnicity.

Can you tell me more about the apparent effect of ethnicity?

We can't put ethnicity on the same gradient as those other factors. There is no scale of ethnicity that matches neatly with health status, but we can show that there is an effect. Even if people are poor, somehow ethnicity has an additional effect. We know this.

In our survey of New Zealanders aged 55 to 70 [see sidebar] we can show those ethnicity-related inequalities in health cut across income, across living standards.

Our health statistics for Māori and Pacific Island people are a national embarrassment. The indigenous groups in our country have a clear gap in mortality and illness and they do need their own approaches. So, in New Zealand there are concerted public health efforts to address Māori health. Think of the breast feeding, smoking, and cervical smear programmes.

For Māori – and people like [Professor] Mason Durie have expressed this very well and clearly – health is not just about the individual, it's about their family and their spirituality, about their land, and their identity as Māori people. Mind you, I think this is true of all human beings to one extent or other.

How do you measure how successful a health promotion has been?

The health promotion perspective is about prevention; it's a positive approach as opposed to the medical approach, which is about fixing people up once they become ill. We are always thinking about keeping people well. But the outcomes are still measured in illness or death.

We just want to drop those numbers down. Or at least even them out so that no one group is disadvantaged – that would help. ■



**Health Promotion:  
A Psychosocial Approach**  
by Christine Stephens,  
ISBN13: 9780335222087,  
ISBN10: 0335222080,  
Open University Press

### When we get older

Christine Stephens is one of a number of Massey researchers who are part of a massive and ongoing study of the health of older people in the transition from work to retirement.

The study's first iteration, led by Massey's Professor Fiona Alpass and funded by the Health Research Council, surveyed 6000 people aged from 55 to 70 years old, 3000 of whom will take part in a subsequent survey.

The study's second iteration, this time funded by the Foundation for Research, Science and Technology, will fund two more rounds of data collection and finish in 2012.

"We have more research partners, we have extended the age range from 50 to 80, and we are going to add a couple of thousand more people in and carry on," explains Stephens, who also has some of her postdoctoral students doing qualitative studies "around the edges".

"I have a Chinese student in Auckland who is doing a study with older first-generation immigrant Chinese people, because typically they don't get picked up by our surveys. We are also doing qualitative work with Pacific Island people."

She hopes the work will help change the perception of older workers. "My view is that people should go on working if they are happy to. Not all of us are happy at 65 to say, well that's it I am off home to the armchair."



**Handbook of Research on Socio-Technical Design and Social Networking Systems**  
(2 volumes) Edited by Brian Whitworth and Aldo de Moor, CommunitySense, The Netherlands

The Internet needs to better reflect social values such as trust, fairness and respect for privacy that will complement its evolving technical capacity, says information technology specialist Dr Brian Whitworth.

Dr Whitworth, a senior lecturer at the Institute of Information and Mathematical Sciences at Albany campus, is the main editor and contributor to the recently published Handbook of Research on Socio-Technical Design and Social Networking Systems.

Socio-technical systems that have blossomed on the Internet include Wikipedia, e-mail, social networks Facebook and YouTube, online learning such as Moodle, blogs, twitter, online multi-player games such as World of Warcraft, online simulations (Second Life), online news, e-voting, online dating, open source programming, online trading (TradeMe), collaborative writing and many other forms which let people form communities to communicate.

The book discusses how to close what Whitworth terms the “socio-technical gap” between what technology does and what society needs.



**Mata Toa: The Life and Times of Ranginui Walker**  
Paul Spoonley (2009), Penguin New Zealand

Urban activist, academic, educator and cultural commentator, Dr Ranginui Walker (Te Whakatohea) is among Māoridom’s most influential leaders and spokesman of his generation. His fascinating life story is told in full for the first time in a biography written by Professor Paul Spoonley (pictured).



**Lighted Windows**  
**Critical Essays on Robin Hyde**  
Edited by Mary Edmond-Paul, Otago University Press

Robin Hyde, the author of the renowned novel *The Godwits Fly* and a prolific poet, political columnist, travel writer and war correspondent, was a remarkable writer overlooked in her own lifetime.

*Lighted Windows*, a collection of 12 essays by New Zealand and overseas literary scholars is the first book of critical essays on Hyde, who committed suicide in 1939, aged 33.

Editor and contributor Dr Paul, the English programme coordinator at Massey’s School of Social and Cultural Studies in Auckland, (pictured here with Dr Nikki Hessel) is currently at work on a volume of Hyde’s autobiographical writings.



**The Global Public Relations Handbook: Theory, Research, and Practice**  
Krishnamurthy Sriramesh and Dejan Vercic (2009), Mahwah, NJ and London: Lawrence Erlbaum Associates

Co-edited by Massey University Professor of Public Relations Krishnamurthy Sriramesh, this prize-winning handbook, now in its revised and expanded 2009 edition, focuses on the history, development and current status of the public relations industry worldwide. Its contributors are 63 leading public relations scholars and professionals from more than 30 countries on six continents



**Images of War: World War One**  
**A photographic record of New Zealanders at war 1914-1918**  
Glyn Harper (2008), HarperCollins New Zealand

Published on the occasion of the 90-year anniversary of the Armistice, *Images of War* brings together 830 photographs taken by New Zealand soldiers during World War I. These have been sourced from the Queen Elizabeth II Army Memorial Museum, the Kippenberger Military Archive, and private collections. Most have never before been published – and many were captured with forbidden cameras hidden in soldiers’ kitbags.

Associate Professor Glyn Harper is Director of the Centre for Defence Studies and one of New Zealand’s most eminent military historians.



**Educating Boys**  
Michael Irwin (2009), Harper Collins Publishers

Boys – it is often reported – are increasingly struggling with learning. This well-documented trend coincides with a shift in New Zealand schools becoming language-laden institutions overburdened with semantics, says Dr Michael Irwin.

In *Educating Boys – helping Kiwi boys to succeed at school*, he takes a pragmatic look at how we educate boys in this country and discusses how to ensure they get the best from school. This is an essential handbook for anyone who wants to help boys succeed at school and in life.

Dr Irwin, a former school teacher and principal is a senior lecturer in education at Massey’s Albany campus.



### College Research Awards



#### College of Humanities and Social Sciences – Research Award (Individual)

Director of Health, Disability and Rehabilitation Studies in the School of Health, **Professor of Rehabilitation and Social Services Steve La Grow** has built an international reputation as an author and researcher specialising in the rehabilitation of those who are blind or visually impaired. He is best known for his work in orientation and mobility. In 2006 he was presented with the Lawrence E. Blaha Memorial Award from Division Nine of the Association for the Education and Rehabilitation of the Blind and Visually Impaired, the largest international professional organisation in the field of blindness. In 2003, Professor La Grow was inducted into Western Michigan University's Blindness and Low Vision Studies Outstanding Alumni Academy. Emeritus Professor Warwick Slinn says Professor La Grow's output is prodigious, numbering more than 140 publications, including two books and 75 peer-reviewed articles. "But it is the recognised quality of his work that is important," Professor Slinn says.

Professor La Grow serves on numerous editorial boards, is regularly asked to review articles and research proposals, and is often invited to contribute articles for publication. As a member of his professional community, he has served on the organising committees of six international mobility conferences.



#### College of Humanities and Social Sciences – Research Award (Supervisor)

**Professor of Applied Linguistics Cynthia White** is a regular contributor to workshops, seminars and staff development sessions on research, supervision and academic career management within Massey, the Centre for Academic Development and e-Learning, and the Graduate Research School. As College of Humanities and Social Sciences representative on the Doctoral Research Committee (2002-2005), Professor White made an active contribution to doctoral studies in the university, contributed to the successful resolution of difficult supervisory relationships, and acted as a mentor for three chief supervisors in different schools. Professor White serves on the review boards of seven international and two national journals, regularly reviews research proposals for funding bodies such as the British Academy, and has been an active researcher and co-leader in collaborative projects with Oxford University, the Open University UK and Nottingham University. In the past five years she has given eight international plenary addresses at major conferences in Hawaii, Germany, the United Kingdom, China, Thailand, Singapore and Malaysia.

**College of Creative Arts – Individual** awardee **Professor Anne Noble** and **College of Science – Supervisor** awardee **Professor Hugh Blair** are also the recipients of Research Medals (see pages 11-14).

### University Research Fellowship



**Associate Professor Margaret Walshaw** of the College of Education is this year's recipient of a University Research Fellowship. Her work is profiled on pages 35 – 37.

### Pasifika Awards



**Ridvan Firestone**, a Pacific Post-doctoral Research Fellow with the Centre for Public Health Research, will establish lung function reference values for Pacific school-aged children using a sample of healthy Pacific school-aged children residing in the Wellington region. Until now, the lack of reference values for lung function in Pacific children has hampered efforts to identify potential causes and effective interventions to reduce respiratory morbidity.



**Lesieli MacIntyre**, a senior lecturer in the School of Educational Studies, will look at how Pasifika boys and girls (4-6 years old and of Tongan, Samoan, and/or Fijian origin) think bilingually (in English and their respective Pasifika language/s) in social contexts.

### Postdoctoral Fellowships



**Professor Elwyn Firth** has secured a postdoctoral fellowship for the project *Bare bones: Crystal Structure in Bone*. The multidisciplinary project is the first large study of bone involving collaboration between the Institute of Veterinary, Animal and Biomedical Science and the Institute of Fundamental Science. Relatively little work has been done to characterise the chemical composition of bone at the micro or nano-structural level, though variations at this scale may profoundly influence bone solubility and hardness. The project aims to extend a well-established programme in bone biology, leading to an improved understanding of bone health and disease mechanisms.



**Associate Professor Christine Thomson** has secured a postdoctoral fellowship for the project *Brain Cell Culture Models* which will be pursued at the Institute of Veterinary, Animal and Biomedical Sciences. Dr Thomson, with support from Cell Culture Central staff, has established an in vitro model for the mammalian spinal cord, and is now working on a similar model for the brain. Research into neurological conditions affecting the brain is hampered by a lack of suitable cell culture models that replicate the brain. The project aims to identify conditions required for brain cultures, and to test particular cultures for their robustness and suitability for studying neurological disease. Models would have uses in neuroscience for conditions such as Alzheimer's and multiple sclerosis.



**Senior Lecturer Gill Norris** of the Institute of Molecular Biosciences has secured a postdoctoral fellowship to complete a project investigating unusual post translational modifications of a small antibacterial protein found to be glycosylated twice. Findings have stimulated the development of catabolically stable glycopeptide mimetics as fundamental tools for biological research and as potential agents for therapeutic intervention.



Dr **Jennifer Tate** has received funding for a postdoctoral fellow for the *Sex Determination in Ribbonwood* project at the Institute of Molecular Biosciences. The project addresses a pending question of international interest about the evolution of New Zealand flora. A hallmark of New Zealand flora is the presence of distinct male and female flowers in a high percentage of cases. Ribbonwood is an ideal plant in which to examine the genetic control of male and female floral development. The postdoctoral fellow will carry out fieldwork throughout the country as well as lab work.

### Māori Awards



**Kura Puke**, a lecturer in the School of Design, will create a new artwork, *Hinatoro*. The artwork and associated project will build on her earlier artwork series *Muramura* of 2008, which formed part of work for her Master in Māori Visual Arts. In *Muramura* tukutuku panels were created with illuminated optical fibres, creating animated pattern configurations through timing, colour and intensity. *Hinatoro* will refine the techniques used in *Muramura*, consolidating the hardware and software into a standardised format for streamlined production.



Artists **Ngataiharuru Taepa** and **Hemi Macgregor** (left and right) from Te Putahi a Toi will research and explore the many facets of Tanenuiarangi and create a collaborative art installation that gives visual form to these findings. The installation will be exhibited at Te Manawa public art gallery in Palmerston North.



**Amanda Yates** of the Institute of Design for Industry and Environment intends to create the working draft of a book, *Oceanic architectures: between sea, sky and land*. The book will explicate Yates's own work, which explores the Māori pa as an architectural form, as well as incorporating her research into Māori architect John Scott's buildings.

## Women's Awards



Images shown in order of text.

**Dr Ngaio Beausoleil** completed her PhD in animal behaviour and welfare in 2007. With her award she intends submitting six or more papers for publication, a number of them consequent on work completed during her PhD. The topics include such things as the analysis of stress responses in sheep, the lateral biases expressed by individual sheep in a Y maze, and whether it is possible to select sheep for domain-general temperament traits.

**Dr Avril Bell** intends to complete her book *Identity Politics in Settler-Indigene Relations: The "New" Pacific*. The book will extend her doctoral research into indigenous-settler relations in New Zealand to the identity politics of three other British-settled colonies: the USA, Canada and Australia.

**Dr Angie Farrow**, a well-established playwright, intends to complete her second volume of plays, *More Plays for Physical Theatre: Seven Plays for Young Adults with notes for their Production*.

**Dr Elizabeth Gray** intends to pursue the publication of a volume of critical essays addressing the work of Alice Meynell, an important literary figure in Britain at the end of the nineteenth and beginning of the twentieth century.

**Dr Kate Lewis** intends to extend the work of her PhD thesis, which examined the meaning young New Zealand entrepreneurs attach to being in business. Youth entrepreneurship is a phenomenon attracting international interest, but, other than in Dr Lewis's own work, it has been given little empirical attention in New Zealand.

**Dr Elspeth Tilley** intends to rework and extend her PhD thesis into a proposed book, *On Vanishing*. This will explicate a powerful colonial narrative trope: the settler disappearance narrative or 'white vanishing myth'. *On Vanishing* will critically examine disappearance tales across literature, cinema, theatre, poetry, media and other cultural forms produced by non-indigenous Australian authors.

## Technicians Awards



**Professor Anne Noble** receives a technician's award to manage the processing, proofing and digitisation of Antarctic photographs as part of the *White Lantern* project. The work also involves the development of a digital archive, exhibition printing, and the preparation of analogue and digital maquettes for publishers and curators. *White Lantern* concludes a five-year investigation of Antarctic representation. Professor Noble has two books in development with publishers.



**Dr Mark Patchett** has received funding for a technician for his project *Glycogins, the next antibiotics* in the Institute of Molecular Biosciences. Glycogins are a new class of peptide antibiotics, with the first and only verified glycopeptides bacteriocin recently characterised by staff at Massey. Staff have identified related gene clusters in other bacteria, each capable of producing at least one novel glycogin. These glycogins need to be characterised as soon as possible.



**Dr Martin (Bill) Williams** has won a technicians award for his project *Single Molecule Stretching* in the Institute of Fundamental Sciences. The technician will use the institute's optical tweezers setup to stretch single molecules of DNA and other biopolymers. A specific objective is seeking to understand the control and possible role of force-driven conformational transitions in polysaccharides. The technician will synthesise specific nucleotide sequences and attach biological macromolecules of interest to beads.



## I made my discovery here

Research into the role of protein misfolding in a debilitating disease has won Carlene Starck the 'Advancing Human Health and Wellbeing' category at the 2009 MacDiarmid Young Scientist of the Year Awards. She's just one of the postgraduate minds making amazing breakthroughs at Massey. The New Zealand spirit of discovery thrives at Massey with the help of world-class academic staff, some of New Zealand's best facilities and the exploring minds of people like you.

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