MASSEY RESEARCH

Close to the bone
Tackling osteoporosis

Channelling Bartók
Reconstructing a deathbed concerto

Oh islands in the sun
Stories we tell ourselves about the South Pacific

Research, Scholarship and Creativity

October
2005

Plus: Literacy • Life's origins • Doing business globally

Massey University

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In praise of postgraduates

In the pantheon of New Zealand scientific greats, one person will always stand above all others: Ernest Lord Rutherford, usually described as "the man who split the atom". This is how collective memory works. One name, one achievement. True as far as it goes but missing nuance and qualification.

In fact, as Brian Cathcart tells it in his book *The Fly in the Cathedral*, Rutherford should really be described as the man who "chipped" the atom, firing alpha particles into nitrogen gas and knocking protons from their nucleii. The first to split atoms, according to Cathcart, were Ernest Walton and John Cockcroft in 1932.

Yet in a significant way Walton and Cockcroft's achievement was also Rutherford's: the two were working at Rutherford's Cavendish Laboratory when the breakthrough was made.

Rutherford was no paragon. He was messy and sometimes clumsy. He was prone to sudden and capricious bouts of rage. He sulked. But he was also kind and generous and full of laughter. He cared about the lives and careers of staff and students. And he was, in Cathcart's words, "a perfectly tuned machine for scientific discovery"– energetic, restless, ever curious.

When another fellowship was needed to keep Walton at the Cavendish, Rutherford found it. When the funding was needed for Walton and Cockcroft's experimental apparatus (this in an environment where legend has it a student who asked for a piece of metal piping was given a hacksaw and told to find a bicycle), funding was forthcoming.

The odd thing is that I feel I know Rutherford, or at least I know a vast number of Massey researchers who have Rutherford-like attributes. Outstanding researchers in their own right, they create communities of interest around themselves. They teach, they mentor, they inspire, they care deeply about how their postgraduate students are faring. They are forever learning, forever exploring.

Where would Rutherford be working today if he were around? My suspicion is that it would be in the burgeoning realm of the life sciences. Perhaps that's why when I look for his equivalents I think immediately of Professors David Penny, Mike Hendy and Geoff Jameson. I think of Dr Emily Parker.

A little further afield, I think of our Massey Medal winners – Professors Paul Moughan, Harjinder Singh, Nanthi Bolan and Robert McLachlan – each surrounded by a community of talent.

And there are many others in the creative arts, sciences, humanities, social sciences, education and business – enough to fill the pages of *Massey Research* many times over.

There is nothing remote or unapproachable about these researchers. For most of them the essence of their work is collaborative, and universally they strive to make often intrinsically difficult subjects comprehensible.

They are one of the reasons why Massey has a higher percentage of research degree completions than any other New Zealand university.

They are one of the reasons why Massey is one of just two New Zealand universities to feature in the *Times Higher Education Supplement* top 200.

They are the reason why I would recommend any postgraduate student contemplating where to go next to give Massey serious consideration.

This magazine is a celebration of their work.

Judith Kinnear
Vice-Chancellor

Partnerships, successes and apprehensions

This year's *Massey Research* follows hard on two pieces of good news. The first, that among the proposals that were recently successful in gaining Partnerships for Excellence Scheme funding from Government, two have a substantial Massey involvement: the Agricultural and Life Sciences Partnership and the Towards a Future-Focused New Zealand Equine Industry Partnership. The second is that the University's total research income is projected to break $60 million for the first time.

Let me begin with that $60 million. This increase in funding comes from across our colleges and from many of our research centres, and it further confirms Massey's status as one of New Zealand's leading research-led universities. This competitively gained income is vital. It flows back to researchers and students, paying for their salaries, scholarships and costs and helping sustain the infrastructure on which they depend.

Here we have a virtuous circle. Success brings more funding; greater funding brings greater success.

So with that projected $60 million and with a pool of talented postgraduate students and researchers, I ought to take a sanguine view of Massey's prospects. We are proving ourselves highly competitive. But there are disquieting signals that the processes governing the allocation of funding by the Foundation for Research Science and Technology are likely to become less so. I hope this is a misreading. Student enrolments are no longer enough to sustain the research infrastructure that has been built up over the years – the infrastructure that produces the graduates whose skills and knowledge power our economy.

Perhaps the strongest example of the contribution Massey's graduates make lies in the land-based and associated industries – by which I mean not only agriculture, but such things as food processing, biotechnology, product design and industrial processing.

New Zealand has natural competitive advantages. Our pastoral dairy land, for example, is more than five times as productive as the global average. But we have also established a reputation for intelligent farming practices, and increasingly the income we earn comes not from raw commodities but from high-value products tailored to the market.

The University began as an agricultural college. It was here that such well-established sheep breeds as the Drysdale and Perendale were first bred. It is Massey-educated veterinarians who attend to New Zealand's livestock. In that New Zealand institution, the Young Farmer of the Year competition, the winner is as often as not a Massey graduate.

We also have a tradition of 'adding value' at every point from the farm gate to the plate. Have you seen the protein bars and body building supplements now on the shelves? In this issue of *Massey Research* you will meet John Ayers, whose work with ion exchangers allowed the cost-effective extraction of protein from whey and helped establish a market now worth hundreds of millions of dollars.

You will also read about the Riddet Centre, which specialises in functional foods – the nutritionally tailored foods of the future – and which currently has around 40 research contracts ranging in value from tens of thousands to hundreds of thousands of dollars.

Given Massey's history, you will understand how pleased I was to learn that the Government had awarded Massey funding for two Partnerships for Excellence.

The Agricultural and Life Sciences Partnership will be established by Massey and Lincoln Universities, with the private sector partners including Meat and Wool New Zealand, Dairy Insight, Fonterra, the New Zealand Fruitgrowers Federation and the Agricultural and Marketing Research and Development Trust (AgMardt). Towards a Future-Focused New Zealand Equine Industry Partnership will employ education and research to help the equine industry achieve its full economic potential. Among the partners are Bomac Laboratories and Matamata Veterinary Services.

Both partnerships promise much. I look forward to Massey building new alliances and building on its past achievements in agriculture, the life sciences and New Zealand's equine industry.

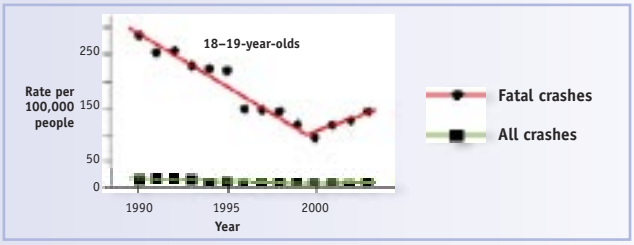
Nigel Long
Assistant Vice-Chancellor - Research

MASSEY RESEARCH

HERE & NOW

FEATURES

FINAL WORDS

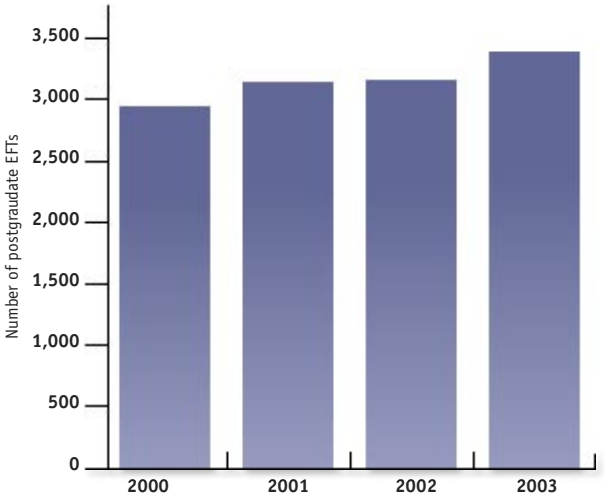


An exceptional postgraduate research experience

Postgraduate student numbers are burgeoning at Massey. According to the most recent (2003) Ministry of Education statistics, more than 18 percent of Massey University's student population are postgraduates. And year-on-year the number of postgraduate students enrolled has grown.

At the pinnacle of postgraduate education are research postgraduate degrees. Here Massey falls second only to the University of Auckland in the numbers of enrolled students.

In research degree completions – a recognised indicator of research performance – Massey betters every other New Zealand university.



Postgraduate Equivalent Full-time Students

The Graduate Research School

The Graduate Research School was established in February 2004. Currently it is responsible for doctoral degrees (in philosophy, business and administration, clinical psychology, and education), and scholarships, both undergraduate and postgraduate. It is also to assume responsibility for research masters degrees. The School provides information and administrative services for doctoral degrees and scholarships.

The Dean of Graduate Research is the Chair of the Doctoral Research Committee, and the of Scholarships Committee, and has an advocacy role for graduate research within the University.

Building a research infrastructure

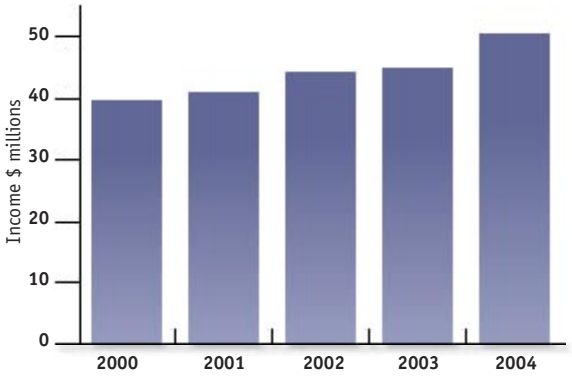
The University is committed to providing its researchers with an environment in which scholarship and creativity can flourish. This includes professional development programmes, generous leave provisions, a system of rewards and recognition, opportunities for promotion and, at the postgraduate level, a range of scholarships. It also includes investing in the equipment and infrastructure that make advanced scientific research possible.

Tangible evidence of this can be seen in New Zealand's most powerful NMR (nuclear magnetic resonance) spectrometer, installed in July 2004 on the Palmerston North campus. On the Albany campus the supercomputer dubbed 'Double Helix' was recently upgraded from 32- to 64-bit technology, recapturing its position as the most powerful supercomputer outside the private sector.

The University has committed $400,000 over the next three years as part of New Zealand's $5 million contribution to the Australian Synchrotron project.

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 $50.7 million in Massey's researchers in 2004, a figure projected to top $60 million in 2005.



Total research and contract income awarded

A research powerhouse

Massey University'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 conducted by the Government in 2003 identified Massey as having strengths in a number of domains:

- applied biological sciences
- veterinary and large-animal science
- accounting and finance
- communications, and journalism and media studies
- design
- management, human resources and industrial relations
- Māori knowledge and development
- social sciences, social policy and social work
- visual arts and crafts.

The University also hosts a span of human health research expertise, including nursing, rehabilitation therapies, public health, and burgeoning new areas such as sport and exercise science.

The University's strength in research – alongside strength in teaching and its international reputation – is one of the reasons the *Times Higher Education Supplement* World University Rankings placed Massey at 108 in the world top 200 universities, the second-placed of the three New Zealand universities to feature.

New link with Peking University

Peking University and Massey University have signed a university-to-university agreement for academic co-operation.

Vice-Chancellor Professor Judith Kinnear says the agreement is one of few made between Peking University and Australasian universities and acknowledges Massey's strength and standing, particularly in the sciences and agriculture.

The agreement will be a positive factor in building high-quality postgraduate recruitment from China, consistent with the New Zealand Government's strategy, she says. "It is also positive for higher education in New Zealand generally."

One important aspect of the agreement will link Peking and Massey in co-operative activities with Xin Jiang University in the north-west of China. "This will enable Massey to engage, as appropriate, in support of Chinese government policies relating to development in the western provinces, in particular in agriculture and horticulture as well as education more generally," says Professor Kinnear.

The new agreement follows a visit by Professor Kinnear to Peking University last year and the return visit of four professors from Peking to Massey in February.

Peking University is the top university in China and the most sought after for academic agreements with universities outside China. It ranked 17 in the *Times Higher Education Supplement* rating of world universities. Massey ranked 108, the second highest New Zealand university in the list.

Professor Kinnear greets the delegation from Peking University. From left: Associate Professor Yingzi Zheng, Director of Project Management with the Office of Scientific Research, Professor Hongya Gu, Deputy Dean of the College of Life Sciences, Professor Zhenfeng Xi, Dean of the College of Chemistry and Molecular Engineering, and delegation leader Professor Xing Zhu.

Extra heft for NMR spectrometer

A new $500,000 instrument that cools Massey University's 700-MHz nuclear magnetic resonance spectrometer will allow better-quality data to be obtained in a shorter time.

Designed to match the capability of the 700-MHz machine, the most powerful spectrometer in the country, the CryoProbe uses ultra-cold helium gas (25K or minus 248 degrees Celsius) to cool the spectrometer's electronic detecting systems.

Professor Geoff Jameson, who leads the Centre for Structural Biology, says the cooling function of the CryoProbe reduces the amount of thermal noise in the spectrometer – the equivalent to static in radio reception. "At room temperature the electrical circuitry is noisy, so minimising this type of noise improves the sensitivity of the instrument about three-to-five fold," says Professor Jameson.

PhD student Jo Claridge and chemist Dr Pat Edwards with the new Bruker CryoProbe.

Dr Regina Scheyvens from the School of People, Environment and Planning, and Associate Professor in Veterinary Anatomy Dr Alexander Davies have won Government awards for excellence in teaching for 2005. The awards were presented by Minister of Education Trevor Mallard at a formal ceremony held in the Grand Hall at Parliament on Tuesday 26 July.

Professor Pearce elected as Epidemiology President

Professor Neil Pearce, Director of Massey University's Centre for Public Health Research, has been elected as President of the International Epidemiology Association (IEA) at the recent World Congress of Epidemiology in Bangkok. Epidemiology is the scientific study of factors affecting the health and illness of populations.

Partnerships for Research

Agriculture

New Zealand may no longer be Britain's farm but the $17 billion New Zealand agriculture industry remains crucial to the local economy.

So news a trust is to be set up to advance research in the agricultural and biological sciences and funded to the tune of $22 million – $8.95 million from the Government's partnerships for excellence scheme, the remainder from industry partners – has been widely welcomed.

"Enhancing New Zealand's international competitiveness is vital if primary industry is to remain a foundation of our economy," Prime Minister Helen Clark told a gathering on the Palmerston North campus.

The Agricultural and Life Sciences Partnership will integrate the research and education capabilities of Massey and Lincoln with the requirements of industry.

Its focus is "to ensure that the on-farm and near-farm sectors of the agricultural and biological industries continue to be led and managed by outstanding individuals who are consistently upgrading their skills and capability, are sustained by a steady influx of New Zealand's best and brightest minds, and are supported and informed by leading-edge research".

Massey Vice-Chancellor Professor Judith Kinnear described the partnership as a landmark opportunity for academe to collaborate with a diverse and important industry. "Not only will it better enable the strategic alignment of New Zealand's $17 billion agricultural industry with its two leading agricultural universities, it will also be a powerful catalyst for further engagement and investment," she said.

Her counterpart, Vice-Chancellor of Lincoln University Professor Roger Field, said Lincoln and Massey had sought opportunities to work more closely together for some time. "This partnership will enable real and meaningful collaboration to develop."

The trust will be established by Massey and Lincoln Universities with the private sector partners including Meat and Wool New Zealand, Dairy Insight, Fonterra, the New Zealand Fruitgrowers Federation, and the Agricultural and Marketing Research and Development Trust (AgMardt).

The equine industry

A new $5 million research partnership between Massey University and the New Zealand equine industry will educate more people in equine science, technology and business.

"To date," Prime Minister Helen Clark said at the Palmerston North announcement, "investment in equine research has been small compared to that in other land-based industries." The Towards a Future-Focused New Zealand Equine Industry Partnership aims to change that via education and research to help the equine industry achieve its full economic potential.

"A feature of the high-performing sectors of the agriculture-based economy is the tremendous value they place on an educated workforce and good-quality research to keep ahead of the international competition," said Professor Grant Guilford, head of the University's Institute of Veterinary, Animal and Biomedical Sciences. "We want to facilitate a similar integrated suite of educational opportunities for the equine industry through this partnership."

One specific goal of the equine partnership is to increase the number of people with in-depth knowledge of equine science, technology and business entering the New Zealand equine industry to manage and grow equine enterprises. Another is to increase knowledge of equine husbandry and training to improve the skill and ability of persons to raise and train winners. The partnership also aims to reduce the incidence of injuries that reduce a horse's performance or push it into retirement.

Professor Elwyn Firth of Massey will lead the research programme, which will enlist the collaboration of researchers at Colorado State University; Lincoln University; Matamata Veterinary Services; Otago University; the Royal College, London; the University of California, Davis; and Utrecht University. The researchers will also work with Bomac Laboratories to develop more equine pharmaceuticals and nutraceuticals.

A robotic jaw

A robotic human jaw is being developed and built on Massey's Auckland campus.

The jaw is being made for Associate Professor Andrew Pullan of the University of Auckland by a team led by Massey's Dr John Bronlund and Associate Professor Peter Xu of the Institute of Engineering and Technology. The jaw will be used to supply information about the mechanics of the jaw muscles and the forces used in chewing and biting.

Professor Jules Keiser at the University of Otago's School of Dentistry has contributed data on the shape of the jaw and teeth. This information will be combined with research by Dr Kylie Foster at Massey's Auckland campus measuring the movement of a jaw as it chews, to provide a complete picture of a jaw in motion from which to base the robotic movement.

Dr Bronlund says the ability of the jaw to mechanically replicate the chewing actions of humans has applications across medicine and food technology. Dental researchers can use the jaw to study how dental implants respond to different foods and to test how impaired dentition affects chewing efficiency. The jaw is designed to be fitted with a variety of teeth, such as the sharp, pointy teeth of a six-year-old or the blunter molars of an adult.

For food technologists, the jaw will be useful in tracking the texture changes in foods during chewing. Dr Bronlund says robotic testing of this type will be valuable when combined with sensory food evaluation techniques.

It is planned to teach the robot to adaptively chew food. It may be made to make its own decisions on how to chew a new food product. If it loses a tooth, it will adjust its motion accordingly.

Massey master's student Jozsef-Sebastian Pap has designed the robot and the six actuators which drive the bottom jaw (the top half of the human jaw remains fixed). PhD student Jonathan Torrence is working on the control of the robot. The team estimates the first prototype robotic jaw is six months from completion.

A better blood pressure monitor

A wrist blood pressure monitor developed by lecturer Dr Olaf Diegel (pictured), promises a significant step forward in home health monitoring.

Dr Diegel, a lecturer in the Institute of Technology and Engineering at the Auckland campus, has a successful track record in developing health related products. He recently made headlines with the development of a tiny refrigerated unit for transporting insulin.

The discrepancies between the accuracy of recordings taken by professional devices and recordings taken by home devices were a major factor in the challenge he faced to design a more sophisticated home blood pressure monitor.

The rigid cuff wrist monitor has been developed in consultation with an international company that specialises in medical technologies for the home healthcare market. Existing wrist monitors look very much like a watch and have Velcro fastenings. Both of these qualities lead to problems in using the monitors for accurate readings, says Dr Diegel.

Having the appearance of a wrist watch is a fundamental flaw, he says, because users wear it with the monitor face upwards, rather than on the inside of the wrist, where it should be worn.

He says the Velcro fastening system was not ideal because users invariably fasten them to differing levels of tightness. The rigid cuff monitor Dr Diegel has developed ensures that the monitor is always on the wrist with the same tension and in the same position.

A tilt sensor and LED indicators tell the user their arm is in the right position to take an accurate reading.

Take-home fertility testing

A take-home fertility-testing kit under development in a Massey laboratory will give women and couples further control over pregnancy planning.

The fertility testing kits, which are under commercialisation by Manawatu BioTech Investment Ltd, test urine in a similar way to pregnancy testing kits. The technology aims to pinpoint the most fertile period of a woman's menstrual cycle by measuring the metabolites (excreted components) of the hormones oestrogen and progesterone. This, scientists believe, will enable a greater degree of accuracy compared with methods now used to pinpoint ovulation and optimum periods of fertility.

Massey graduate Dr Delwyn Cooke says the take-home kit will reduce the amount of stress involved in laboratory-based fertility testing, and will also reduce the cost of this type of testing. "Unlike laboratory assays it becomes feasible to monitor whole cycles on a day-by-day basis, and I also think it is appealing to the women as it does give them a feeling of control."

The kit is expected to be available within the next two years.

Crocodile tracker

At 2.00 am on a mid-July morning, Massey master's student Bindi Thomas and team captured, satellite-tagged and released their first crocodile, a 4.2 m male *Crocodylus porosus* now nicknamed Sputnik, into the estuaries of the Adelaide River, 100 km east of Darwin, Australia.

The work, which will go towards Ms Thomas's thesis, is a collaboration between the University and Australia's Parks and Wildlife Service, Northern Territory and the Queensland Parks and Wildlife Service.

In a procedure developed and fine-tuned by Dr John Holland and postgraduate students in the University's Natural Resource Management programme, the estuarine crocodile was tagged with a six-inch transmitter with two aerials. Attached painlessly and safely between scales on the crocodile's neck, the waterproof transmitter will communicate with a bi-polar satellite, allowing data of its location and movements to be collected regularly over the course of a year.

Using a Geographic Information System (GIS), the location data will be combined with various other types of meteorological data to gain a greater understanding of the range of the crocodile, ultimately improving the management of the interaction between the crocodiles, humans and livestock.

Since the species was granted protection in 1971, its numbers in the region have steadily increased from 3,000 to 70,000, bringing many more interactions between people and crocodiles.

Dr Holland says Ms Thomas's success has been extraordinary. "You give her a couple of words and she comes back with gold, a real adventurer and an up-and-coming croc-ologist.

"This research is important on a global scale, but it is especially important for the Northern Territories because it will fill a gap in the information about this shy, elusive creature. We know next to nothing about their home ranges. With this information managers will know where they are, and where they move around, both to protect people and also to ensure they have areas reserved for them."

Dr Holland's team in the Natural Resource Management group have used transmitters and GIS technology in similar projects with the New Zealand falcon and with elephants in Africa.

Ms Thomas has designed a website that enables the public to watch Sputnik's movements themselves, and has received positive feedback from international scientists as well as children. Visit http://www.croctrack.org.nz to see Sputnik's movements and to read more information about the project.

GPS system tracks racehorse fitness

Researchers at Massey's equine research centre in Palmerston North are using Global Positioning Satellite (GPS) technology to provide a comprehensive picture of the athleticism and fitness of racehorses.

Through two seasons of racing and training, two- and three-year-old horses carried GPS units in their saddlebags and the jockeys' helmets were fitted with receiver antennae. A heart-monitor enabled the simultaneous analysis of heart-rate data with the measurements of speed and time collected by the GPS receivers.

Knowing the speed and heart rate of a horse at any given moment helps trainers identify peak fitness, or a state of over-training, says Dr Chris Rogers, a senior researcher in the Institute of Veterinary and Animal Biomedical Sciences.

The equine research team is also applying GPS technology to the study of thoroughbred foals in the paddock.

Barcoding the biosphere

Massey scientists are participating in an international research project that plans to identify every living creature in the world using genetic 'barcodes'.

Massey's Professor David Lambert from the Allan Wilson Centre for Molecular Evolution and Ecology will lead New Zealand's contribution to the Barcode of Life project.

Professor Lambert's team will create DNA barcodes for New Zealand's flora and fauna, beginning with native birds and later including other animals, plants, insects and fungi. The team will also use DNA from ancient bones and soft tissues to identify extinct birds, such as moa, and their genetic similarity to modern species.

"Biodiversity, conservation and biosecurity management can only be conducted against a background of the known species composition of ecosystems, habitats, or countries," says Professor Lambert.

To date, taxonomists have identified about 1.7 million species, but the Barcode of Life project aims to sample the genetic barcodes of all 10 million species of life on Earth. The project will cost an estimated US$2.5 billion and is expected to take up to 20 years to complete.

Researcher Margo van den Berg tests her alertness in the new Human Time Isolation Facility at the Sleep/Wake Research Centre. She is using a psychomotor vigilance task device which measures reaction times. The electrodes attached to her head and face measure brain activity, eye movement and muscle tone in order to determine her neurophysiological alertness and sleep state. These electrodes will not be used in Ms Paine's melatonin study.

No rest for sleep researchers

New Zealand's first Human Time Isolation Facility was put to the test at the Sleep/Wake Research Centre in January.

Sleep/Wake researcher Sarah-Jane Paine put three of her colleagues to bed for 18 hours, but sleep was definitely off the agenda. So were coffee, tea, alcohol, chocolate and bananas: all interfere with melatonin production.

The Isolation Facility removes the external cues that might influence the circadian body clock, such as daylight, temperature, noise, television and clocks. The facility consists of three cubicles in a sound-proofed room, with controlled temperature, humidity and lighting, and an attached bathroom.

"The study looked at melatonin production over the course of the night. Melatonin is a hormone produced at night in the brain, and sunlight and artificial lighting can suppress production. The evening rise in melatonin secretion is one of the most reliable markers of the phase of the circadian body clock," Ms Paine says.

"You need to isolate someone from the normal time cues in order to see what their body clock is doing. I enlisted three of my colleagues for the trial run to test out study protocols and procedures."

The circadian clock is the biological clock in the human brain that regulates many aspects of metabolism, physiology and behaviour, including sleep and awake patterns. Ms Paine and her team of researchers, Riz Firestone, Heather Purnell, and Margo van den Berg, were rostered on through the night to monitor the study. Saliva samples were taken every half hour. These are analysed in Adelaide to measure melatonin levels.

Although the Isolation Facility is designed to remove significant external cues, the unexpected can still occur. A 5.5 earthquake struck during the morning, but didn't last long enough to disrupt the study. "We were relieved it only lasted a few seconds," says Ms Paine. "If it had been worse we would have had to abandon the study."

For sleep researcher Nat Marshall it was a long night. After 30 hours awake he says he was hanging out for a sleep. Although confined to bed for the period of the study, he was permitted to watch DVD movies, play games or read.

Ms Paine is a PhD student at Massey, supported by a Health Research Council Māori Health Scholarship. Her full study, which also has support from the Lottery Grants Board, will compare the melatonin rhythms of 30 morning-type people and 30 evening-type people recruited from a questionnaire survey, to see if their differences in sleep patterns are linked to differences in their circadian body clocks.

Researchers Dr Leigh Signal and Margo van den Berg are planning a 40-hour study to investigate the effects of sleep inertia: the feeling of grogginess that people with disrupted sleep patterns such as shiftworkers experience.

Larks and owls

We all know them and sometimes we are them: morning people who rise early, prefer to be active in the morning and are earlier to bed; and their counterparts, the evening people who favour rising later and staying up late. But what proportion of us fall into which camp?

Sleep/Wake researcher Sarah-Jane Paine investigated the prevalence of morning-type and evening-type people. The study found that one in four New Zealanders aged 30–49 are morning people, one in four are evening people, and the rest fall between.

Age and work schedule were found to be important. "As you get older, you are more likely to be a morning person," says Ms Paine. "And night workers are more likely to be evening people."

The study found that evening people were more than twice as likely to report poor health than morning people.

"In our 24-hour society, where shift work is becoming more common and people are up at all times of the day and night, a better understanding of sleep and wake patterns is important," says Ms Paine. "Our circadian clock, which is located in the brain, regulates body functions such as sleep and wakefulness, changes in core body temperature, and the release of hormones such as melatonin."

Ms Paine is now setting out to determine how much of a person's preference for early mornings or late nights is due to differences in the timing of their circadian clock and how much is due to societal pressures such as work and family commitments.

Individual

Professor Robert McLachlan of the Institute of Fundamental Sciences is no stranger to honours: he was awarded a personal chair in applied mathematics in 2002, a research medal by the Association of Scientists in 2003, and in 2004 the Maclaurin Fellowship from the New Zealand Institute for Mathematics and its Applications.

Professor David Parry, head of the Institute of Fundamental Sciences, describes Professor McLachlan as standing alongside such eminent New Zealand mathematicians as applied mathematician Professor Roy Kerr, who explored the physics of black holes, and world-renowned algebraist of the early 1900s Professor Alexander Aitken.

Professor McLachlan has been awarded research grants totalling more than $1.7 million and had 55 publications in international refereed journals and book chapters, with another nine either due to be published, submitted for publication or in preparation.

He holds a BSc with first class honours from the University of Canterbury and a PhD in applied mathematics from the California Institute of Technology in 1990. Professor McLachlan founded and organises the Wellington–Manawatu Applied Mathematics Day, held biennially at the University, and has been editor of the *Newsletter of the New Zealand Mathematical Society* since 2000.

The individual researcher award carries with it a $20,000 research grant.

Research Team

The **Riddet Centre** was established in 2002 as a national centre for high-quality research in food and biological innovation. It draws on an exceptional network of talent from three of New Zealand's leading universities: Massey University as host, the University of Auckland and the University of Otago, as well as from the expertise in overseas institutes.

This network gives the centre unprecedented leadership in foods research in Australasia. The centre brings innovative solutions to the food industry, particularly in functional foods and in food ingredients with novel characteristics.

Based in Palmerston North, the centre is driven by co-directors Professor Paul Moughan and Professor Harjinder Singh. Professor David Mellor, Professor Jim Mann (University of Otago) and Professor Don Chen (University of Auckland) are also principals. Each is able to draw from the pool of scientific staff across the universities.

More than 30 people are directly involved with or employed at the Centre, including three new associates and three visiting fellows appointed this year. Eighteen postgraduate students are currently enrolled; nine have completed their studies.

In its brief existence, the Centre has secured more than $12 million in external funding. Among its national and international research partnerships and collaborations are the Biolysine project (related to amino acids in food), the Omega-3 Enriched Foods project (working with the University of Newcastle to produce foods with high levels of fish oil), the multi-million-dollar PosiFoods project with Fonterra, and a joint venture with Alpha Healthcare International, a Chinese company specialising in nutraceuticals.

Supervisor

Professor Nanthi Bolan, one of New Zealand's leading soil scientists, is the director of postgraduate studies in the College of Sciences' Institute of Natural Resources.

In the 20-plus years Professor Bolan has been with Massey he has supervised 20 students towards PhDs, 15 for master's and several postgraduate diploma and honours students. He is often invited to give seminar presentations to other PhD supervisors.

According to Institute head Professor Russ Tillman, Professor Bolan's students – many of whom come to New Zealand to study with him – have an exceptionally high completion rate. A number remain in touch. He has published or presented more than 350 journal and conference papers.

In 2000 the New Zealand Soil Science Society awarded him its fellowship, and in 2004 he received an ML Leamy award in recognition of his published contributions to the science from 2002 to 2004.

Born in India, Professor Bolan holds a BSc and MSc from Tamil Nadu Agricultural University and a PhD from the University of Western Australia. He came to Massey in 1984 and was appointed professor in 2003.

Early Career

Dr Nikolaos Kazantzis is a senior lecturer, in the School of Psychology. Dr Kazantzis is researching a component of Cognitive Behaviour Therapy (CBT), which targets changing both how those receiving therapy think (the cognitive component) and how they act (the behavioural). Unlike some other talking treatments, CBT focuses on here-and-now problems and difficulties.

Those taking part in CBT are given 'homework' – therapeutic activities such as changing behaviours in everyday life – to do between sessions.

However, it can be difficult to get people to engage in their 'homework', and the mechanism by which such homework produces its effects has not been closely studied.

Dr Kazantzis has drawn together a team to pursue conceptually driven research into CBT homework.

The team is collaborating with international experts in the field and has established a research laboratory for postgraduate students.

Among Dr Kazantzis's honours is an Early Career Award from the Australian Association for Cognitive Behaviour Therapy.

Early Career

Dr Justin O'Sullivan is a senior lecturer in molecular biology. His work addresses a fundamental biological question: how do cells transcribe genes at the phenomenal rate they do? His work suggest that DNA directly facilitates the rate of transcription by actively producing DNA loops.

Dr O'Sullivan's work links DNA topology with a number of cellular processes, including ageing.

Dr O'Sullivan's latest results recently appeared in *Nature Genetics*.

Within 12 months of joining Massey in 2004 Dr O'Sullivan had secured a Marsden Fast Start grant and research funds from the Maurice and Phyllis Paykel trust, the Auckland Medical Research Foundation and the Massey University Research Foundation.

Early Career

Dr Stephen Marsland, a lecturer in the Institute of Information Sciences and Technology since February 2004, completed his PhD in machine learning at the University of Manchester, UK. Dr Marsland currently teaches courses in artificial intelligence, operating systems and concurrent programming, and cryptography.

Dr Marsland applies mathematics to problems in scientific computing, such as machine learning, computational image analysis, and complex systems. His work has application in such realms as medical informatics, medical image analysis, bioinformatics, robotics and fluid dynamics.

In 2004 Dr Marsland won a Marsden Fast Start grant to undertake a focused research project on diffeomorphisms – functions that have interesting mathematical properties, many yet to be investigated. Diffeomorphisms are useful in fluid dynamics, plasma physics and image warping. Dr Marsland's particular interest is in image warping, which is used in analysing medical images and is lending itself to the diagnosis of diseases such as Alzheimer's, schizophrenia and Huntingdon's.

Early Career

Dr Mark Waterland lectures in physical and inorganic chemistry in the Institute of Fundamental Sciences.

His research focuses on Raman spectroscopy: the study of light spectra to determine the chemical composition of substances and the physical properties of molecules, ions and atoms.

Dr Waterland applies the method of analysing Raman scattering intensities to determining the optical response of photonic molecular materials. He is also building a Stark spectroscopy apparatus to provide complementary data. Dr Waterland and his colleagues are one of the few groups in the world applying both Stark and Raman techniques to the study of optical materials.

The Raman technique probes the motions of the nucleii of the molecules; the Stark technique probes the motions of the electrons. Taken together, the two methods provide a detailed picture of how molecules respond to electromagnetic radiation. The Massey group works in collaboration with a group at the University of Otago that specialises in the calculation of the properties of optical materials.

2005 Marsden grants

Dr Ian Bond, from the Institute of Information and Mathematical Sciences, will conduct a search for planetary systems in the galaxy using a newly developed, remarkably sensitive technique. Known as 'microlensing', the technique uses the systems as large naturally occurring lenses, and is sensitive to planets with masses as low as that of the Earth. Microlensing events will be detected using a new 1.8m telescope at the Mt John Observatory in Canterbury. Dr Bond's major scientific goal is to discover extrasolar planets in large enough numbers to measure the abundances of low-mass (below 10 Earth masses) 'rocky' planets in the galaxy. A parallel goal is to look for evidence of planetary systems similar to that of our own solar system. Researchers will also use microlensing observations to search for isolated black holes and as a novel technique for measuring stellar shapes. They will use the Deep Impact spacecraft to conduct stereoscopic observations of microlensing events from Earth and from the spacecraft. This will identify a class of lens star systems that may comprise a significant fraction of the galactic dark matter. Led by Dr Bond, the research team's research will lay the groundwork for possible future New Zealand participation in Antarctic and space-based astronomy.

Dr Barbara Holland, from the Allan Wilson Centre for Molecular Ecology and Evolution, will use genome-scale data sets to measure the impact of lineage-specific molecular evolution of plant species. Her team will gain a better understanding of plant phylogeny – the development of a species over time as contrasted with the development of an individual. When biologists estimate evolutionary trees they rely on mathematical models and encounter difficulties when realistic situations are too complex for the mathematical modelling. Dr Holland says that almost all mathematical models of evolution assume the same processes across the evolutionary tree. Using these simple models of sequence evolution to estimate evolutionary trees for more recent divergences, such as mammals and birds, has been hugely successful. However, for deep divergences the fact that DNA sequences in different lineages acquire their own properties is too important to ignore. Her study will use a genome-scale data set of nucleotide and protein alignments for 47 chloroplast genes and 30 taxa. By restricting the taxa to different subsets – flowering plants; land plants; green plants and green algae; all algae and plants – Dr Holland's team will measure the impact of lineage-specific molecular evolution for a range of time scales and gain a better understanding of deep plant phylogeny.

Dr Kim McBreen and **Associate Professor Peter Lockhart,** from the Allan Wilson Centre for Molecular Ecology and Evolution, will use the native New Zealand plant genus *Pachycladon* to understand adaptive plant radiations. While some plant lineages have maintained very similar forms over long periods of evolutionary time, others show recent phenotypic diversification. The floras of island groups, such as New Zealand, provide many examples of this type of diversification. The drivers of morphological and ecological diversification are unclear, but it is generally accepted that a few key genes are involved in the evolution of plant form. Progress into the identification of these genes is being made using comparative approaches with model organisms. In particular, study of the model plant *Arabidopsis* and its close relatives is leading to a much greater understanding of the genetic processes involved in plant development and evolution. The native *Pachycladon* is closely related to *Arabidopsis*, recent in origin, and shows considerable diversity of form among its species. By taking advantage of the resources that are available for *Arabidopsis*, and the natural diversity within the *Pachycladon* group, the research team hopes to make an important contribution to understanding the genetic processes important in plant species radiation.

Dr Gill Norris and **Dr Mark Patchett,** from the Institute of Molecular Biosciences, will identify and study the bacterial farnesyltransferase enzyme to find out how it adds farnesyl groups to proteins. Proteins are the molecular workers of life, and their diversity is far greater than can be predicted from genomes. Modifications to proteins after synthesis contribute to this diversity, effectively increasing the range of tasks that proteins perform. The addition of prenyl groups to C-terminal cysteines (one of the amino acids) of proteins is a pivotal eukaryotic modification associated with cell signalling and cancer. This modification is completely unknown in bacteria despite the universal availability of requisite isoprenoid substrates, and the

existence of various other lipid-modified proteins. Drs Norris and Patchett have discovered that *Lactobacillus plantarum* produces a small antibacterial protein with a farnesylated C-terminal cysteine, the first example of cysteine prenylation in bacteria. To carry out this modification, *L. plantarum* must produce an enzyme with farnesyltransferase (FTase) activity. The researchers aim to find the bacterial FTase enzyme investigate FTase distribution in prokaryotes, the biological consequences of its activity, and its evolutionary origin including any relationship to eukaryotic FTases.

Dr Steve Pascal, from the Institute of Fundamental Sciences, will study the mechanisms of protein interaction linked to prostate disease and neurodegenerative disease. Cancer, Alzheimer's disease, stroke and coronary heart disease are related to the process of programmed cell death, or apoptosis. The human body naturally kills many of its own cells from time to time, but in cases of cancer, damaged cells evade apoptosis and multiply to form a tumour. In Alzheimer's disease, stroke and heart attack, otherwise healthy cells are triggered to die, damaging the brain or heart. The Par-4 protein is linked to each of the above conditions: it was first identified by its appearance in apoptosis-sensitive prostate cancer cells, and since has been found at unusually elevated levels in dying brain and heart cells. Dr Pascal will study how Par-4 interacts with other human proteins in order to understand how it affects apoptosis. Already, Dr Pascal's researchers have determined that by introducing Par-4 into a tumour, cancer cells can be killed without affecting the surrounding tissue. They will study this mechanism in greater detail, and gather data that may lead to drugs designed to either inhibit (in heart and brain) or trigger (in tumours) apoptosis.

Dr Bill Williams, from the Institute of Fundamental Sciences, will investigate the nanomechanical structure-function relationships in nature's structural biopolymers with single molecule stretching. He says there is a common perception that the smart materials and devices of the 21st century will be engineered at the nano-scale. "Nature already performs such bottom-up processing with aplomb, assembling structures at the molecular level in order to yield materials with desired macroscopic attributes," he says. In addition, biomaterials are often 'smart', changing their properties in response to external stimuli, and are processed at ambient temperatures, from sustainable resources, before being seamlessly recycled into the biosphere at the end of their usefulness. To be able to imitate this natural molecular change in the construction of our own materials and devices, the structure-function relationships it exploits must be understood. Recently, the molecular origin of bio-mechanical properties has been investigated, with prototypical structuring biopolymers being stretched at the single molecule level. It has been found that certain polysaccharides, which play a major role in satisfying the structural requirements of both plant cell walls and animal connective tissues, undergo conformational transitions in their sugar rings under tension. This project will investigate how such transitions are controlled and utilised in nature.

Dr Shane Cronin and **Dr Vernon Manville,** from the Institute of Natural Resources, will conduct a highly opportunistic experiment, afforded by an expected lahar on the Ruapehu volcano, to study the secrets of a lahar. They will develop new techniques for understanding and monitoring geologic mass-flows. Since the eruptions of 1996, the volcano's crater lake has risen behind a barrier of loose debris. Sudden failure of this dam and the triggering of a lahar is predicted from late 2005 onward. New eruptions could also generate mass-flows at any time. The researchers will use this unique circumstance and employ aerial and digital photographic surveys to analyse post-event changes in channel morphology, sediment erosion and redistribution. They will develop innovative ways to apply mechanical, electromagnetic, vibration, and pressure detection systems to understand the velocities, sediment distribution, flow and erosion processes within rapidly moving sediment-water slurries. The new monitoring systems will be tested in the lab as well as at Ruapehu and a debris flood-prone area in Indonesia. Results will form a globally unique data set to enable the testing of evolving scientific hypotheses of sediment-water flow mechanics. The data will also serve as a global-standard against which the new generation of numerical and physical mass-flow models can be calibrated and refined.

Fast Start Funding Recipients 2005

Dr Paul Plieger, from the Institute of Fundamental Sciences, will design an anion (a negatively charged ion) receptor capable of switching between binding two anions (that possess different geometric shapes and charges) with the application of a driving force (e.g. an applied electrical potential). Anion recognition is an area of supramolecular chemistry (the study of molecular assembly using weak forces) that has gained increasing attention in recent years. Molecules (receptors) can be designed to 'recognise' or bind negatively charged species (anions) using appropriate functional groups, the number and position of which can induce selectivity – or the preferential binding of one anion over others. Electrical control of an anion receptor to 'catch' an anion is desirable. Currently, most research is focused on passive anion recognition where the anion receptor has been designed to match one specific anion: in order to bind a different anion a new molecular 'glove' is needed. It is intended that the skills and knowledge learnt from this study will be adapted to use for the design of anion drug delivery systems.

Dr Beatrix Jones, from the Institute of Information and Mathematical Sciences, will integrate information from genetic data, and information from demographic data (such as the size, age and location of individuals), in a process called parentage analysis. She will examine parentage analysis as a tractable case study for understanding how the amount of data of different types affect parameter uncertainty. Hierarchical models are crucial statistical tools for integrating diverse data sources. One application is studying the mating and dispersal patterns in natural populations. In many hierarchical models, including parentage analysis models, the relationship between the quantity and type of data collected and the quality of inference about model parameters is still imperfectly understood. This poses a barrier to designing efficient data collection schemes. Dr Jones's results will be applicable across the range of hierarchical models, as well as providing tools of immediate application to those studying population demographic structure with parentage analysis.

Dr Alona Ben-Tal, from the Institute of Information and Mathematical Sciences, will study the transition from normal breathing to Cheyne-Stokes respiration (CSR) in humans. CSR is a form of sleep-disordered breathing where a person experiences cycles of increasing ventilation followed by decreasing ventilation, followed by periods of breath holding. This form of breathing is seen in people with heart failure and neurological disorders, in infants, and in healthy people at high altitude. The phenomenon is still not well understood. Known as 'bifurcation' in mathematical jargon, CSR has previously been explained by one type of bifurcation found in mathematical models that averages the ventilation over time. However, other types of bifurcations that could possibly give rise to CSR could not have been captured by the previous models. This research will look for other types of bifurcations (and hence new mechanisms to explain CSR) by studying simplified mathematical models that do not average the ventilation over time. Understanding the mechanism for the onset of CSR could help develop new methods of treatment and diagnosis of patients who suffer from CSR, including those with cardiovascular disease.

Dr Christine van Dalen, from the Centre for Public Health Research, will investigate the role of lung macrophages in asthma pathology. A primary feature of asthma is the persistence of acute inflammatory cells recruited to the airways during an asthma attack. They normally die soon after by a controlled process termed apoptosis. The major advantage of this form of cell death is that the tissue-destroying contents of the dead cells remain sealed away from surrounding tissues. They are then removed from the lung by engulfment (phagocytosis) within the lung macrophages, leaving the surrounding tissues undamaged. If the inflammatory cells are not removed in this way, they break apart and release their contents into the airways. New inflammatory cells are then recruited, making the airways susceptible to a further asthma attack. This project will investigate whether a defect in the ability of lung macrophages to remove such cells from the airways of asthmatics contributes to tissue destruction and the persistence of inflammation. It will compare the ability of macrophages obtained directly from the airways of asthmatics and non-asthmatics to engulf inflammatory cells. If the hypothesis is correct, the study will uncover a defect of cellular function fundamental to the development of chronic inflammation in asthma.

Dr Sebastian Link, from the Department of Information Systems, will investigate complex-value database design problems using Brouwerian algebras. A key challenge for database researchers is the provision of a central approach for the representation and efficient management of complex application data. Such data occur in areas such as molecular biology, chemical reactions, cell processes, e-business, seismology, vulcanism and geographic information systems. While the mathematical and logical basis for traditional database systems is sufficient for dealing with simple data, there are not yet such strong foundations for complex-value data. Researchers have observed that Brouwerian algebras provide a coherent framework for extending traditional database design solutions to deal with complex structured data from many different application areas. The goal is to use the theory of Brouwerian algebras to formally specify dependencies among complex data; to investigate how their semantics can be captured and processed efficiently; and to study how such dependencies can be used to provide syntactic guidelines for semantically well-designed databases that are free from data redundancies and processing difficulties. The researchers aim to obtain a better general understanding of common characteristics of complex data, and therefore contribute to a mathematically sound foundation for future-generation databases.

Fast Start grants, which are worth $50,000 a year for two years, are awarded as part of the Marsden Fund, which is administered by the Royal Society of New Zealand.

Health research funding for new and established projects

The health of older adults as they move from employment to retirement is the focus of a research project awarded more than $650,000 from the Health Research Council (HRC). It is one of several Massey projects to succeed in the HRC's annual funding round of more than $62 million for 75 projects this year.

Dr Fiona Alpass, a researcher in the School of Psychology, and a team of researchers will identify the influences on health and wellbeing in later midlife that lay the basis for community participation and health in later life.

The three-year project will explore the relationships between physical and mental health and personal circumstances for people aged between 55 and 70 years as they move into retirement. It will examine how this relates to positive ageing, independence, and maintenance of health as people grow older. Data will be collected through postal questionnaires and interviews, with follow-up interviews every second year over a 10-year period. The study will dovetail with achieving the goals of the Government's Positive Ageing Strategy.

From the School of Māori Studies at the Palmerston North campus, **Amohia Boulton** has been awarded an HRC Strategic Development Contract to explore the issues and challenges that funders, planners and providers have in contracting for 'whānau ora' at the district level.

At the Auckland-based Centre for Social and Health Outcomes Research and Evaluation, **Helen Moewaka Barnes** has been awarded more than $878,000 for a three-year study of the intergenerational experiences of environments and wellbeing.

Four projects based at the Centre for Public Health Research at the Wellington campus have also received funding. **Professor Neil Pearce's** research programme into the causes and control of communicable disease received further funding of $1.7 million.

Dr Andrea't Mannetje earned project funding of $1.111 million over three years to research dioxin exposure levels and health effects in phenoxy herbicide production workers, and **Dr Sunia Foliaki** received $68,582 over three years for a study of cancer in Pacific populations.

Janice Wenn and **Professor Chris Cunningham** of the Research Centre for Māori Health and Development received funding of $84,620 over three years for an interactive study into developing quality standards for Kaupapa Hauora services.

Staff to receive HRC funding as participants in research projects outside of the University include: **Amohia Boulton**, **Associate Professor Paul Merrick**, and **Professor Chris Cunningham**.

The HRC is the government agency responsible for funding public good health research in New Zealand.

$1.5 million for jobs research

The Foundation for Research, Science and Technology has made a $1.5 million grant – $300,000 per year for the next five years – to a multidisciplinary Massey University team to undertake an action-based study of sustainable employment in the uncertain world of work.

The research will focus on the demand side of the labour market, and build on the findings of the eight-year Labour Market Dynamics Study, led by **Professor Paul Spoonley**, which concluded in June 2005.

This found that the work environment is precarious and, increasingly, people are piecing together a living from a mix of part-time, casual and contract work, and self-employment.

The team will investigate how best to generate sustainable employment, looking at targeting skills training and education, and available and future opportunities across industries. The research will include a survey of 1,000 New Zealanders two years apart, and in-depth employment history interviews with people aged 15 to 34 years in Auckland, Wellington, Manawatu and Gisborne. Employers in the four areas will be surveyed on their strategies for organising labour supply and the associated costs and benefits.

Professor Spoonley says that a poor fit between training and employment opportunities has been exacerbated by emigration, an ageing population and the poor use made of immigrants' skills. Among employers there is a common perception that would-be employees lack a 'work culture'.

"Thirty-nine percent of firms in New Zealand are experiencing difficulty in getting people with the right skills," he says.

The team includes **Professor Paul Spoonley** and **Dr Ann Dupuis** (sociology), **Professor Anne de Bruin** (economics), **Professor Kerr Inkson** (management and international business) and **Eljon Fitzgerald** (Māori Studies).

At the opening of the New Zealand Guitar Centre on Massey's Wellington campus during September's International Guitar Festival. From left, Professor Benjamin Verdery of Yale University, eminent New Zealand classical guitarist Professor Matthew Marshall and Chair of the Wellington City Council Arts Committee Ray Ahipene-Mercer.

A highlight of the Guitar Festival, Australian group Guitar Trek.

A new psychology clinic has opened as part of the Wellington campus. The clinic will be used for research, to support the postgraduate clinical psychology training programme, and to provide a clinical service. Massey has the largest clinical psychology training programme of any New Zealand university, with students studying at each of its three campuses.
Pictured from left: Professor Janet Leatham, Professor Ian Evans, Hon. Annette King, Dr Duncan Babbage and Professor Ken Heskin.

We like it here

Most New Zealanders are proud to be Kiwi and want to live in New Zealand for the rest of their lives.

The 2005 New Zealand Values Survey, conducted by the Centre for Social and Health Outcomes Research and Evaluation (SHORE) in Auckland and the School of Sociology, Social Policy and Social Work in Palmerston North, is part of the World Values Survey which aims to provide cross-country comparisons.

Of almost 2,500 people over the age of 18 asked in a random telephone survey, nearly 70 percent said they were 'very proud' and one-quarter said they were 'quite proud' to be a New Zealander.

When asked to rank their commitment to spending most of their lives in New Zealand from one to five, 78 percent responded in the top two categories while 11 percent chose the least committed categories and the remainder were neutral. Those aged between 18 and 24 were less likely to be committed to living in New Zealand (66 percent), than tertiary-educated people (75 percent) and those with primary education (80 percent).

Regardless of their level of commitment, all respondents were asked what factors they considered important to a decision to live in New Zealand. A good public health system topped a list of eight factors in their decision, with 96 percent considering it was important. A high-quality natural environment was second, considered important by 94 percent, and a good work/life balance and good education for children were factors for 93 percent. A low crime rate was a factor for 92 percent of those committed to staying in New Zealand, 82 percent deemed high employment important, while low poverty and possible earnings were a factor for 79 and 77 percent of respondents respectively.

"Only three factors were significantly different between those who were committed to staying in New Zealand and those less committed," says Professor Sally Casswell, director of SHORE. "Those very committed to spending the rest of their lives here are significantly more likely to value a high-quality natural environment, a good work/life balance and New Zealand's artistic and cultural heritage."

The survey is one part of the country's most substantial study of the nation's political, social and moral opinions.

Young people and alcohol

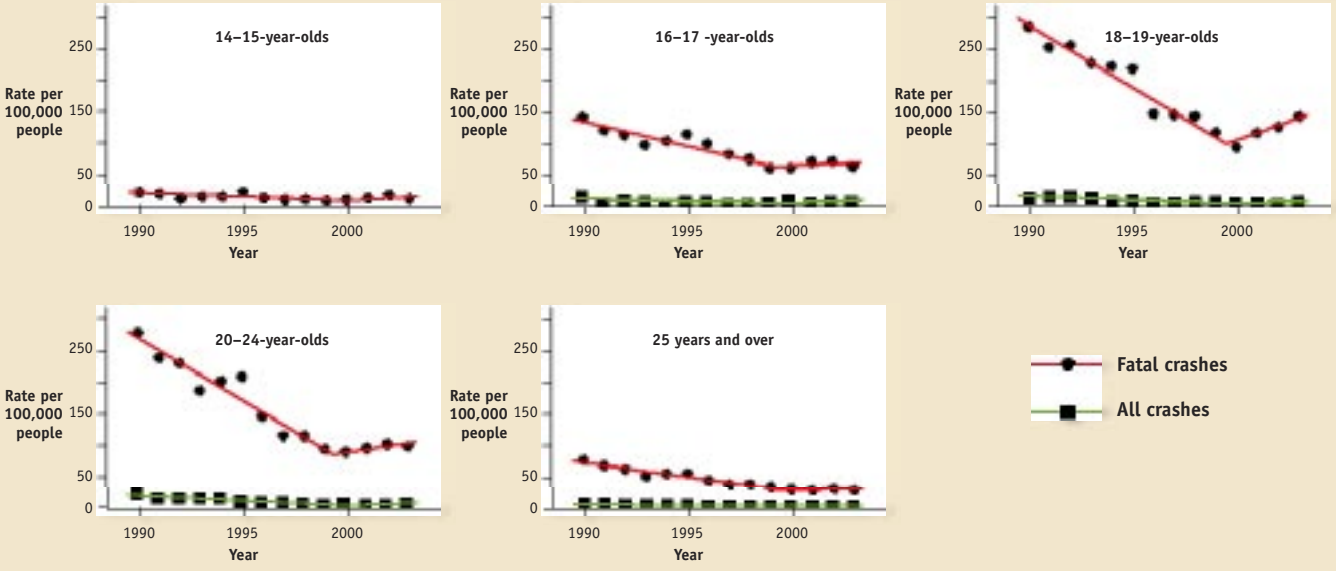
In New Zealand between 1990 and 1999 there was a series of liberalising alcohol changes. The most conspicuous of these was the lowering of the minimum purchase age from 20 to 18 years in 1999. But there were other major shifts as well. The number of liquor outlets rose steeply after the relaxation of the conditions for obtaining a licence to sell alcohol and the sale of wine being allowed in supermarkets and grocery outlets. (In 1990 there were 6,000 licences to sell alcohol; in 2002 there were 14,000.)

An analysis conducted in 1995 found from February 1992, when the advertising of brands of alcohol was allowed in the broadcast media, to 1995, when an analysis was done, televised alcohol advertising increased fourfold.

Additionally, the alcohol industry became more sophisticated at addressing their products and marketing to young people; the extensive range of ready-to-drinks (premixed spirit-based drinks often flavoured to suit a youth palate) introduced to the New Zealand market in 1995 being a good example.

What, then, have been the consequences? Taisia Huckle, Megan Pledger and Professor Sally Casswell set out to analyse alcohol-related harms and offences from 1990 to 2003.

They found that the liberalisation of alcohol through the 1990s may have influenced younger people and that this may be expressed in increases in disorderly behaviour and drink driving. They also found – as is tellingly illustrated by the accompanying graphs – that the lower minimum purchase age may be associated with a rising incidence of fatal road crashes among 18-19-year-olds.



More moa or fewer?

How many moa species were there? Since the English anatomist Richard Owen first identified the existence of the moa in 1840 the number has fluctuated. By the 1890s Hutton had identified 26 species. In 1949 Oliver had the number at 29. In the 1970s it had fallen to 11. But certainty about the actual number was always going to be elusive as long as bone anatomy was the basis of identification.

In 2003 this changed. By copying ancient nuclear DNA extracted from moa bones up to 6,000 years old Professor David Lambert and his team were able to identify 10 species, in the process folding together two 'species' with the discovery these were simply the smaller male and the much larger female.

But 10 has not lasted long. Now, there are 14 species of moa. Professor David Lambert and his collaborators – Professor Allan Baker from the Royal Ontario Museum and the University of Toronto and Dr Craig Millar from the Allan Wilson Centre at the University of Auckland – have identified five more species of moa, including one giant of more than 140 kg, and at the same time another two 'species' have been folded into one. (Hence the two identical moa to the right of the diagram.)

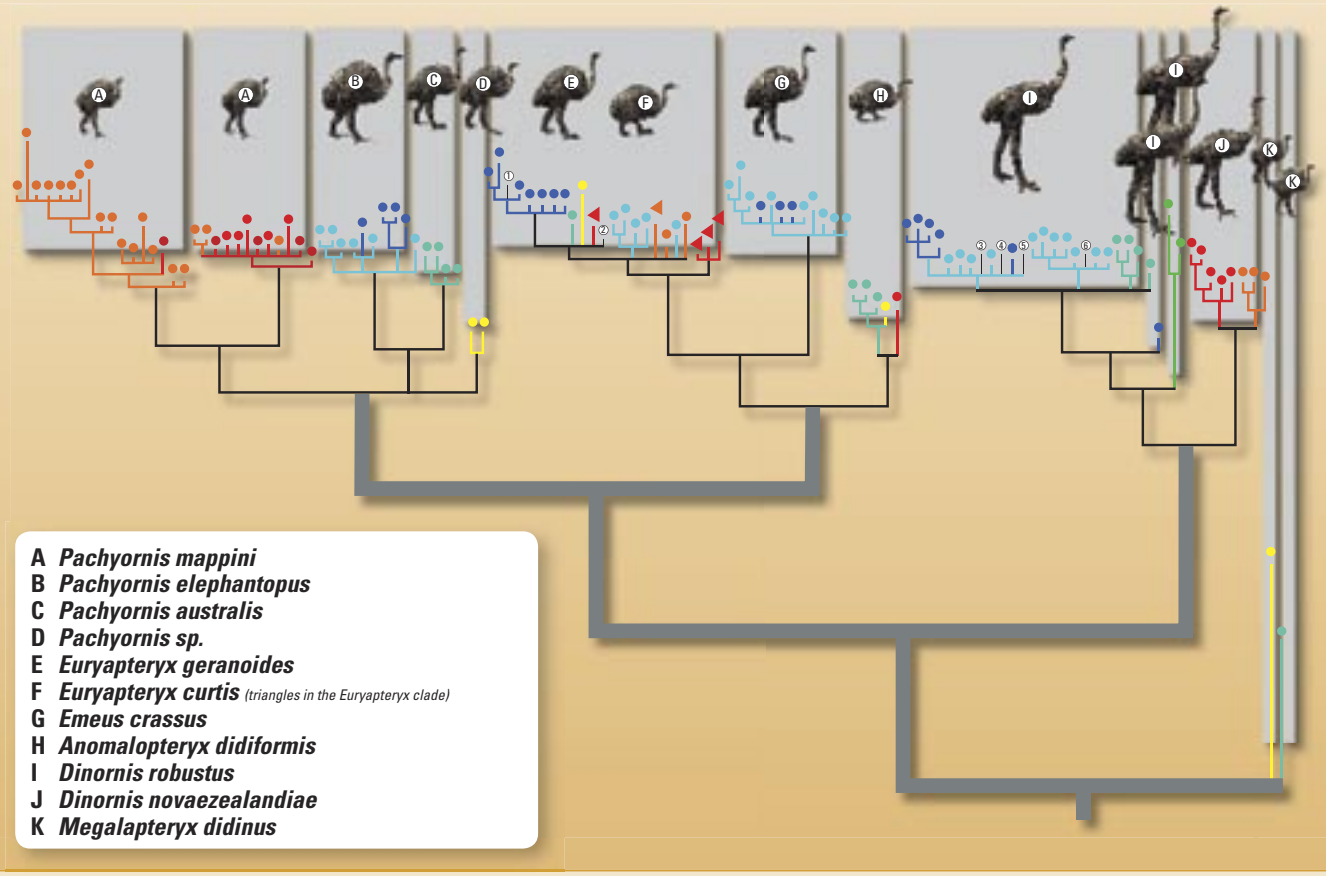
Again, the identification of the new species has been enabled by the extraction and analysis of DNA. Samples of ancient DNA were extracted from 125 moa bones and genetically typed. The researchers have been able to construct the most accurate family tree of moa available to date. It shows that evolution of moa is much more recent than had been thought.

"Not only does this tell us who was related to whom but it also tells us how long ago they all separated. It's commonly thought they evolved tens of millions of years ago but our evidence suggests in fact it was from four to ten million years ago. In scientific terms, that is quite recent," says Professor Lambert.

According to the researchers, the different moa species began to diverge about four to six million years ago, when New Zealand's land mass was broken up by the advent of new mountains and there was a general cooling of the climate.

"This resulted in the isolation of lineages and promoted ecological specialisation. The spectacular radiation of moa involved significant changes in body size, shape and mass. The moa radiation provides another example of the general influence of large-scale palaeoenvironmental changes on vertebrate evolutionary history, similar to that of the Galapagos finches and the Hawaiian honeycreepers."

The paper on reconstructing the tempo and model of evolution with the extinct moa has featured in the *Proceedings of the National Academy of Sciences USA*.



Consciousness and the unborn

Unborn babies may look as if they are reacting to external stimuli but they are not doing so consciously, according to Professor David Mellor.

"Touch, sound and other stimuli have various effects on the body, including eliciting movements. But the evidence, accumulated over the past 25-35 years, is that this does not occur at the conscious level," says Professor Mellor. "There are many other examples of sensory inputs that have effects on the baby (including body movements) that do not involve consciousness. For instance, babies with no cerebral cortex (the part of the brain essential for consciousness) can respond with movements and hormone release and heart rate changes."

A literature review published by Massey Professor Mellor and Auckland University colleagues in Brain Research Reviews and cited in *New Scientist* says that babies are in sleep-like unconscious states throughout pregnancy, as both the fetal brain and placenta produce potent sleep-inducing hormones, including the neurosteroidal anaesthetic pregnanolone.

Professor Mellor and his colleagues have cautioned against giving fetuses anaesthetics or analgesics during surgery, as rather than offering relief from pain these may harm the fetus.

Mercury exposure linked to health problems

School dental nurses who were exposed to high levels of mercury as young women have more health problems than other women of the same age.

A study conducted by psychology lecturer and researcher Dr Linda Jones has compared the health of 43 middle-aged women who were exposed to high levels of mercury at work and 32 women in a matched control group.

Dr Jones says the group exposed to mercury had more health problems, including headaches, a persistent metallic taste, dry skin, sleep disturbances, anxiety and tremors.

"The most notable difference was reproductive health, where 25 percent of exposed women had hysterectomies, compared with 6 percent of the control group," she says.

Prior to 1974, when its use was abandoned, copper amalgam was used as the material for the fillings given in New Zealand school dental clinics. The amalgam was produced by heating pellets, and in so doing releasing mercury vapour. On average a clinic would produce amalgam 10 times per working day.

The study's findings lend support to the theory that symptoms of mercury poisoning are gradually unmasked as people age. The study is one part of a broader PhD thesis, titled *The Quicksilver Quest: Two Psychological Studies Investigating the Effects of Mercury in Dentistry*.

Credit card interest rates: consumers uninterested

Between 1996 and 2003, credit card borrowing rose from about $1.5 billion ($1.1b of it interest-bearing) to more than $3.5 billion ($2.5b interest-bearing). Over that time the gap between the benchmark cost of borrowing, the 90-day bill rate, and the rates charged by credit card companies grew steadily.

Why is this? Surely the rational consumers found in classical economics texts would shift their debt elsewhere. Shouldn't market competition drive interest rates down?

To find out what was happening, Christine Chandran and senior lecturers Claire Matthews and David Tripe from the Department of Finance, Banking and Property surveyed 200 people in August 2003.

They found the lack of competition rooted in consumer apathy; most of us neither know nor care what interest rates or fees our credit cards charge us. Up to 80 percent of cardholders regarded rates of interest as a "trivial issue", 65 percent did not know their card's current interest rate, and 59 percent did not know what fees they were paying.

The survey also found that 50 to 60 percent of 'smart users' pay off their full balance each month, avoiding interest and penalty charges; a further 25 percent pay interest charges on outstanding balances of $500 or less; and the remaining 15 to 25 percent pay interest on outstanding balances of greater than $500.

As for that 5 percent of credit card holders with outstanding balances of $5,000 or more, for whom interest rates are likely to be a "significant issue", earlier research has shown that in many instances they will not be at liberty to shop around, being more likely to be "credit constrained" and so less able to get approval to refinance the debt.

Internet banking – who uses it?

When it comes to Internet banking, men and women have different perceptions about what matters. And whether you are Asian, European or Polynesian may also affect your acceptance – or otherwise – of the advantages and risks of banking by computer. Dr Gurvinder Shergill, a senior marketing lecturer, and student Bing Li, of the Department of Commerce, surveyed 200 banking customers who use Internet banking.

The study found women regarded privacy protection and ethical standards more seriously than men. Customers of European origin had higher expectations of privacy than Asian customers and higher expectations of ethical standards than Māori customers, while customers of Māori, Asian and other ethnic backgrounds regarded speed of response by bank websites as more important than did European New Zealanders.

Most customers used Internet banking for only the most basic purposes, to check their account balances or bank statements. Less than 5 percent used Internet banking every day and barely a quarter would 'log on' to their accounts even a few times a week. The study argues that growth in Internet banking is crucial for banks to survive and remain competitive, but growth is dependent on customers' perceptions of how secure it is and the quality of service of banks' websites. "People are still scared to use Internet banking in an extensive way, fearing that their information might be leaked or somebody else might steal the information," says Dr Shergill.

Medical information and the Internet

Is information taken from the web supplanting the advice of GPs? Perhaps.

A survey was conducted in December 2004 to determine how people use the Internet to find health information and whether it is an effective way of reducing the gap in information between providers and users of health care.

The survey was conducted by Dr Guy Scott and Terry Auld of Massey's Department of Applied and International Economics, who questioned 126 people in the Wellington region who used the Internet to find health-related information.

Dr Scott says some of the results were surprising. One-third of respondents said they'd changed eating or drinking habits after seeking medical information on the Internet, and almost 10 percent said they'd given up smoking. About 13 percent said they'd done nothing.

Respondents estimated the benefit of the information they found on the Internet at $60, compared to the cost of an average GP visit of $42.

Looking for medical advice on the Internet did not, however, deter people from seeing their GPs; more than 35 percent went on to consult a GP after finding health information online. The most common response (58 percent of respondents) was to talk to a family member, friend or workmate.

Dr Scott says the study showed both the potential benefits and the risks of using the Internet to source health information. Poor-quality information could lead to harm to individuals and the waste of health-care resources; good-quality information could lead to a better understanding of illness, increase compliance and cut waste.

The study's authors are urging the Government to set up an improved health information website.

"Given that some of the information may be unreliable or even unsafe, a valuable public health policy initiative would be to provide an improved New Zealand health information website," says Dr Scott.

Dispensing advice on medication

A team of Albany-based marketing researchers, led by Associate Professor Lynne Eagle, has undertaken a study of the role of marketing communications in getting consumers to understand and comply with instructions for taking their prescribed medications.

The participants were asked to rate the importance of a range of information sources on medication options. Their doctors were seen as the most important, but a third cited alternative medicine practitioners as very important sources and more than 30 percent rated the media as a very important information source.

The research also suggests that millions of people are failing to take prescribed medications correctly, whether by accident, by design or because they've failed to understand instructions. Ineffective or inadequate communication with consumers accounts for about half of all non-compliance with medication regimens.

The researchers say non-compliance with prescribed medication regimens is a major problem, with compliance/adherence rates internationally on average no better than 50 percent and rates for behaviourally demanding treatment much lower.

Ngā Tai Matatū –
Tides of Māori Endurance
Mason Durie
Oxford University Press (2005), $49.95.

Professor Mason Durie's fifth book builds logically on his previous writings on Māori health, Māori development, politics and self-determination. Using the metaphor of the 'tide' *Ngā Tai Matatū – Tides of Māori Endurance* – describes and analyses the position of Māori and Māori interests at the start of the third millennium.

Scholars and students alike will find this book both readable and informative, addressing a range of high-level issues from research and science to the law; from the development of human potential to leadership and politics. With his particular talent for identifying structure and order, Durie gives no fewer than 35 frameworks of analysis which serve as succinct summaries of endurance and progress.

This book makes many individual contributions to Māori and New Zealand scholarship, and space dictates that I discuss only representative examples.

In Chapter 3 Durie gives a full account of the issues, chronology and roles of various players in the unfolding maelstrom which has the been the debate over the foreshore and seabed. While this debate may have been new for many New Zealanders, both Māori and the law have had a long history of interaction with these issues. Most readers will learn something from his rich description and analysis which tactfully leaves the final judgement to the reader.

Chapter 6 deals with Putaioa – the tides of discovery. Durie gives an exploration of Māori knowledge, world views and research methodology. His views on 'research at the interface' between Māori and scientific paradigms, and the implications for the research, science and technology sector, move us forward from an historical position of opposition and misunderstanding.

Chapters 7, 8 and 9 deal with Māori and the state, Māori and the law, and Māori in Parliament. Covering issues from Māori policy, to legislation, to parliamentary representation, these chapters give an historical retrospective account from which most readers will benefit. Durie's own influence in many of these matters (read the reference list!) affords the reader a unique perspective.

Only the least perceptive reader could fail to see that Mason Durie has chosen the 'tide' as a metaphor at a time when the foreshore and seabeds are themselves the subject of much debate in New Zealand. And possibly Durie has paralleled the approach of King Canute in acknowledging that tidal control is not the province of mere humankind. Yet the book ends on a note which is optimistic, encouraging and strategic – characteristically Mason Durie.

Chris Cunningham, Ngāti Raukawa, Ngāti Toa, Professor, Māori Health

For a review of *Ngā Tai Matatū* by Shannon Pakura (Te Atihaunuiapa-parangi), General Manager of Development Services, Child, Youth and Family, Head Office, Wellington, as well as more about other recent Massey-associated books, turn to page 75.

Professor Howe by one of the National Maritime Museum's displays.
Photo courtesy of the National Maritime Museum

Oh islands in the sun

Professor Kerry Howe investigates the unreliable histories of Oceania. Malcolm Wood meets him on the Auckland campus.

He fell for the Pacific early. From Narrow Neck Beach, close by the family home, the boy would gaze out past the pohutukawa, past the volcanic cone of Rangitoto, to where the ships came and went, their destinations distant and exotic.

He had an uncle, a merchant seaman, who would tell him tall, sometimes macabre tales. One tale from the tropics, he remembers, was of sharks, fed newly boiled whole pumpkins, churning the sea in their death throes as the pumpkins burst.

Around the bays, beaches and mangroves north of Auckland he fished, snorkelled and messed about in small boats. He read Defoe's *Robinson Crusoe*, Melville's *Moby Dick*, Stevenson's *Treasure Island*, Bligh and Christian's [Edward Christian, Fletcher Christian's brother] *The Bounty Mutiny* (some in the Classic Comic editions) and Thor Heyerdahl's *The Kon-Tiki Expedition*. He traced Cook's voyages on the map.

In hindsight it seems inevitable that he would one day light out for the Pacific islands.

In 1971 Kerry Howe made it. The boy was now a PhD student undertaking his field work, and the Loyalty Islands had all the travel-brochure tropical trappings: atolls fringed with expanses of white-sand beach, azure water and coral reefs. But it was a strait-laced paradise.

"Sunday you basically went to church for the entire day," says Howe. "I remember sitting in these dreadfully hot churches and not understanding a word of what was going on with the singing and preaching. You'd look out the windows and there would be these absolutely glorious beaches with not a soul on them." Beside him in the pew Merrilyn, his wife, sweltered in the neck-to-knee Mother Hubbard propriety demanded of her.

What is the Pacific like? It is not a question that can really be asked without asking another: How has the Pacific been imagined to be?

For centuries the West has projected its vision on to the Pacific and its islands, which have variously been seen as paradise and as paradise lost, as a paradigm for man living in harmony with nature and as cautionary examples of what happens when environmental destruction goes unchecked.

The peoples of the Pacific have been depicted as noble and as brutish; as the hapless victims of colonialism and as participants in the colonial enterprise. Their epic journeyings around the Pacific have been depicted as controlled and purposeful, and as little more than the consequence of drift and chance. They have been cast as one of the lost tribes of Israel, and as Johnny-come-latelies who have usurped the place of older, more sophisticated civilisations of Atlanteans, Celts, Egyptians or what-you-will.

What is the Pacific like? How would you like it to be?

Kerry Howe – now Professor Kerry Howe – is talking to me in his office on the Auckland campus at Albany, not far from where he grew up. The boy who messed about in boats has become an academic who in his free time messes about in sea kayaks. (On a wall map the red line of Howe's kayaking travels snakes up the coast from East Cape to North Cape, and he has recently published *Coastal Sea Kayaking in New Zealand: A Practical Touring Manual*.) And while he is no longer as absurdly youthful as he appears in his photos from the Loyalty Islands, there is still a certain exuberance to him. In a well-mannered way he is still a bit of a stirrer, a debunker of received opinion.

For 40 years he has been studying the history of the Pacific and the historiography of the Pacific – the history of the writing of the history. The histories of the Pacific tell us as much about the historians and the times they lived in as they do about what happened, says Howe. What we think of as histories are, more often than not, thinly veiled morality tales.

If history is as much about the teller as the tale, then who is Kerry Howe?

Kerry Howe, the kid from Devonport, headed to university in 1965, the first of his wider family to do so. "It wasn't really until I got to university that I became conscious of things called ideas: economic ideas, political ideas. It was quite a mind-blowing experience. There were people there who had written books – I'd never met people who wrote books."

He reels off the names. Historians like Keith Sinclair, Keith Sorrenson, Russell Stone and Howe's thesis supervisor, Judith Binney. He became aware of painters like Don Binney, Ralph Hotere, Colin McCahon and Pat Hanley. Poets like Hone Tuwhare and, again, Keith Sinclair. Writers like Maurice Shadbolt, who was exploring the nature of postcolonial New Zealand society in novels and short stories. Looking to them and their like, Howe became, as he puts it, a romantic nationalist.

The sixties also ushered in the Vietnam War and accompanying protest, the American civil rights movement – which Howe credits with having had a huge and still largely underestimated influence in New Zealand – and a swag of ideologies, among them feminism, anti-racism and anti-colonialism.

But the greatest 'ism' – the one that left its imprint on his generation – was optimism. "We grizzled about the world and we grizzled about the Vietnam War and we started to grizzle about the environment, but there was always this sense that the future was only going to get better and better and better," says Howe. "By being involved in mainstream politics we would make the world a better place."

It was a good time to make one's mark as a Pacific historian. Hallowed orthodoxies were being overthrown. The Great Migration with its Great Fleet of canoes was no more, demolished by Andrew Sharp and David Simmons as being the product of a nineteenth century historian's efforts to tidy up oral traditions. (As a guest lecturer Sharp would declare to his Auckland University audience: "I stand before you as a heretic.") Archaeology was being revolutionised by carbon dating, and instead of solely addressing material culture it had begun to take a broader ecological approach.

For his masterate thesis Howe chose to examine the interaction of Māori, missionaries and civilisation in the upper Waikato from 1833 to 1863. Superficially the examination of a thin slice of history, the thesis would allow Howe to delve into one of the controversies surrounding contact history: the validity of the 'fatal impact' interpretation. In essence, the fatal impact version of contact history follows a simple narrative in which a superior culture meets and overwhelms a primitive culture; perpetrator meets victim.

Howe's supervisor, Judith Binney, leaned towards a fatal impact interpretation of the contact between Māori and European. Howe's belief – which his thesis would turn out to support – was that contact histories tend to represent a more complex interplay, with each culture learning from and exploiting the other.

His MA thesis completed, Howe headed to Canberra and the Department of Pacific History at the Australian National University to do his PhD. Well resourced and internationally staffed, the Australian National University was an amazing place, Howe remembers, where everyone was writing books. (A visiting fellow who particularly impressed Howe was David Lewis, who studied Polynesian navigational methods and had sailed single-handed around the Antarctic.)

In place of imperial history – history as seen through the eyes of missionaries, traders and administrators – the Australian National University had pioneered an 'island-centred' perspective, placing island events in the context of the indigenous culture.

Howe's field research took him to the Loyalty Islands, which lie in a band along the east coast of New Caledonia, to which they belong. For Howe the islands looked like an ideal place for a field study.

For one thing, unusually for Melanesia, the Loyalty Islanders had responded to the overtures of the missionaries in the nineteenth century and become ardently Christian – which interested Howe. For another, blessed with an absence of covetable resources, the Loyalty Islanders had been left largely to their own devices, unlike mainland New Caledonia, where the exploitation of the island's huge reserves of nickel was accompanied by mass dispossessions and social disruption. (Being obviously non-French speakers did the Howes no social harm.)

The Loyalty Islanders took the Howes into their lives. "They fed and clothed us and took us around. They did everything for us. This wasn't just courtesy or custom. It genuinely was a very welcoming society," says Howe, for whom the experience was life-defining. "People lived very simple lives. None of the roads were sealed. People were still cooking on primuses, and there were Coleman lamps at night. In our romantic youthful way we thought this all was quite wonderful."

Howe would visit sites unchanged from the nineteenth century – the hill where there had been a battle between the Catholic and Protestant factions of the Islanders, or the beach where the sandalwood trade had been conducted – and talk to Islanders for whom the last century's events lived on.

"The Islanders could remember stories going back to the 1840s and the 1850s and the names of traders and which island women they had married. These were aspects of their history that were part of their everyday world."

Why had the Loyalty Islanders proven so susceptible to Christianity when their near neighbours in New Caledonia had not? The answer lay in the structure of their societies: the Loyalty Islands had tribal, chiefly structures, which New Caledonia largely did not, and Christianity could be used to a chief's political advantage. Some chose English Protestant missionaries, their enemies then chose French Catholic ones.

Back in Palmerston North courtesy of a Massey University postdoctoral fellowship, Howe turned his PhD thesis into a book, *The Loyalty Islands: A History of Culture Contacts 1840–1900*.

Now he nurtured wider ambitions. He was wary of micro-history: writing ever more detailed monographs about ever more esoteric subjects. He yearned for some larger synthesis, to pull back from cinematic close-up to a more instructive wide focus.

These days he quotes the New Zealand philosopher Peter Munz. Had Darwin been a historian rather than a naturalist, Munz wrote, he might well have described the different shapes of finches' beaks on the various islands of the Galapagos and left it at that. Instead, because he was looking for more overarching explanations, his observations helped form and support his ideas about natural selection.

Howe looked at the Pacific and its host of different societal interactions and wondered where he might make some attempt at explaining human cultural interaction more broadly.

Where the Waves Fall: A New South Sea Islands History (1984) was the result, a wide-ranging survey and synthesis which found patterns in the detailed research findings of others. Howe found, for example, that through much of Polynesia the early period

of contact with Europeans tended to bring about a political centralisation by indigenous leaders.

But one of the lessons of *Where the Waves Fall* is that no one narrative holds true. Each island's contact experience and subsequent history are uniquely its own. If, for example, Christianity in the Loyalty Islands had been driven by chiefs seeking political advantage, then in New Zealand and Samoa the tendency had been for ordinary individuals to convert first and the upper echelons to follow. Howe describes *Where the Waves Fall* as the most influential of his books.

Howe now struck out into a new genre with a biography, *Singer in a Songless Land: A Life of Edward Tregear, 1846-1931*, though his choice of subject would still involve him in

Different legacies

Race relations in Australia and New Zealand

In 1970, three months into his PhD at the Australian National University, Howe and his wife skived off from Canberra in a Holden station wagon for an extended trip to see the country. Outback Australia, with its immensity and beauty, enthralled him; the condition of its Aboriginal inhabitants left him distressed and appalled. Their lives were afflicted by poverty, drunkenness and brutality.

His response, "partly my own way of sorting out things in my own head", was a short book, *Race Relations Australia and New Zealand: A Comparative Survey 1770s-1970s*.

Why were the contact histories of Australia and New Zealand so different? "Perhaps more than any other single factor, the respective natures of Māori and Aboriginal societies in pre-European times help to explain why Māori and Aboriginal relations with Europeans have been very different in the two countries," writes Howe in the book's opening sentence.

In turn the societal differences were in part an expression of the physical environment: New Zealand, rugged, fertile and temperate; Australia, largely flat, infertile and arid.

The Māori practised agriculture – as well as hunting, fishing and gathering – and lived relatively settled existences; the Aborigines had no agriculture, moving their campsites according to the seasonal availability of food. Māori society was stratified and hierarchical; Aboriginal society was not. The Māori were practised warriors whose object was often land; such Aboriginal intertribal warfare as took place was mainly skirmishing, and territorial conquest was virtually unknown.

These very different societal characteristics – combined with European ethnocentricity and racism – put the Māori far closer to the accepted British norm.

The stark difference in European attitudes to Māori and Aborigines is made flesh in the person of missionary Samuel Marsden, who arrived in Sydney in 1794 and would later mount a series of voyages to New Zealand. "He was only too keen to proselytize among Māori [he favoured the idea of the Māori being one of the lost tribes of Israel], but he wanted nothing to do with Aborigines, who he thought were cursed with the mark of Cain," says Howe.

For their part, unlike the Māori, the Aborigines initially had little use for Christianity – or indeed for many of the European beliefs and trappings.

The book led to Howe teaching a course in comparative race relations at Massey for many years, until the Springbok tour made this untenable. "Many people felt obliged to nail colours to wall. It was all tied up with post-colonial mentality. It became impossible to hold a rational discussion about contact history when there were such heated emotions all tied up in an explosive mix of rugby and race.

"I don't think you could teach a course like that now. Unless you were taking a line that indigenous people were universally damaged and dispossessed all to the same extent you are probably on a hiding to nowhere. Any attempt to say that New Zealand has a better record on race relations than Australia and I think you'd just be screamed down."

Nor, despite approaches from publishers, has he any inclination to update the book. "I think books are creatures of their times. You write them and move on."

his specialist interests – contact history and Pacific historiography – and in much else.

"One of the attractions of writing a biography is that you are dealing with the smallest unit of history: a person. But you can't just write about that. You have to write about the life and the times. So I ended up having to write an enormous amount about New Zealand's history during Tregear's lifetime."

Born in England in 1846 and raised in comfortable circumstances, Edward Tregear had emigrated to New Zealand in 1863 at age 17. With him he brought his family, which was in newly parlous circumstances; Tregear's father, a sea captain, had died two years earlier after first squandering the family wealth.

Tregear became a soldier and then a surveyor, spending months at a time in Māori communities. It was a hard scrabble for existence in an alien land, but one to which Tregear brought his own peculiar sensibility. Classically schooled, Tregear had been able to read and write Greek and Latin at age seven. From his early years he had been captivated by Celtic, Nordic and classical legend. Now, as he acclimatised, Tregear set about applying his learning and his passion for the new sciences of comparative mythology, religion and linguistics to his new land and its people. In 1885 he published *The Aryan Māori*, which was able to find relics of Aryan heritage embedded in Māori language, mythology and custom.

Tregear was one of the founders of the Polynesian Society. He compiled well-regarded dictionaries of Māori and Polynesian languages. This is Tregear the interpreter of matters Māori and Polynesian.

The other Tregear is the civil servant and social reformer. In 1891 he was appointed Secretary to the Department of Labour. He largely administered the Industrial Conciliation and Arbitration Act of 1894, and he became the leading publicist and theoretician of New Zealand labour reform.

Did Howe find himself liking his subject? The question is off the point. "You don't have to like them, but you have to connect. You need to understand why they did what they did," he says.

"I didn't approve of a lot of things that he believed in; he was a creature of the nineteenth century and I am one of the twentieth. In many ways he is an archetypal kind of New Zealander; some of the values and concerns he stood for you can see continuing on through New Zealand society: his concern that we should have an ordered and a decent society. A society that would have none of the evils of the old world. A society that would have no class conflicts. He was an idealist, but he was a practical idealist."

It isn't hard to see Tregear as Howe's spiritual kin: both romantic idealists, both nationalists, both authors, both followers of literature and the arts.

The times in which it was written also gave the biography a personal resonance. "It's what we now call 'presentism'," says Howe, "the sub-agenda I had in the 1980s gave the book a particular slant. I often think that had I written it in the 1970s it might have been quite different."

Even as Howe was writing, the welfare state, which had nascent beginnings in Tregear's times and which Howe and

his parents had grown up in, was being dismantled by Roger Douglas and David Lange. "It was quite jarring. It wasn't just institutional change. It was a change in values from those of the collective common good to those of the market and the individual."

Within the universities the change was also visible in a new managerialism that challenged the primacy of older, more academic values.

Writing *Singer in a Songless Land* brought home to Howe how shallow the time frame is for New Zealand history and how close-knit the political scene. Howe tracked down two of Tregear's grandchildren and one of his nephews. All had adult memories of Tregear, who lived into his eighties, dying in 1931. "I got an enormous amount from them."

The book was launched at Massey in Palmerston North by former Prime Minister Bill Rowling and with Tregear's relatives present. "I rang him to see if he would read the book and then launch it, and he said 'Yes, yes, I'll do that'," says Howe. "So we had the Tregear extended family there and Rowling, who was the last representative of a particular philosophy, beginning with Tregear and the Liberals, in New Zealand political behaviour."

There may be another reason why it was a good time for an excursion into biography: for the moment the writing of contact history had become highly politicised, to the point of being a no-go area.

Who 'owns' history? Writing from within the nineteenth century colonial enterprise Tregear had, of course, 'appropriated' Māori history without qualm. In nineteenth century New Zealand the ownership of history was not an issue. Come the mid-twentieth century and there was a consciousness that the issue existed. Yet even in the 1970s there were voices from within Māoridom urging Pākehā historians to do more to incorporate Māori history into their accounts of Aotearoa. However, in the late 1970s and early 1980s factions within Māoridom began to argue vehemently that non-Māori should not be writing about Māori history at all.

One of the most famous exchanges, says Howe, took place in 1978 between the historian Michael King and Professor Sydney Mead in the pages of the *New Zealand Listener*. Mead took Pākehā to task for, as he put it, "reaching into Māori culture and pulling out features with which they can identify, taking hold of quite generous portions which they then try to fit into a Pākehā cultural world".

Within factions of Māoridom, Pākehā historians were accused of being cultural raiders, too arrogant to realise that as Pākehā they would never understand tikanga Māori.

"King never went back to Māori history in the same way even in later years," says Howe. "There was what amounted to censorship. The historiography of cultural contact as it was written in this country came to an end in the 1970s and it only got going again in a different guise, with what I call grievance history, when the Waitangi Tribunal came along. It is only now that we are moving along again."

In other Pacific islands – usually those where indigenous people were heavily outnumbered by later immigrants and their descendants – there was a similar backlash. During a period of teaching at the University of Hawai'i, Howe received death threats from extreme nationalists, which he

now understands were more a matter of form than of intent. Elsewhere the sentiment was present but muted.

"You would get up at conferences and the locals would berate all the white faces in the audience for being white academic imperialists, then have a cup of tea with you afterwards. It was sometimes an uncomfortable time. You had to maintain your own sense of integrity and get on with it. Some people survived and some people didn't – they gave it up."

Howe's next book was a return to Pacific history, or, more accurately, to historiography. *Nature, Culture and History: The 'Knowing' of Oceania* is a mature-career book, an erudite meditation building on decades of careful reading and research, and expanding on his Macmillan Brown Lectures.

Just as Howe had bucked against the orthodoxy of the fatal impact, now he would tilt at postcolonial extremism, first because of

its insistence on a grand narrative – the rise and fall of imperialism – and second because of its reductive moralising: colonialism bad; postcolonialism good.

"It can be a shallow game," Howe says. "Instead of reading Cook's entire journal, for example, you only have to read and deconstruct a single paragraph and find in it every possible sin such as racism, sexism, culturalism. Cook becomes the personification of all modernist evil."

Howe is less dismissive of that other major movement to sweep through the humanities, postmodernism; in fact he has taught courses in it. In the postmodern understanding interpretation is everything; reality only comes into being through our interpretations of what the world means to us individually.

Postmodernism, Howe says, was useful in its insistence that the question not be, 'What is history?' but 'Who is history for?' But then history, Howe says, has always had a sceptical approach, and the race relations and contact history Howe wrote had always had an awareness of the 'other'. And no matter what approach postmodernism brings, things (deaths, wars, acts of Parliament) indisputably happen.

But he has his criticisms. Postmodernism, he says, can be a cul-de-sac that disables historians from talking outside of their tribe. It has had a corrosive effect on the traditional teaching of some disciplines, notably English. And there has been a flavour-of-the-month character to it. He remembers conferences, Howe writes, where "every young presenter (and some of the older ones) fell over themselves to spend the first half of their papers wallowing in their ideological positioning. I used to seethe at the waste of time as they went through the convoluted arguments of dozens of crazed French poststructuralists, before turning their attention to some event in the Pacific – and then there was usually no connection."

If Howe disagrees with some of the orthodoxies of academic historians, then he is more than testy about the strains of Pacific 'history' that find evidence of visits by Chinese caravels, of settlement by Peruvians (sorry Thor Heyerdahl) or Celts, or, for that matter, of the existence of advanced civilisations that flourished tens of thousands of years ago. Notions like these should not stand without challenge.

"When there are issues of public comment that historians – or anybody else – know something about, then they should be saying things on the radio or in the columns of the newspaper," says Howe.

The Quest for Origins: Who First Discovered and Settled New Zealand and the Pacific Islands?, the bestseller that is the most recent of Howe's history books, was written in part as a response to the proliferation of nonsense history. *Quest for Origins* sets out the linguistic, archaeological and biological evidence for the pattern of New Zealand settlement, as well as presenting the theories that once held sway and locating them within the context of their times.

As to the examples Howe looks to, he suggests that historians would do well to attend to writers outside of their profession. "The history that has made the most impact in recent years has been history written by non-historians," he says. "I am thinking of Jared Diamond [*Guns, Germs and Steel* and the recently published *Collapse*], Simon Winchester [*The Map that Changed the World* and *Krakatoa*], Dava Sobel [*Longitude* and *Galileo's Daughter*]. They are all writing about historical things in a way that strikes a chord. People find it accessible and they respond to it."

Howe's current project is a collaboration with five other academics that will result in a high-tech exhibition, which will tour internationally, and an accompanying scholarly, large-format lavishly illustrated book, for which Howe is the general editor and the author of two chapters.

An initiative of the Auckland War Memorial Museum, *Waka Moana: Voyages of the Ancestors* will be of a similar scale to the much-lauded *Te Māori* exhibition of

1990. *Waka Moana* will set the Pacific islands and New Zealand in the context of global settlement. Oceania was the last region on earth to be settled and New Zealand, settled just 700 years ago, truly is, in the words of Kipling, "last, loneliest, loveliest", says Howe.

The exhibition will explore the origins of the peoples of Oceania and how and when settlement took place. It will illuminate some of the debates. And it won't be, says Howe, just a white man's scientific story. "We've gone to a lot of effort to present how indigenous peoples may have thought about the cosmos and their place within it.

"So the stars, for example, are not just navigational instruments. They represent such things as ancestors," explains Howe. "The names people gave things can be traced all the back way across, the Pacific. These are cultural footprints."

How does Howe feel about the current state of Oceania: the failed state of the Solomons, the Fiji coup, the depopulation of some islands, the pollution and overcrowding of others?

In many ways, says Howe, we shouldn't have been too surprised that these things have happened. "Most of us didn't see that in the sixties, seventies and eighties because we wished for something else.

"When the new nation states in the Pacific achieved independence, which was late in global historical terms – it wasn't really mostly until the 1970s that it happened – there was this enormous sense of optimism. All you needed was a constitution. Pull down the colonial flag and put up a new one and it would be marvellous, and of course it wasn't.

"The sort of divisive tribalism that people talk about and the lack of a 'national' cohesive society in a Western sense was always there. It was just masked by the overlay of colonial rule and colonial control."

But it is simplistic to finger colonialism for the woes of the Pacific, or to blame the nature of Pacific island societies. For many of the Pacific islands the geographical disadvantages of being small, resource-poor and isolated are overwhelming, yet their inhabitants are still saddled with the expectations of modernity.

"Something is happening to human societies everywhere on earth. We had the industrial revolution and the electronic revolution. We are a technologically and industrially driven world community, and some countries have the capacity to benefit in a way that others don't," says Howe. "You can't give everybody the ability to go to The Warehouse and put goods on the credit card. It isn't going to work."

Kerry Howe would like to show me something. From among volumes that line his walls he excavates his battered talisman: *Pirates, Ships and Sailors*, a Giant Golden Book. This is one of the books he credits with snaring his childhood imagination and starting him along the path that would eventually lead him to his professor's office.

The enchantment of history is the enchantment of stories, and stories – successful stories – set up and meet certain expectations, conform to certain templates. Many first-time readers of Thor Heyerdahl's *Kon-Tiki Expedition* must still be enthralled. *So Easter Island was settled by South Americans. Extraordinary!* The daring adventurer is vindicated.

Who can blame them? Even readers who know that Heyerdahl got it wrong must catch themselves thinking, 'Wouldn't it have been great if Heyerdahl had been right?' It would be more satisfying, a better campfire story. But if enough people believe them, stories – factual, ill informed or flights of fancy – have consequences. Tregear's writings claiming – erroneously – an Aryan ancestry for the Māori people affected the way generations of Pākehā and Māori viewed themselves and each other.

If we want to change the world then it helps to understand it accurately.

Do we now have truth in history, or at least in history as practised within academia? Not invariably, says Howe. Some history has been written to conform to fit the critical theory of the day, some to comply with what he terms a lazy political correctness. Some misapplies the standards of the present to the past. Some shows little evidence of the requisite reading and research.

Howe, who started out in his career puncturing the orthodoxies of his day, still has his work cut out. "A young prick become an old fart," he mockingly terms himself in some seminar notes. Only the first part of the statement seems to hold some truth.

In an age hungry for simple verities, Howe is one of those who believes the truth to be seldom pure and never simple. Good history is self-aware, complex – sometimes to the point of being contradictory and confused – and seldom deals in moral certainties. That's what makes it so interesting.

Publications

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Understanding an enzyme

Associate Professor Emily Parker has spent the larger part of her career concentrating on variants of just two enzymes. Understanding just how they work could lead to new treatments for intractable diseases like TB. Malcolm Wood learns more.

A DAHP synthase from *Pyrococcus furiosus,* a bacterium that lives without oxygen in the heated marine sand surrounding sulphurous volcanoes.

There is a certain satisfaction in watching a bacterium get its comeuppance. In the presence of penicillin, the individual *E. coli* bacteria grow and grow. Then, at the point of division, *wham!* The wall ruptures; the contents spill. The cell explodes.

The discovery of penicillin by Alexander Fleming is one of science's legendary instances of chance favouring the prepared mind. He observed the cell-free halo surrounding a contaminant blue-green mould on a bacterial culture and went on to isolate the substance killing the bacteria, which he would call penicillin after the name of the mould it came from.

Fleming had created a paradigm. In the decades following WWII, tens of thousands of substances would be screened for their bioactive effects. But the bonanza is largely over.

"So now the emphasis is turning towards rational design, to understanding how things work and targeting individual processes quite specifically," says Associate Professor Emily Parker.

"People become more particular about the drugs they take and what those drugs do. They want to know what processes are being interfered with."

Penicillin, for example, has a structure called a beta-lactam ring which sabotages the enzyme that links the molecules in the cell wall. Without those links the wall becomes structurally unsound.

Of course penicillin worked long before it was understood how it worked. But understanding how it works opens up so many possibilities.

When I went to meet Parker in her office on the Palmerston North campus I found her door, which had a child's drawing of a cat thumb-tacked to it, was locked.

So I turned to the collection of casually dressed graduate students chatting in a room nearby, and with a gracefully apologetic smile, one of their number detached herself: Dr Emily Parker.

If there is a something of a school's-out atmosphere about it maybe that is because this is a semester break, the students are away, and those marathon sessions of marking papers are over.

But here in the Science Towers it may also have something to do with the fact that things are going well. Very well. In the past few months Parker and her group have had their hand in four major papers.

In one, they explore the workings of the enzyme DAHP synthase from *Pyrococcus furiosus* (literally, "the rushing fireball"), a bacterium that lives without oxygen in the heated marine sand surrounding sulphurous volcanoes.

In another, the mechanisms of DAHP synthase are explicated by substituting one of the normal molecules catalysed in the reaction for another which has been artificially synthesised (racemic 2-deoxyerythrose 4-phosphate in place of erythrose 4-phosphate).

A third explores the biochemical properties of the DAHP synthase in *Helicobacter pylori*, a pathogen that causes chronic gastritis, is associated with peptic ulcers, and has been linked to the development of gastric cancer.

A fourth, a collaboration with Professor Ted Baker at Auckland University, solves the structure of the enzyme DAHP synthase from *Mycobacterium tuberculosis*, the causative agent of TB. "We are very excited about that," Parker confesses.

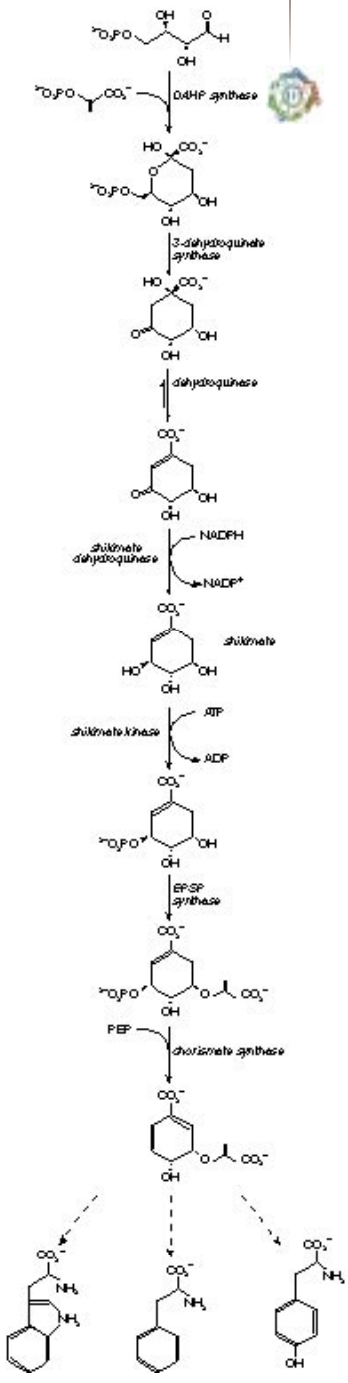
The work on TB is being carried out under the aegis of the Centre for Molecular Biodiscovery, of which Parker is an Associate Investigator.

DAHP synthase (3-deoxy-D-arabino-heptulosonate 7-phosphate synthase, to give its name in full), the common denominator in all of this, catalyses the reaction in the first step in the seven-step shikimate pathway. (Shikimic acid, a molecule produced in the course of the pathway, was first isolated from the Japanese plant 'shikimi-no-ki'.)
The pathway leads to the production of a molecule called chorismate, which is the precursor of a number of aromatic amino acids, some of them essential.

Humans and other mammals lack such a pathway; they ingest the product of the shikimate pathway in their diet.

Because the shikimate pathway is required as part of the primary metabolism of many pathogenic organisms – such as TB – and not in humans, it is a tempting target for new compounds that target bacteria without harming their human hosts. It is a good candidate for fungicides and herbicides too.

In fact, glyphosate, a compound which disrupts the working of the enzyme in



the penultimate step of the pathway, is already in use, says Parker. Glyphosate is the active ingredient in the herbicide Roundup, Glyphosate would also be a useful antibacterial – it has been shown to inhibit the growth of malaria and toxoplasmosis – but for the fact that it breaks down too readily.

"So we are looking for stable compounds that target the enzymes of the pathway," says Parker.

Parker has spent the larger part of her postgraduate years and subsequent career in exploring particular steps in the shikimate pathway. After graduating from Canterbury with a BSc Hons in 1990, Parker headed to Cambridge to work on dehydroquinate synthase, the enzyme active in the second step of the pathway, for her PhD.

She found Cambridge "fairly different" to a New Zealand university environment. "A big place you can be very lost in." And her memories are not of the heritage values or mediaeval eccentricities of Britain's second-oldest university but of odd domestic customs. "I learned how to do dishes with bowl in the sink," she says. Still, Parker and her husband – a New Zealand-born engineer – must have settled in. The couple were to live in Cambridge for nearly seven years and their two children were born there. Had the e-mail from a friend advising her of a job at Massey come a little later the couple might well have chosen to stay put.

Associate Professor Emily Parker at centre and, left to right, PhD students Celia Webby, Meekyung Ahn, Ben Mulchin and Scott Walker, and MSc student Andrew Coleman.

Parker's current research focus, DAHP synthase, knits together a three carbon molecule and a four carbon molecule (phosphoenol pyruvate and erythrose 4-phosphate), both of which are derived from glucose.

The enzyme and the molecules it brings together are vastly different in size. DAHP synthase (or perhaps, better put, synthases, for there are many) is far larger than the molecules it brings together. "You've got this very big molecule – the ones we are dealing with are between 30,000 and 50,000 daltons," says Parker sculpting the shape of a molecule in the air with her hands, "whereas glucose is around 300 or 400 daltons.

"You've got your small molecules and your large molecule and you want to look at it from both points of view."

Like other proteins, the DAHP enzyme is made up of a chain of amino acids, so sequencing it is the first step towards understanding how it performs its biological function. A variety of techniques – including nuclear magnetic resonance (NMR) and X-ray crystallography – are then applied to resolve the three-dimensional structure.

"Knowing how the molecule folds, how it brings different parts of the molecule together to form little pockets into which these smaller substrates fit, is absolutely key to working out how they function," says Parker.

It is also possible to selectively change the amino acid sequences of the enzyme to see what happens. This is done by employing a technique called site-directed mutagenesis to make small changes to the particular sequence of the cell's DNA that directs the production of the enzyme.

The mix of techniques calls on disciplines traditionally seen as distinct: chemistry with its focus on small molecules; biochemistry, concerned with larger organic molecules; and even a touch of quantum physics – the principles of which determine the workings of NMR and X-ray crystallography.

Chemist and crystallography expert turned biochemist Professor Geoff Jameson, whose office is close by Parker's, is a frequent collaborator. "There is a lot to be gained from collaboration," says Parker. "Science is so big. There is so much you can do."

Oddly enough, though the products they catalyse may be the same, DAHP synthases are not. "There are massive variations in nature," says Parker. "Take DAHP synthase from TB and it's about 50,000 daltons in size. Take it from another organism charged with the same biological role and it is around 30,000. There are also massive differences in linear sequence. If you tried to overlay sequences from TB and from *E. coli*, less than ten percent would be identical in whole sequence."

There are also variations in the way the particular enzymes catalyse reactions. The commonalities and variations represent opportunities to produce both broad-spectrum drugs on the one hand, and drugs targeted at particular pathogens on the other.

Parker's work also has implications for our understanding of the workings of biomolecular evolution.

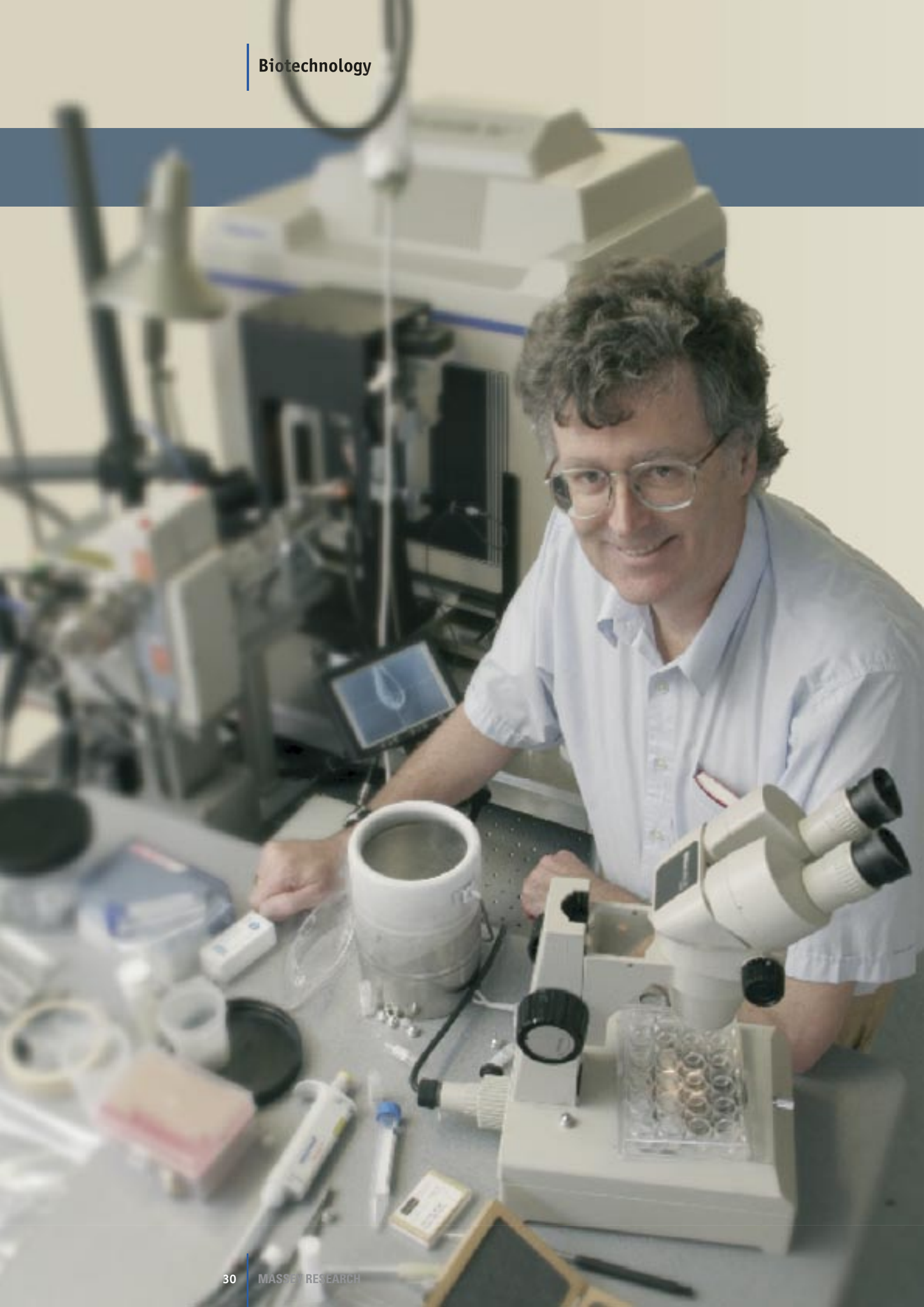
KDOP synthase, an enzyme related to DAHP synthase, is involved in cell wall biosynthesis.

"It is part of the pathway that makes a molecule which links the cell surface sugar molecules to the cell wall in gram-negative bacteria – many of which are nasty – and in plants. We believe both enzymes can be traced back to an ancestral enzyme capable of doing both roles. We are trying to track the evolution."

Parker's work and its excitements are a lure for postgraduate students. She has two post-doctoral, eight doctoral and three master's students in her group. They have come from an assortment of New Zealand universities and from as far afield as the United States and Korea.

"The area of the interface between chemistry and biology is clearly popular," says Parker wryly. (It is a situation for which she must bear some blame: Parker won the Distinguished Teacher Award from Massey's Institute of Fundamental Sciences in 2003.)

The interaction with her postgraduates is one of the reasons she treasures what she does: "They open my eyes to many things I haven't seen before. It is very exciting. We are doing some wonderful work and I am very lucky."



Life lessons

Malcolm Wood meets Professor Geoff Jameson

Professor Geoffrey Jameson – or Geoff, as he is more familiarly known – leads a busy life. When I meet him he is in an intense conversation with a postgraduate student, running through how best to deal with a reviewer's questions. Someone else's problems will be dealt with over the phone. A daughter will be assured that, yes, her father will provide transport to an unscheduled hockey game.

Tall, tousle-haired and bespectacled, Professor Jameson gives his entire attention to each person, to every question, to each of the incoming e-mails stacking up on his computer screen.

In interview he speaks fluently, negotiating polysyllabic tongue-twisting chemical names with virtuosic ease, explaining the Latin root of a species name *en passant*, digressing into areas that fascinate him – as many do.

Piles of papers are fetched up against one wall. An eighties bike helmet sits on a bookshelf above a wastepaper bin marked Dry Non Hazardous Waste Only. All this *stuff*, I have the feeling, lies on the periphery of Jameson's vision: there, but not important.

It is this ability to focus that may explain his productivity: Jameson has more than 100 papers in the international peer-reviewed literature; one analysis of citations made in publications in chemistry journals ranked him internationally as being in the top 1.1 percent of all chemists publishing.

Jameson did not start out as a structural biologist. He began, as was more usual for the day, as an inorganic chemist, graduating from Canterbury with a PhD in 1977. "I was in the small molecule business," he says.

The small molecule business took him to the United States for postdoctoral work, to Switzerland as a research scientist, and, in 1982, to Georgetown University in Washington DC, where he would be first an assistant and then an associate professor.

At Georgetown he worked with a panoply of techniques. "We did resonance Raman, we did magnetic susceptibility studies in the solid state and paramagnetic NMR spectroscopy in the solution state, we did electronic spectroscopy, we did a bit of theoretical work, all in conjunction with studies of molecular and crystal structure by X-ray diffraction methods."

"I am a compulsive generalist," he explains.

The methodology he developed during the early 1980s for handling problem X-ray structures is now widely applied. "Though it didn't seem non-obvious to me," he says awkwardly.

Jameson first came to Massey in 1990 on a year's sabbatical at the invitation of Professor Ted Baker, the founder of Massey's structural biology programme. In 1994 he came back full time.

The move was timely. Bioinorganic chemistry, except as an applied science, was becoming played out, says Jameson. Biochemistry, on the other hand, was full of the sorts of intriguing loose ends and big questions sure to appeal to someone whose motivation, he admits, has always been pure intellectual curiosity.

The key constituents in structural biology are proteins. These are chains of amino acids joined by peptide bonds that fold into unique – and complex – three-dimensional structures.

In the late 1970s, when Jameson was beginning his professional career, only about a few dozen protein structures were known.

One of the first protein structures to be determined outside Britain and the United States was that of the blue copper protein azurin. It was solved at Massey by Professor Baker using X-ray crystallography.

Like Baker, Jameson was an expert with X-ray technology, but in the realm of small molecules, and it remained to be seen how well he would do when confronted with proteins; his appointment was, he says, something of a gamble.

These days he is involved in origins-of-life work with Professor David Penny on ribonucleic acid (RNA) (see page 44); in long-term studies of the protein beta-lactoglobulin, the principal protein in milk whey (work that has implications for both milk treatment and, more broadly, the understanding of how families of proteins evolve); in studies of various superoxide dismutases (see overleaf); in collaboration with Associate Professor Juliet Gerrard of the University of Canterbury on investigating the structure and mechanism of the lysine biosynthetic enzyme dihydrodipicolinate synthase; and, in collaboration with Massey colleague Associate Professor Emily Parker (see page 27), studies of the enzyme 3-deoxy-D-arabino-heptulosonate 7-phosphate synthase (DAHP synthase). He is also collaborating on a structural genomics approach to the molecular structure and mechanism and inter-molecular interactions of enzymes of fungal secondary-metabolic pathways.

Clearly the gamble that Jameson would remake himself into a structural biologist has paid off. However, his mastery of inorganic chemistry and its techniques has not passed from collective memory. Within New Zealand Jameson is still widely seen as the person to turn to when a problem involving crystallography of small molecules proves intractable.

"Though I have a tendency to want to add something more than just solve a structure for someone else," he says.

He can't help himself.

The Centre for Structural Biology

The Massey University Centre for Structural Biology combines state-of-the-art crystallographic, nuclear magnetic resonance spectrometry (NMR), computational, biochemical, and biophysical approaches to the study of biomolecular structure, dynamics and interactions. The centre's research includes investigations into proteins, nucleic acids, carbohydrates and ligands.

The centre houses New Zealand's finest collection of NMR spectrometers (700, 500, and 400 MHz), a 200 MHz MRI spectrometer and a new X-ray diffraction suite. Its resources include a dedicated computer facility and a fully equipped molecular/protein laboratory. The centre is home to about 30 research personnel from both the Institute of Fundamental Sciences and the Institute of Molecular Biosciences.

Motivated PhD students sought

Interested in understanding life at the atomic level? Then contact any member of the Centre for Structural Biology or visit the centre's website : http://csb.massey.ac.nz.

E-mail addresses: Geoff Jameson, G.B.Jameson@massey.ac.nz; Gillian Norris, G.Norris@massey.ac.nz; Andrew Sutherland-Smith, A.J.Sutherland-Smith@massey.ac.nz; Steve Pascal, S.Pascal@massey.ac.nz; Emily Parker, E.J.Parker@massey.ac.nz.

Cells and SODs

Superoxide dismutases (SODs) are a particular source of fascination for Jameson.

SODs are the family of enzymes that mop up superoxide ions, which are a by-product of respiration and are the first formed of the damaging reactive oxygen species.

Superoxide dismutases, explains Jameson, protected life from the worst pollution crisis of evolution – the production of oxygen by cyanobacteria, which began 2.5 billion years ago – and it is superoxide dismutatases that enable life as we know it. Were it not for the superoxide dismutases the oxygen you breathe while reading this would slowly poison you.

The role of the SODs was discovered by Joe McCord and Irwin Fridovich at Duke University in North Carolina, who in 1968 decided to look more closely at a blue-green protein called haemocuprein and discovered that what had been thought to be a repository for copper was in fact an extraordinary catalyst, speeding up the conversion of superoxide radicals ($O2^{\bullet-}$) into hydrogen peroxide and oxygen by a factor of a billion.

Subsequently many other superoxide dismutases have been found. They fall into three families: the manganese and iron SODs, the copper–zinc SODs, and the nickel SODS. Humans have a manganese superoxide SOD that protects the mitochondria (where respiration takes place), and a copper–zinc SOD that is found in the internal fluid of the cell. Many bacteria, plants and fungi also have an iron SOD. The nickel SOD is found only in a few bacteria.

By solving the structure of individual SODs, Jameson hopes to understand how they function and to be able to trace evolutionary relationships.

One of the things that interests Jameson as a chemist is how SODs that employ different metals – metals with distinctive electronic and chemical properties – somehow achieve similar enzymatic effects and oxidation and reduction behaviour.

In a recent collaborative paper Jameson looked closely at the structure and function of manganese superoxide dismutase (MnSOD) from *Escherichia coli*. This appears very similar in function to its iron superoxide relative. Yet when iron is substituted for manganese in MnSOD or manganese for iron in iron superoxide dismutase (FeSOD), neither enzyme works.

How does the protein molecule 'tune' the performance of the metal? This is a very general question in biological systems, where metal ions are found in unusual environments doing unusual chemistry that cannot be readily reproduced in a simple test-tube.

Technically speaking, the paper suggests the presence of an until-now unobserved hydroxide ion, which makes Mn in its Mn^{II} state a more willing electron donor – the manganese is persuaded by the protein to do chemistry more typical of iron than of manganese. The paper also suggests a direct proton shuttle mechanism that is completed being only in the presence of superoxide at the metal centre.

Another SOD Jameson is looking at – "a really interesting one" – helps its host, *Deinococcus radiodurans*, withstand circumstances – ionising radiation, complete desiccation, complete vacuum – that would be the death of other organisms.

"This enzyme turns over superoxide very cleanly. No matter how high the concentration of superoxide – which you get truckloads of when you have ionising radiation around – it turns over very cleanly."

Most other SODs are far less efficient: "With the *E. coli* enzyme and especially the human enzyme, if you have relatively high concentrations of superoxide the SOD shuts down. It gets shunted off into what is called a kinetic dead end. The superoxide locks on to the enzyme and the reaction slows.

What makes the *D. radiodurians* SOD so efficient? Jameson is working with Diane Cabelli at Brookhaven National Laboratory in New York to find out.

"We are trying to understand what it is in the structure of this enzyme that lets it perform the way that it does."

Jameson has also looked at an FeSOD from the obligate anaerobe *Methanococcus thermoautotrophicum* and an MnSOD from the aerobic bacterium, *Pyrobaculum aerophilum*.

The first of these enables its host to survive transient 'insults' of oxygenated cold water, says Jameson, for in normal circumstances *M. thermoautotrophicum* inhabits an oxygen-free environment.

The second is interesting because unlike the manganese SOD in *E. coli*, it still works moderately well when iron is substituted.

What might be the applications to come from a better understanding of SODs? Although to Jameson this is a little off the point, there are a number that suggest themselves, including the regulation of cell damage and ageing, ways of triggering cancer cells into apoptosis or cell death, and mechanisms for combating diseases, such as TB (the disease-causing bacterium *Mycobacterium tuberculosis* exports an FeSOD as a first line of defence against the body's immune system).

About free radicals

$C_6H_{12}O_6 + 6\ O_2 = 6\ CO_2 + 6\ H_2O$ + energy

Glucose and oxygen give you carbon dioxide, water and energy in the chemical form of adenosine triphosphate (ATP).

But this is not the simple, clean reaction it appears to be. The cell very carefully separates the oxidation of glucose to carbon dioxide from the reduction of molecular oxygen to water in a manner very similar to a battery. In fact, to produce water from oxygen, four electrons, shuttled ultimately from the oxidation of glucose, must be added one at a time and then coupled with the addition of hydrogen ions (H^+).

In the most important path, oxygen (O_2) becomes first the oxygen superoxide radical (denoted $O_2^{\bullet-}$) then hydrogen peroxide (H_2O_2), then the hydroxyl radical ($^{\bullet}OH$) and finally water (H_2O). Most of the oxygen we breathe is converted to water by an enzyme called cytochrome c oxidase. But some of the oxygen escapes – about 4 percent if we are exercising heavily.

Two of these escapees or intermediates – the superoxide and hydroxyl radicals – are free-radical reactive-oxygen species (ROS), molecules with an unpaired electron which are capable of independent existence.

It is the unpaired electron that makes free radicals unstable and gives them the potential to destroy proteins, DNA and RNA.

The hydroxyl radicals snatch electrons from where they can, causing a chain reaction as electrons are scavenged down the line. The superoxide radical, by contrast, must find somewhere to either jettison that extra electron, returning to the relative molecular stability of oxygen, or to pick up another electron, becoming hydrogen peroxide. Free metal ions and even metal ions in proteins, especially iron or copper, are subverted.

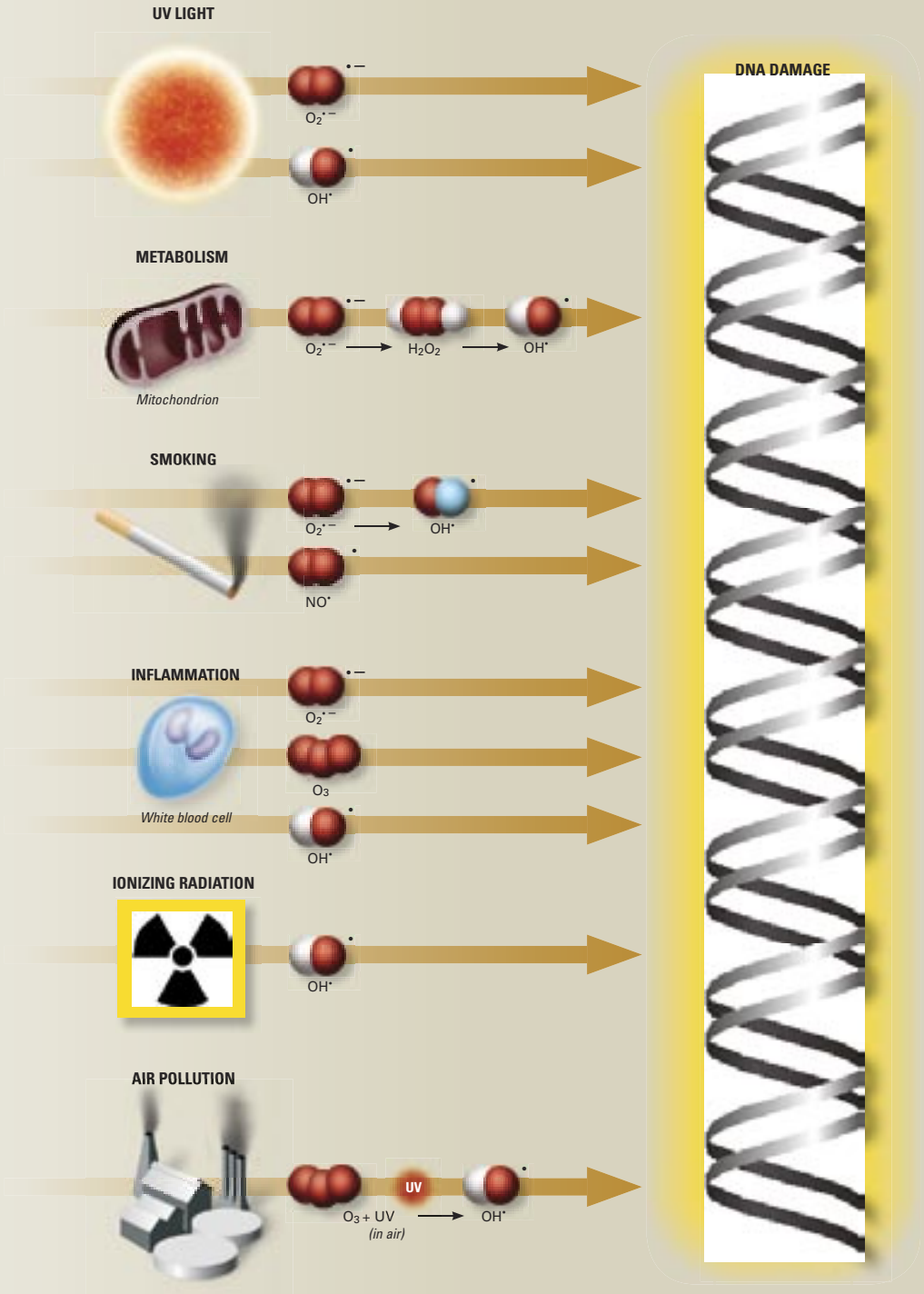
If unchecked, the reaction of superoxide with iron feeds back into a chemical loop known as Fenton chemistry, in which superoxide is converted into lethal hydroxyl radicals.

It is not just oxygen-dependent organisms that have to cope with superoxide radicals. Free radicals are also produced in cells when ionising radiation reacts with water, organic matter, proteins, DNA and RNA.

Recommended reading

Oxygen: The Molecule that Made the World
Nick Lane, Oxford University Press, 2003

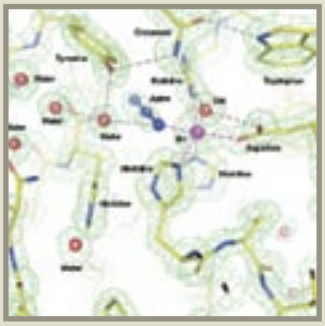
Formation of free radicals



Superoxide dismutase

Superoxide dismutase is an extraordinary catalyst that protects us from superoxides by converting them into oxygen and hydrogen peroxide before they can do damage.

The entire manganese superoxide dismutase molecule in cartoon form: alpha helices are shown as spirals and beta sheets as flattened arrows. All bonded atoms are shown in a thin stick representation. The highlighted box corresponds approximately to the region illustrated in the frame below.



Close-up of the active site of manganese superoxide dismutase. The diffraction pattern of frame (a) is transformed into electron density (green chicken wire). The protein chain is then threaded through this electron density (yellow lines for carbon, blue for nitrogen and red for oxygen atoms). The inhibitor azide is shown in a ball and stick representation. Water molecules (red spheres) are seen as discrete blobs of electron density. Some of the important bonds anchoring the manganese ion (Mn) to the protein are shown as magenta dashed lines. Selected hydrogen bonds are shown with grey dashed lines.

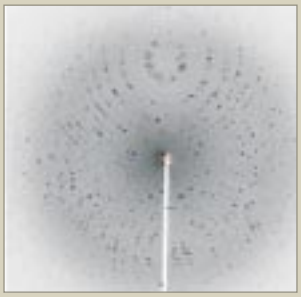
Tools of trade

Although there is no microscope capable of directly 'seeing' the convoluted structures of such things as proteins at an atomic level, there is a suite of tools that will allow the structures to be solved and 'seen' indirectly. These include nuclear magnetic resonance (NMR) spectroscopy and X-ray crystallography, particularly with the aid of synchrotrons.

In NMR spectroscopy, the sample is held in a very strong magnetic field created by a supercooled magnet and pulsed with radio frequency radiation. After the sample has been pulsed it will 'relax' back to thermal equilibrium, the nuclei of the different atoms within a molecule resonating at different frequencies and coupling with each other. These frequencies can be measured by means of the voltage induced in a surrounding coil of wire. The stronger the magnet, the better the resolution and sensitivity – hence the importance of the 700-MHz NMR spectrometer Massey acquired in 2004.

X-ray crystallography records and analyses the pattern produced by the diffraction of X-rays when atoms are arranged in a regular periodic manner, as in a crystal. Here it is the electrons that surround the nucleii, rather than the nucleii themselves, that physically interact with the incoming X-ray photons.

Because it registers the interaction of electrons, X-ray diffraction is better suited to identifying some atoms rather than others. Carbon atoms with six electrons and iron atoms with 26 electrons are good candidates for X-ray diffraction; hydrogen and its heavy isotope deuterium, each with only a single electron, are not.



A two-dimensional slice of the three-dimensional X-ray diffraction pattern from a typical protein crystal. Each dark spot, or reflection, has a position and an intensity. A typical protein crystal yields 20,000 to 300,000 reflections.

Hydrogen and deuterium atoms are better suited to neutron diffraction, a technique that employs a beam of slow-moving neutrons, which have dual wave–particle properties, to interact with nuclei. However, because nuclei are very small – the "fly in the cathedral", to steal the metaphor used as a title for a recent book – the technique requires very large crystals and lots of time.

X-ray crystallography, while a good tool for looking at the positions of atoms and how they are bonded, is also less suited to providing information about protein dynamics, says Jameson, for proteins are not static molecules. And protein dynamics are important.

The DAHP enzyme, for example, "breathes", explains Jameson, opening out to allow two molecules to come in to contact, closing up to squeeze them together, then opening again to release the catalysed product. Here NMR has the advantage. X-ray crystallography provides a snapshot; NMR provides the movie.

The most versatile – and expensive – tool used in structural biology is the synchrotron, a facility capable of subjecting samples to exceptionally intense, tightly focused beams of radiation. Depending on the application, the researcher can select radiation ranging from infrared to visible light, ultraviolet and X-rays.

Jameson's recent paper exploring the workings of superoxide dismutase used a synchrotron in Germany to achieve ultra-high-resolution data.

"We were lucky enough to collect data to 0.9 Ångstrom resolution. At this resolution we can 'see' hydrogen atoms and, in particular, many of those that are chemically and biochemically important."

He looks forward to the Australian synchrotron, a multimillion dollar enterprise which will open in 2007 in Melbourne and in which Massey has made a $400,000 capital investment and commitment to running costs. "It is going to be hugely beneficial to people who at this stage don't even know that it is going to be useful to them," he says. "If you have anything where you are interacting matter with light – from hard X-rays through to infrared, then a synchrotron does it with better sensitivity, better resolution and more quickly. The challenge is to get people to recognise the opportunities to transform their research."

However, even the synchrotron has its limitations, he cautions. The intense radiation, for example, can damage samples. "You should never let a synchrotron supplant having the best possible equipment you can afford in the lab."

The Australian Synchrotron is under construction at Monash University, Melbourne and scheduled for completion in 2007. The building, at top, is approximately 130 metres in diameter. The storage ring (the orange ring in the lower panel) is 70 metres in diameter and 216 metres in circumference. Synchrotrons provide extremely intense, pulsed beams of highly collimated light with energies from hard X-rays to visible light to infrared radiation. Bunches of electrons are accelerated to 3GeV (greater than 99.95 percent of the speed of light) and magnets then guide the electron beam around the storage ring. Wherever a magnet bends the path of the electron beam, extremely intense electromagnetic radiation is produced tangentially. This radiation is guided to experimental stations that are arrayed like spokes round a hub. Synchrotrons are key instruments of modern structural biology and materials sciences. Their applications span from fundamental physical and biological sciences to medical imaging, nanolithography, microscopy and drug discovery. Massey University is a major contributor to the New Zealand consortium that is investing in this $250m instrument. For more information visit http://www.synchrotron.vic.govt.au.

Looking for LUCA

LUCA – the Last Universal Common Ancestor of all life on this earth – was given her name in 1996 at a conference in Provence. It is one of the few certain things about her. Who was she? What environment did she inhabit more than 3.5 billion years ago? In organisms preceding LUCA were proteins absent, leaving RNA with functions of both catalysis and storage of genetic information? Beyond a few safe assumptions, the answers are up for grabs.

One of the debates is about which of the three domains of life – bacteria (or prokarya), eukarya or archaea – LUCA was most representative.

It is a debate in which Massey's Professors David Penny (see page 44) and Geoff Jameson are active participants.

In recent decades it has been generally supposed that the first life on Earth was some form of bacteria. There is some logic to this: bacteria lack the complex cell structures of the eukarya, such as the nucleus and they have a small range of organelles. Wouldn't it make sense for life to begin simply and accumulate complexity? Bacteria are simple; eukaryotes complex. *Ipso facto*, the bacteria were here first.

Perhaps. Or perhaps not. For there is another way of looking at it and that is to view bacteria as reproduction machines: the more simple and stripped down the organism the speedier and more efficient that reproduction will be. There is an evolutionary pressure to be frugal. So an argument could be made that bacteria are the descendants of more metabolically complicated ancestors. The eukaryotes were here first. The bacteria evolved later.

(The archaea, a domain of life known for inhabiting extreme environments, feature characteristics intermediate between bacteria and eukaryotes.)

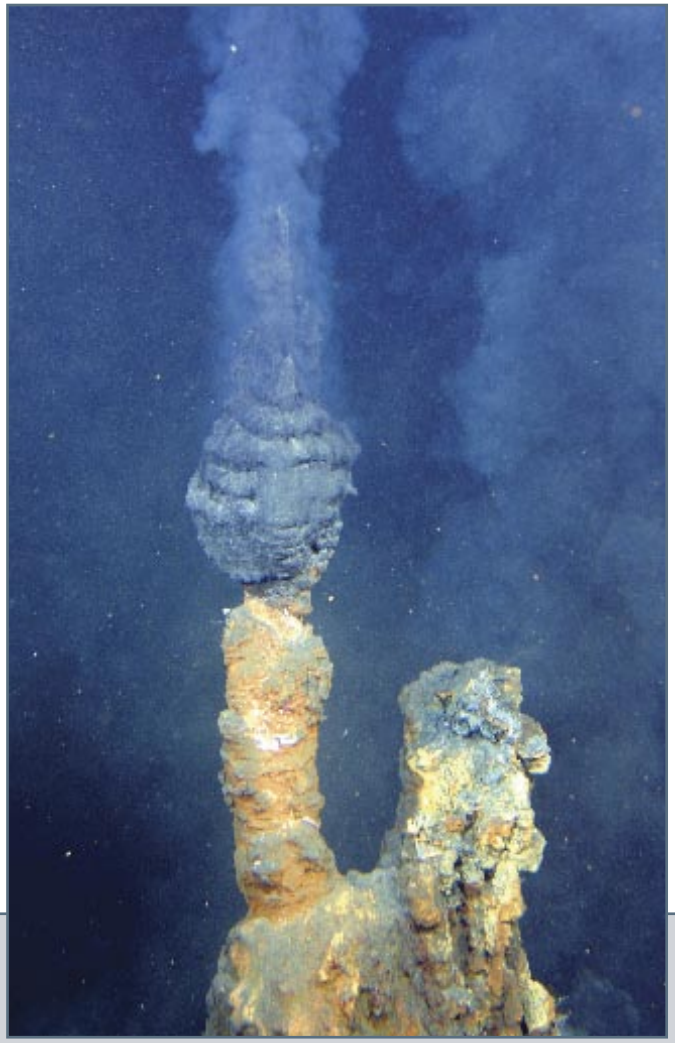
Jameson's interest is in an organelle made of RNA called the ribosome. The ribosome is the factory that builds a protein from a set of genetic instructions. Whatever the form of original life, it *must* have had RNA ribosomes. Ribosomes are a "cantilever".

In the 1960s and 1970s the analysis of ribosomal RNA was used to look at the degree of relatedness between eukaryotes and bacteria, the expectation being that the evidence would support the theory that eukaryotes evolved from bacteria. It did not. The two groups of RNA sequences are highly distinct – the implication being that the split between eukaryotes and prokaryotes must have happened very quickly and very early.

Given that eukaryotes have far more RNA activity than is present in either bacteria or archaea, Penny and Jameson are inclined to come out against much of current thinking and cast their votes for the first life being eukaryotic in character. This being the case, then the presumption might be made that life arose in the cold to mild conditions that favour present-day eukaryotic life. This is further favoured by the nature of the RNA molecule, which, says Jameson, is not particularly stable; at temperatures above 55 to 65 degrees Celsius it unfolds, and at slightly higher temperatures it becomes chemically unstable.

There may, however, be environments in which RNA can withstand high temperatures. The high pressures in the deep sea may offset the effects of high temperature and make for a more stable molecule. One line of theory has it that life evolved in hot volcanic underwater vents. "Quite a few people have been looking at proteins under conditions of extreme pressure," says Jameson. "Some denature and others retain stability, but nothing has been done with RNAs."

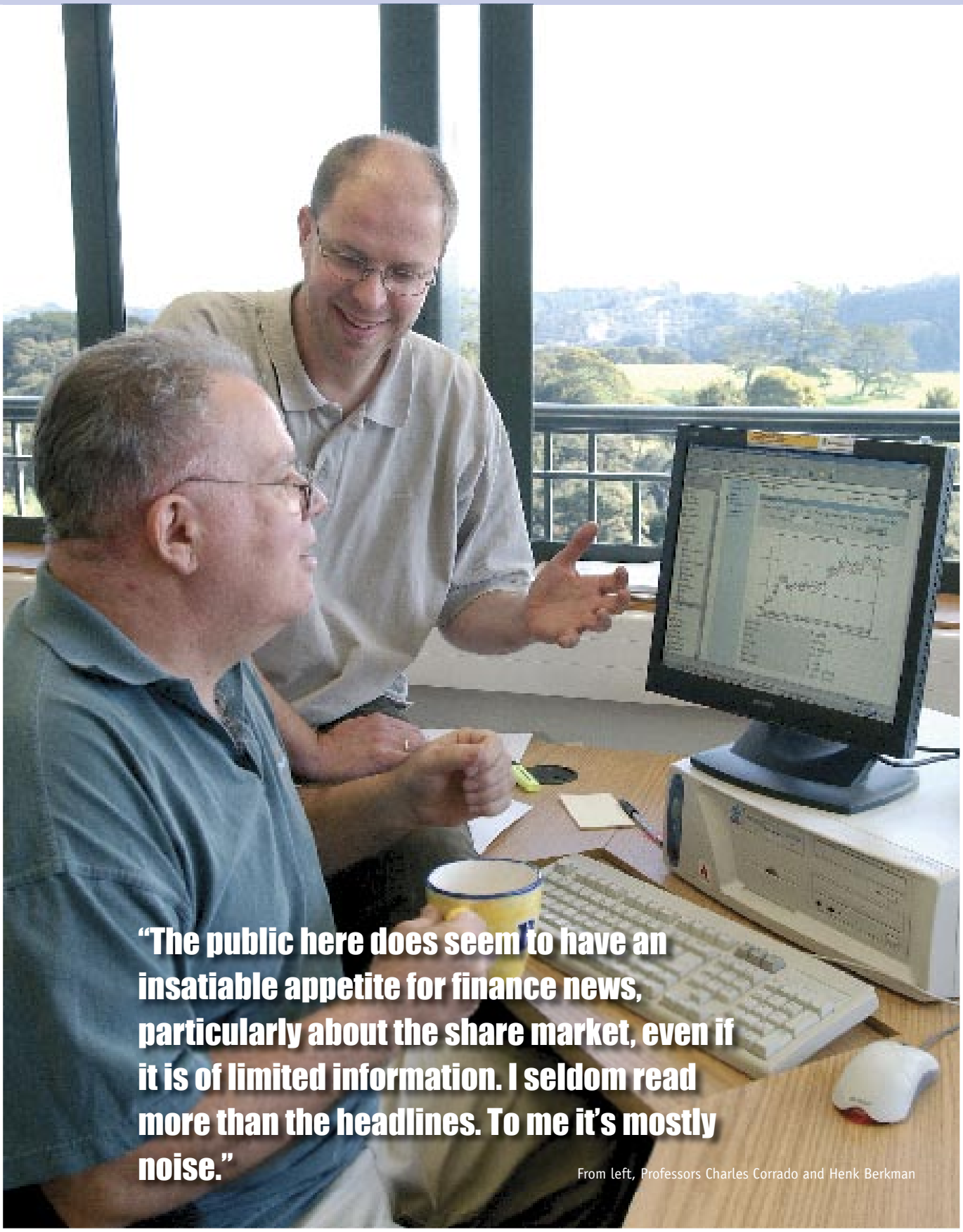
Jameson and NMR expert Dr Patrick Edwards are planning to use Massey's new high-field NMR facility to look at the folding of RNA under conditions of high (300 to 600 bar) pressure, to give a more detailed picture of unfolding and decomposition events than can be obtained by other complementary techniques.



Did life evolve at high temperature and great depth? Shown here is the top of a tall (~5 m high) chimney structure at the NW caldera site of the Brothers volcano, about 400 km NE of Whakatane, along the Kermadec arc. The depth to this chimney is about 1650 m and the hydrothermal fluid is venting at about 300°C. This photograph was taken from aboard the submersible *Shinkai 6500* during the joint Japanese/New Zealand SWEEP Vents expedition of October/November 2004. *Photograph courtesy of GNS and JAMSTEC*

The player

Di Billing meets Professor Charles Corrado



"The public here does seem to have an insatiable appetite for finance news, particularly about the share market, even if it is of limited information. I seldom read more than the headlines. To me it's mostly noise."

From left, Professors Charles Corrado and Henk Berkman

Mug of coffee in hand, Professor Charles Corrado is on the move. He has an idea and who better to share it with than his colleague Professor Henk Berkman. The chance to work alongside other world-ranked finance researchers like Berkman is one reason Corrado decided to join Massey. (Eight other prominent researchers from the US and the UK have also recently joined the programme.)

Another may have been his spacious office with its panoramic view over Albany's green fields. "It literally broadens my view. Until now I have only worked in small, dark cupboards which tend to dampen the mind," he says.

Not that this mind ever seems to have been dampened. Corrado has two PhDs, one in economics and the other in finance – no mean feat for someone whose academic training was interrupted by service in the Vietnam War. (US-born Corrado recently returned to Vietnam for the first time since 1968 in the company of a young Hanoi-born PhD student. "It provided," he says, "two very different perspectives, which greatly increased the value of the experience.")

In his current work, Corrado specialises in statistics and investments with a particular interest in options and futures. "For example, I am sometimes enlisted as a consultant to place a fair monetary value on employee stock option programmes."

Despite his expertise, he says he can't say – and nobody can really say for sure – what is going to happen to the stock market. "You may get a cycle, an 'up' and a 'down', and within that cycle there will be confounding effects. But no stock market is readily predictable. After all, the people involved are not predictable – much less the events that may have an impact on the market."

Here, he says, we may be surprised to learn what does and does not affect the markets. This year's general election? "It will have had an impact, of course, but perhaps not as much as some might think." Terrorism attacks? He is glad I asked. "Now that is very interesting. We would think yes. But an article printed recently in the *Wall Street Journal* finds that the attacks in New York and Washington in September 2001 did not have as much impact as is generally thought. The article concludes that on average terrorism incidents have little impact. Cold as this may seem, investors do not react strongly to something affecting what is, after all, a small proportion of the population."

Despite the difficulty in predicting market behaviour, he is a player and has been for three decades. He started with mutual funds and bonds but these became boring, so he switched to the share market.

He agrees that there is such a thing as a risk-taking or gambling personality, someone attracted by the excitement as well as the potential for financial gain, and acknowledges that he may fit the profile. He lights up as he talks about his investment portfolio: "I have been a technology investor, which I suppose shows some foresight but means I have seen my portfolio go up and down by huge amounts over the years. I still remain mainly interested in technology investments, mostly offshore, but I also keep part of my money in so-called stock index funds.

"I'm hooked, although I'm becoming aware that retirement will come up sometime and around about then, the high-risk levels in my portfolio may have to be reduced."

In the meantime, his research and investment interests are served by a virtually paper-less office. Once he subscribed to every major financial journal, enough to fill his office twice over. Now, almost everything is available online. He spends little time with New Zealand commentary.

"Is most of it useless? I wouldn't go that far. The public here does seem to have an insatiable appetite for finance news, particularly about the share market, even if it contains limited information. I seldom read more than the headlines. To me it's mostly noise."

Local publications, including *National Business Review*, do feature among his Internet favourites. But the *Wall Street Journal* is at the top, just above CNN. And there is one hard-copy resource on hand: a veteran, rather battle-worn copy of Kendall's *Advanced Theory of Statistics* by A. Stuart and J.K. Ord (originally by M. Kendall), published by the Oxford University Press and regarded by Corrado as the best single reference work in statistics. "This is my bible," he says, taking it off the shelf and proudly showing off its dog-eared pages. "I refer to it constantly."

Professor Charles Corrado

Born in the US, Charles Corrado completed two PhDs, in economics and in finance, at the State University of New York and the University of Arizona respectively. In an academic career that has largely focused on investments, he has taught at Loyola University in Chicago, the University of Missouri in Columbia, the University of Auckland, and the University of Technology in Sydney. He is a senior associate of the Australian Institute of Banking and Finance, a member of the American Finance Association, the Financial Management Association, and Western Finance Association; and is an elected director of the Multinational Finance Society, as well as associate editor of the *Multinational Finance Journal* and the *Journal of Futures Markets*. A recently published paper covers forecasting stock index volatility, and his many research awards include two for the best paper on Australian and New Zealand capital markets.

In a survey based on publication between 1990 and 2004 in 21 leading financial journals, Professor Corrado was ranked 12th among individual academics in the Asia-Pacific region. Massey's finance programme – strengthened by the arrival of a further eight prominent researchers from the US and the UK – was also ranked 12th in the Asia-Pacific region. The survey, conducted by researchers at Western Kentucky University and the University of Daytona, recently appeared in the *Pacific Basin Finance Journal*.

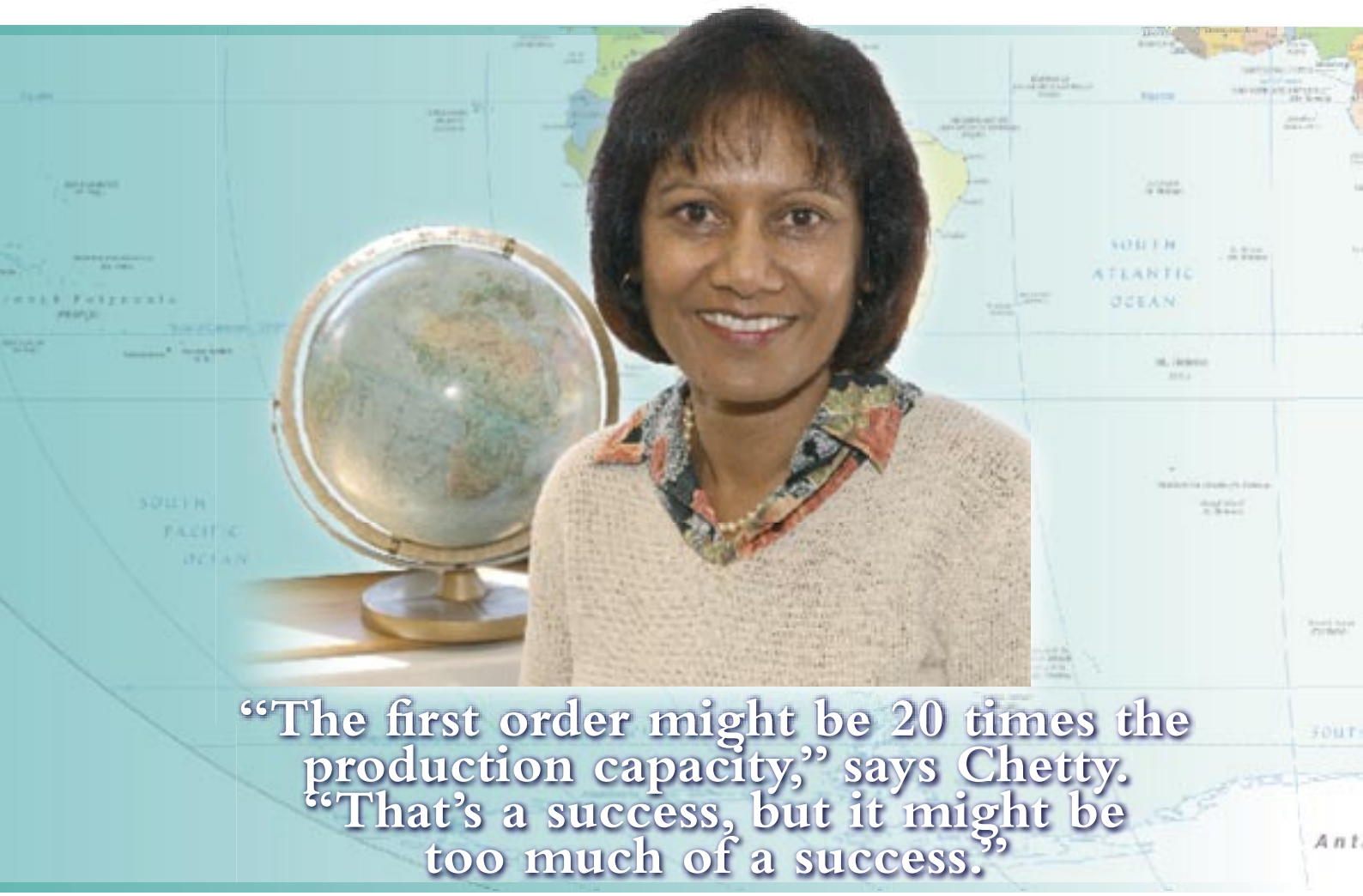
Professor Henk Berkman

Professor Henk Berkman completed his PhD at Erasmus University, Rotterdam. Before joining Massey, Professor Berkman served on the faculties of Erasmus University and Auckland University. He was visiting professor at the Universities of Sydney, Kansas and Maastricht.

His teaching experience covers most areas in finance at undergraduate, honours and postgraduate levels. He has published in a number of major international journals, including the *Journal of Financial Economics*, the *Review of Financial Studies* and *Financial Management*.

Going global

Jane Tolerton meets Professor Sylvie Chetty



"The first order might be 20 times the production capacity," says Chetty. "That's a success, but it might be too much of a success."

New Zealand firms export themselves in their own Kiwi way, according to Sylvie Chetty, Professor of Marketing and one of New Zealand's leading researchers in international business.

"The theories in the business and marketing textbooks we use in New Zealand were mostly developed in the United States and Europe," says Chetty. "But New Zealand is a small, isolated economy far from its major markets. So our question is: when New Zealand firms go into the international market, do the theories apply?"

The short answer is no, according to Chetty, who is one of a multi-disciplinary team of nine academics from four universities working on the Competitive Advantage New Zealand (CANZ) project. Her role in the team is to study how New Zealand businesses actually make the leap into the international market.

European and United States companies usually do it by first selling through agents, then licensing a local partner, and finally setting up their own off-shore manufacturing plants.

"That's what the textbooks say – but that's not what we do," says Chetty. According to her research, New Zealand firms do it in three different ways.

The first, dubbed the 'regional' model, is to launch into Australia – believing it will be easy to do business there.

"But often New Zealand firms have found it hard to do business in Australia," says Chetty, "because of an attitude there that 'New Zealanders can't do something better than us'. One company in the study said it was easier to operate in Singapore or London than in Australia. This is an example of how we have contradicted received theories."

The second group are 'born globals' which go international within two years of start-up. "Often they have past experience in business, and they have international networks.

Traditionally, high-tech products go global very quickly. The seafood sector also has a lot

of born globals – not just fishing and selling, but using new technology to do it."

Again, the research found a new twist. "The theory says the domestic market is not so important for 'born globals'. But we found it is important because if they don't sell in their own market they don't have international credibility. So they have to make some sales in New Zealand."

New Zealand is a good launching pad for firms with products specifically developed for conditions here. "For example, lighthouse beacons. They are invented to withstand New Zealand conditions, and because of the physical geography they have to be very strong and very high quality. This is an example of where we turn our unique situation to advantage."

'Globals', the third model, develop a strong domestic market over a long time and then launch out into the world very slowly. But once they go international they are often so successful they can't keep up with themselves – a phenomenon dubbed 'the gusher'.

"The first order might be 20 times the production capacity," says Chetty. "That's a success, but it might be too much of a success. How the company manages it is crucial. Some companies deal with it by making the decision that they're just not going to grow beyond 100 employees. They fear that the quality of production will go down or that the firm will lose its unique culture – or lose control. They are aware that if they grow too fast, they could lose the thing that gives them their competitive edge."

One strategy firms use to avoid 'the gusher' is to explore the opportunities and then focus in on one. Often this means specialising – for example, focusing on one successful product rather than a diverse range of products.

The CANZ research project started eight years ago, with funding from the Foundation for Research, Science and Technology, and will run for four more. It has produced "very rich case studies", says Chetty, of companies that have successfully made the leap into the international market. Interviews with CEOs and international business managers were often two hours long. "They were very generous with their time."

The firm's 'social capital' is a key to success, the project has found. "It's not just the money – it's the whole network, and the resources that come from that network. In business that's so critical. Serendipity comes into it. You might bump into someone and the whole direction changes."

But successful New Zealand firms do make sure they are in the right place at the right time. "New Zealanders are pro-active. From our studies we see that people are ready to travel. They spend a lot of time talking to distributors, talking to their customers, eating and drinking with them. They say you really have to be there, you can't do it on the Internet."

Another key attribute is the ability to work collaboratively. "These firms network. They develop relationships, for example, with subcontractors and suppliers, so that they have a mutual commitment. A lot of it is trust and adapting to each others' needs, and it often takes a lot of time."

A vital ability is being able to identify opportunities – and then take them, even though that means taking a risk.

Chetty's own career has many of the hallmarks of these successful firms – including working collaboratively. She is not only part of the national project here but is part of an international research team at Uppsala University in Sweden.

Being proactive and willing to travel, welcoming serendipity, being able to spot an opportunity and having the guts to change direction and take a risk – all are evident in Chetty's personal history.

She was born in South Africa but left for Britain as soon as she could because of the apartheid system. She got her under-graduate degree from Salford University – in sociology: "That's why I use a lot of it in my research."

She gained an MSc in Business Studies at Edinburgh University, and was on her way to the University of Queensland for a one-year job 16 years ago when, with a couple of months to kill first, she offered to do a few visiting lectures at the University of Canterbury.

She was offered a job there, took it, and did her PhD on the international trade performance of New Zealand firms. She came to Massey in 2000, via Victoria University.

It was a visit to Sweden, home to leading theorists on international business expansion, during study leave in 1997 that set her thinking about whether their theories fitted the New Zealand situation. She goes to Sweden every year as a visiting professor at Uppsala University.

Chetty is now comparing the strategies of New Zealand firms with those of other countries. She has already looked at Sweden, and will move on to Finland and Ireland.

She has also received e-mails from doctoral students in Belgium, Holland, Denmark, Portugal and Israel eager to replicate her work to see if it applies in their home countries.

Chetty has delivered about 20 seminars on the research findings so far, including addressing this year's conference of the Economic Development Agencies of New Zealand. "This is important because New Zealand firms have to have the big picture, but they are too busy with day-to-day firefighting. Now business people are coming and getting advice on strategies, and policy makers are also consulting us."

What they're learning is that although we don't do it by the text book, many firms have gone global very successfully, and many more will – well armed with the CANZ research.

FOR REMEMBRANCE

There can be few artists or designers who walk to work past their *magnum opus*. Kingsley Baird is one.

Each weekday morning he makes his way past the Tomb of the Unknown Warrior in front of the National War Memorial in Wellington.

Often he will pause for a moment. Sometimes, even at this early hour, other people will be there as well, standing in quiet contemplation. Often the mantle of the Tomb will carry a scattering of flowers or a wreath, sometimes from ceremonies of state (at writing Prince William was the most recent), sometimes from private citizens marking their own observance.

The Tomb and its occupant – a soldier who died in France during World War I – represent the more than 9,000 New Zealanders whose bodies lie forever in foreign soil, their lives cut short in wars of the twentieth century.

Baird walks on; just a few hundred metres away is the Wellington campus where he is a senior lecturer in the College of Creative Arts.

The Tomb of the Unknown Warrior in Westminster Abbey, which represents the war dead of the British Empire (of which New Zealand was a part), dates back to 1920. Soon after the re-interment ceremony for the British warrior, New Zealand's Prime Minister, William Massey, made it known that his government wished to bring home the remains of an unknown New Zealand warrior, but the expense stymied the idea both then and when it was raised again after World War II.

Elsewhere in the Commonwealth towards the close of the millennium other memorials were commissioned: Australia unveiled its own Tomb of the Unknown Soldier in 1993; Canada in 2000.

In 1999 the idea resurfaced in New Zealand, this time gaining traction. In 2002 agreement was reached with the Commonwealth War Graves Commission to repatriate the remains of a New Zealand soldier killed in the First World War, and a design by Robert Jahnke – now Professor Jahnke, the head of Māori Studies at Massey – was accepted. But Jahnke's design was predicated on a redesign of the forecourt and steps of the War Memorial proposed by the Ministry for Culture and Heritage, and when, after public opposition, the redesign was abandoned, the Ministry awarded the contract to design and construct the Tomb to Kingsley Baird.

Baird set out to make the Southern Cross-inspired Tomb jewel-like. "So that when people came to it they would sense that this was a very carefully crafted, beautiful object made specially to honour the sacrifice of the warrior and those he represents."

The detail had to be just so, from the precision with which the four crosses were inlaid into the bronze mantle atop the Tomb, to picking the right stone for the crosses around the base: a coarsely grained difficult-to-work but appropriate local stone was chosen over an easily worked Italian alternative.

Baird says the significance of the Tomb to the national psyche became apparent to him when the warrior was returned home from France.

"There was a huge wound I think we were unaware of. It was only when the warrior returned and people visited him when he was lying in the Legislative Chamber at Parliament that people realised the significance of what was happening."

On Armistice Day, 11 November 2004, the unknown warrior was laid to rest. A memorial service was held at Wellington Cathedral of St Paul, a military funeral procession wound through central Wellington to the National War Memorial, and an interment ceremony with full military honours took place.

Baird was peculiarly well qualified to head the New Zealand design team; he already had one major memorial commission behind him: the New Zealand Memorial in Canberra, his design having been chosen over competing entries. Baird entered in collaboration with the Studio of Pacific Architecture, and the Memorial was unveiled by Prime Ministers Helen Clark and John Howard in 2001.

It was while working on the New Zealand Memorial and simultaneously completing a master's installation and video project addressing the unresolved grief surrounding the death of his brother in a motorcycle accident many years earlier that Baird began to fully appreciate the importance of the need to remember.

"My master's project helped me to reconcile myself to the death of my brother. It helped assuage the loss. I realised that if art could do this for me then art could do this for others as well."

Baird believes it is a fundamental part of human nature to memorialise – to cherish sites or objects that evoke particular people or events.

He remembers his family burying dead birds at their beach house.

"We would recognise these small deaths by burying each creature with a memorial gesture; we would make up a name for it, carve a form in pumice, and surround the grave with flowers."

A successful memorial has to succeed on a scale people can relate to, says Baird: grandiose memorials motivated by strident nationalism usually miss the mark; abstract and understated memorials are more successful because people can engage with them and take their own stories from them.

One of the memorials he most admires is Maya Lin's Vietnam Veterans Memorial in Washington: a black polished granite

Marita Vandenberg writes

wall inscribed with the names of the many thousands of US soldiers who died.

"People take rubbings of their loved ones or friends' names; it works."

So, evidently, does the Tomb of the Unknown Warrior.

A visitors' book inside the foyer of the National War Memorial holds the impressions of some of the more than 50,000 people who have visited the Tomb. Adjectives such as beautiful and peaceful constantly recur.

"People are often very emotional," says Paul Riley of the Ministry for Culture and Heritage, who sees people interacting with the Tomb every day. Something he has noticed: "Everyone who visits seems to have to touch it."

Design team leader Kingsley Baird stands before the Tomb of the Unknown Warrior. Other members of the design team included architect Michael Bennett and, from the College of Creative Arts, typography lecturer Annette O'Sullivan. Graphics lecturer Gray Hodgkinson and industrial design tutor Peter Fraser, also of the College, made contributions. The project called on the skills of engineers, bronze casters, stone masons and Māori cultural experts.

The paper trail

Baird's work in the design and crafting of memorials is counterpointed by his textual and documentary explorations.

In early 2005 he travelled to Canada to present a paper at the Society of Architectural Historians' Conference on the subject of the historical, political, social and cultural contexts surrounding the New Zealand Memorial and the Tomb of the Unknown Warrior.

He then visited memorial sites in Hawai'i, Vancouver, Ottawa, Washington, New York and Boston, photographing and documenting his experiences as he went.

Early in 2006 he intends to visit memorial sites in the United Kingdom and Europe.

On his return he intends to write a paper examining changes in the relationship between the United Kingdom and New Zealand in the period between the interment of the original unknown warrior in Westminster in 1920 and his New Zealand counterpart in 2004.

Escaping the frame

Professor Sally Morgan talks to Marita Vandenberg about the legitimation of fine art as research.

A scientist carries out a series of experiments, arrives at a set of conclusions, and publishes a paper in a research journal or a set of conference proceedings. Publication is the currency of academia; another credit goes into the account.

But how would the world view that researcher if that research paper – the text explaining the work – disappeared as soon as it was written?

For many artists working within academia their artworks must serve as research and text; an artwork requires no written explanation.

What is more, for some, the performance artists, their creations will exist fully only in the moment; they cannot form part of a physical portfolio.

Professor Sally Morgan, who heads the College of Creative Arts and is herself an established performance artist, knows the difficulties in equating research in the realm of the creative arts with research in the hard or social sciences.

"Scientists have a question or a problem – they solve it – whereas we're much more about posing sets of questions," she says.

"Whether designers, fine artists, or musicians, the biggest challenge for all of us is how do we get the predominantly science-orientated world of universities to understand what we do, and to understand the importance of it as research."

Previously Head of Fine Arts at the Bristol School of Art, Design and Media, University of Western England, Morgan took up the reins at Massey as the founding professor in 2001.

"My aim has been to create a comfortable environment for artists so they can take their place alongside scientists and people in the humanities and social sciences and have their work – their research – seen as just as valid.

"That was my biggest challenge at Bristol and that's my biggest challenge here."

That artworks are in themselves research outputs is now accepted in academic environments in the United Kingdom and United States, she says.

It's been five years since Wellington Polytechnic's Music and Design schools became part of Massey University and a School of Fine Arts was established. The latest fine tuning of what has been a huge cultural transition is currently taking place.

Morgan describes these latest changes as a "reconfiguration": regrouping the college under its new title of the College of Creative Arts to set up coherent collections of research interests and streamlining administration so staff have more time to concentrate on their own research projects.

"Universities are about being research-led. We have fantastic teachers who are actually very good researchers. It's just that they don't know that. We are now saying that to be the best you can in the classroom or studio or workshop, you need to be at the forefront of your discipline. You do that by being an active researcher."

Morgan, who became a Pro Vice-Chancellor last year, leads by example.

She came to New Zealand with an established international reputation as a practising artist, arts administrator and prolific writer. She concedes that sometimes it is enormously difficult to pursue her own work while leading the College. However, she continues to write and to create paint-on-canvas works and experimental sculptural installations in her shared Lyall Bay studio. She also remains active in performance and installation art. (At writing her latest show is being held at the Show Gallery in Wellington.)

As well as postgraduate art qualifications, Morgan has a passion for history, in which she has a master's degree from Ruskin College, Oxford. Love of history, and particularly archaeology, is an underpinning theme in the performance installation work she has gained most recognition for: *A Life in Diagrams 1 – 5*.

This series of performances evolved as her response to her father being diagnosed with a fast-growing and inoperable brain tumour in 1991. Three artists performed alongside Morgan: Sally Tallant, Gillian Dyson and Tim Brennan, all members of Performance South West, of which Morgan was a founder member.

The work explores grief, loss and the inconsistencies of memory.

The audience sees a rectangular-shaped mound of earth that proves an ambiguous archaeological site. Morgan is the archaeologist, carefully uncovering objects and handing them to a colleague for precise cataloguing, transforming objects into knowledge.

This is possibly her father's grave and the objects she is retrieving trigger her memories of his life and death. Texts that had been written during the months when she visited her dying father are read out. These emotionally charged readings are interspersed with readings from a box of facts; a juxtaposition of science and art, objectivity and subjectivity, creating their own tension.

Sometimes the archaeologist breaks down as the texts are read and she herself is measured: her response quantified and recorded.

The performances change each time. Morgan cries in different places, or doesn't cry at all. Texts are added. There are differing levels of interaction with the audience. Some viewers stay for the full three to five hours.

Six performances took place over several years, most notably at London's ICA, Bristol's Arnolfini, and the Belluard Bollwerk International Performance in Fribourg, Switzerland. Shorter versions were performed to a French audience.

A critic from the Arts Council of Great Britain described the work thus: "A rigorous and dynamic project and one that can truly represent the best of current British performance practice."

The performances came to an end, explains Morgan, because they were so physically and emotionally draining.

Since coming to live in New Zealand with her Kiwi partner in 2001, Morgan has become a citizen; she describes herself as a New Zealandophile. However, while she enjoys being an artist living in New Zealand she believes she will never be allowed to become a New Zealand artist.

"When you look at the art establishment

– though not the artists – it is wedded to the notion of art as an expression of cultural identity." If an artist's work does not reflect that current obsession then it's "pretty hard here", she says.

"At the moment there is a working-through of the ideas of what it means to be an artist in a New Zealand context in a very specific way."

She argues that this is a valid evolution for New Zealand art to go through. However, this parochialism has meant that some very good artists are not currently getting the recognition they deserve, while others are erroneously proclaimed as great.

Simon Morris, a colleague at the College, is one of those she believes should be noticed: "He is an absolute painter's painter and I think he would shine anywhere. What he's doing is very on the edge but that's not being recognised in the way it deserves."

Morgan believes the failure to join the search for cultural identity was also behind the uproar over et al's exhibit, *Fundamental practice*, for the prestigious Venice Biennale. (In a generally favourable article in *The New Zealand Herald* the exhibit is described as "looking like a gritty construction site, housing a computer that is programming a distorted and warped belief system".)

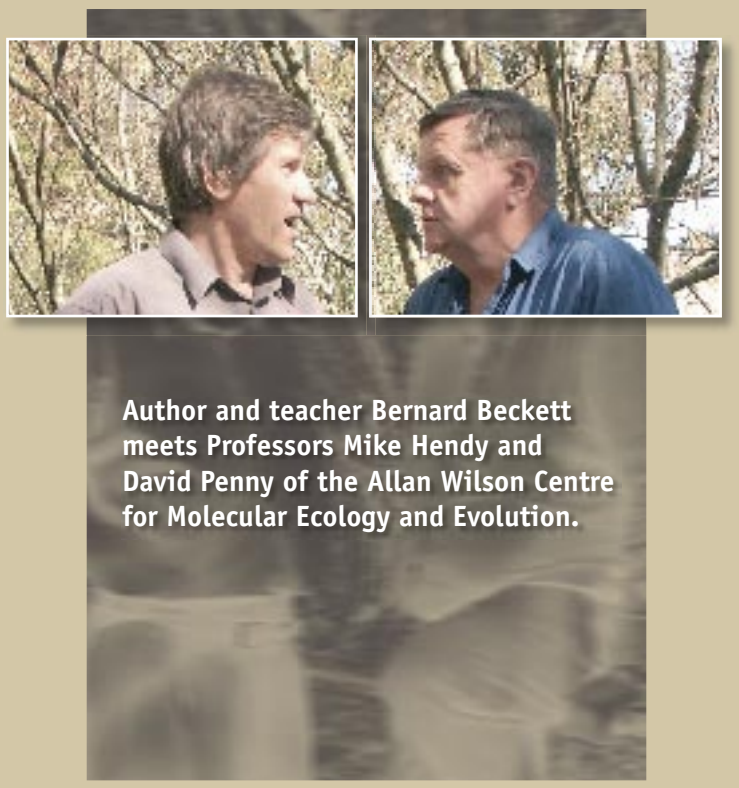
The Biennale is at the complex end of the art spectrum, she explains. Work seen there is supposed to be difficult and challenging. To gain acceptance there is to be a sophisticated player in world art and New Zealanders, she says, should feel proud – in the same way we are about our sporting achievements – that we were represented.

"For some odd reason there's this notion that art should be utterly and absolutely accessible to everyone immediately. I get really worried about pretending to people that you can make all art instantly accessible to all people. That's what's great about art: some of it's straightforward – and some of it's complex.

"The beauty of being in the university is you deal with the esoteric end. You can explore art and push it in a way that you can't if you're having to sell it on the market, working at that end that is accessible."

And as for anyone who asks the hackneyed question 'But is it Art?', as they did repeatedly with et al's work, Professor Morgan responds: "That's a very nineteenth century question. Since the mid twentieth century art's job has been to challenge us, and to push us beyond what we think we already know. It would be refreshing if we could accept that, rather than constantly demanding it conforms to our tired assumptions."

A casual conversation of thirty years



Author and teacher Bernard Beckett meets Professors Mike Hendy and David Penny of the Allan Wilson Centre for Molecular Ecology and Evolution.

Professors Mike Hendy and David Penny did not always seem destined to be colleagues. During his school days David Penny's fascination with biology was such that he would daydream about DNA while doing the chores. Hendy, on the other hand, chose mathematics over biology for prosaic reasons – mathematics smelled better. Only years later would he to come to biology in reaction to a firebrand creationist.

These days the two are the co-directors of the Allan Wilson Centre for Molecular Ecology and Evolution, where, as a writer and mathematics teacher on the lam, I am based for a year.

Penny and Hendy are the twin strands of the Centre's DNA. For 30 years the two have been engaged, as Penny puts it, in "a casual conversation". To understand what the Centre is, it helps to understand who they are.

The intertwining of their professional lives owes much to the twin pillars of chance and selection.

Flash back a few decades, way back in the evolutionary past, to when 15-year-old budding scholar Hendy was facing his first major academic decision. *Biology or mathematics?* The timetable would not let him do both. As he remembers it, the smell wafting from the "dogfish dissection room" was the clincher. Hendy chose mathematics.

If it took the stench of fish and formalin to drive Mike away from biology, it was the odour of bad science that drove him back. It was the early seventies, and creationist provocateur Duane T Ghish was touring the country, confident his oratory would triumph over reason in a series of staged debates. His Palmerston North opponent was Robert Brooks, an eccentric biochemist said to have given as good as he got. Hendy, at that stage a pure mathematician setting out on his academic career, was in the audience. The Ghish performance was just the catalyst needed to turn his attention to the 'evolutionary problem'.

Karl Popper, the famed philosopher of science, claimed that evolutionary thinking had at that point fallen short of the requirements of a scientific theory: it provided plenty of description, but not enough prediction. Only through prediction and the possibility of refutation can a theory be properly tested.

Was the criticism fair? Probably not. Evolutionary theory had by then made some remarkably accurate predictions, such as the existence of a unit of heredity. Nonetheless, the debate caught the imagination of both Hendy and Penny, a biologist newly arrived at Massey.

Penny's path to biology wasn't straightforward, either. Maths and English were his strongest suits at school; biology was, in fact, his weakest. But a mention by his high school teacher of the discovery of the structure of DNA rattled around inside young David's head while he was doing one of his farming chores, feeding whey to his grandfather's pigs. Even while doing mundane chores, he says, "you can be thinking about what is really interesting".

Penny and Hendy met at Massey at around the time that sequencing – first of protein chains and then of DNA – was becoming an established technique.

Here, they realised, was the perfect riposte to the Popper challenge. Evolutionary theory makes very strong predictions at the molecular level. Common ancestry and modification by descent predicts not only the observed physical relationships between all living creatures, but also a parallel set of relationships in the information carried in their DNA. The Hendy/Penny paper, testing the hypothesis that different protein sequences would yield similar phylogenetic trees when comparing species, was published in *Nature* in 1982. In many ways the Allan Wilson Centre, a centre of research excellence established in 2003, represents the continuing evolution of that project.

While coincidence may have provided the catalyst, it takes something more to fuel 30 years of investigation. In the case of both Hendy and Penny, that something is a deep level of personal enthusiasm.

Why should society be bothered enough to fund such investigations? I asked. They were quick to answer. They started by pointing out blue sky research has always produced unseen practical benefits, and cited as examples the development of the laser, initially a neat trick without any obvious application, or Volta and Ampere messing about with eels and frogs at the beginning of the nineteenth century, and coming up with the battery.

I got the feeling there was something more they wanted to say on the topic though, so I kept asking. What if, I speculated, the research had no practical applications? Would it still have value? Apparently so. By their thinking, there is more to research than the symbiotic relationship between speculation and application.

Hendy explains it this way. It is not just what is discovered that is important, but how it is discovered. As an active researcher he feels he is able to provide students with a model of the techniques and methodology of science, and so pass on the baton of 'conjecture and refutation'. Popper has definitely made his mark. Let's hope he was right.

Penny expresses it differently. Small children, he observes, burn with an innate sense of curiosity. They instinctively ask the 'why' questions. Sadly, a poorly delivered education system, focusing more on the acceptability of the answer than the urgency of the question, can extinguish the flame. His job, he says, is to keep us asking questions, stop us growing up. This then is a model of intellectual inquiry for its own sake, a magical anti-dogma machine.

A current Allan Wilson Centre project which highlights this attitude as well as any is the exploration of the dinosaur extinction at the KT boundary some 65 million years ago. Here the orthodoxy has the crushing weight of myth behind it. In all probability you will have heard the story. A dirty great meteorite smacks into the Yucatan peninsula in Mexico. The resulting nuclear winter – clouds of ash, forest fires, tsunami, the works – does for the dinosaurs and leaves the small warm-blooded mammals to radiate out of their holes and inherit the earth.

The appeal of the story is significant. We humans like a good tale of catastrophe, and there is something simple and emotionally appealing about evolution's path being dictated by the big booming outside events, the hand of God as it were. But a good story need not be a correct story. Molecular analysis being carried out at the Centre supports the belief that both the mammalian and bird evolutionary trees had already branched significantly by the time of the Big Impact. The extinction of dinosaurs may owe much to the inexorable logic of microevolutionary processes. They want the story to be supported by data as much as it is by whimsy.

By contrast, another of the Centre's major projects has the trade winds of story telling squarely behind it. By examining the DNA of Pacific rats, kūmara, gourds, taro and other artifacts, researchers are adding new pieces to the puzzle of early human migration in the Pacific. One study of Māori mitochondrial DNA helped establish estimates for the size of Aotearoa's founding population, and supports the notion of an organised migration. Analysis shows the kūmara is South American in origin, hinting at the landing of Polynesians on South American shores. Work is now being done on the gourd to see if this tale can be added to.

Meanwhile, broader mitochondrial studies are adding weight to the out-of-Asia hypothesis as the source of the area's first human explorers. Overall, the data fits a tale of intrepid ocean exploration, and for reasons a writer can readily appreciate, this makes it a far easier sell than the dinosaur story. But again, the researchers expressed a certain pride in preferring data over drama. I nodded, and pretended to understand.

To finish, I asked Penny and Hendy where they expect the most exciting developments in their field to occur over the next 30 years. Penny plumped for an explanation of the origin of life itself, and in the spirit of those who tilt at windmills, maybe a better understanding of those so-called human intellectual abilities already present in chimpanzees.

Hendy expressed excitement at new potential challenges to the orthodoxy, pointing out that our understanding of the relationship between genetics and development is incomplete. In a nod to the applied sciences, he also mentioned advances he hopes will revolutionise medicine, on the back of new discoveries in the field of genetics.

Then our time was up. They went back to their theorising, and I went back to telling stories. I get the feeling their casual conversation has barely started.

BERNARD BECKETT is one of New Zealand's leading writers of young adult fiction. He has written several novels and plays for teenagers, including *Malcolm and Juliet*, which received the 2005 NZ Post Young Adult Fiction Award. Beckett also teaches at Wellington's Onslow College. This year he is studying at the Allan Wilson Centre for Molecular Ecology and Evolution as a Science, Mathematics and Technology Teacher Fellow. During his fellowship, Beckett is working on a project examining DNA mutations in various Pacific crops as a means of tracing human migration patterns.

Close to the bone

Even as you read this it is likely that your bones are betraying you. If you are over the age of 30 then your skeleton's best years are probably behind it. Little by little, you are losing bone mass.

If you are a woman, that loss of calcium will accelerate markedly in the first five years after menopause. If you are a man, there is no reprieve; the rate of calcium loss over your later life will just be more constant.

Over a lifetime the small losses add up. Lose enough calcium from your bone mass and things break. Hips, wrists and vertebrae: any area of structural weakness can fail.

Bone – how it forms, how it is broken down, how to maintain it in good health – is Associate Professor Marlena Kruger's preoccupation.

Her office on the Palmerston North campus is surrounded by laboratories specialising in the science of bone. Here is the machinery used to measure bone mineral density in humans. Here, the machinery to scan small animal bones at high resolution, a low dose X-ray technology called dual X-ray absorption. (A computerised tomography scanner is a walk away elsewhere on campus.) Here is the equipment used to measure the biochemical markers of bone turnover that circulate in blood; here, the facilities to host cultures of living bone cells.

The quest to understand and combat osteoporosis is not just professional. Statistically, white women once they pass the age of 50 face around a one-in-three chance of suffering a hip, spine or wrist fracture. (For white men the odds are more than one in five.)

And Kruger has seen what osteoporosis does. In field trials she has visited rest homes and seen women bowed down by multiple vertebral fractures, or bed ridden after hip fractures.

Kruger has been involved in the science of calcium metabolism since doing her PhD (on the effect of fatty acids and prostaglandins on calcium flux in muscle) in the early 1980s, and in the study of bone health since 1991, when she joined the University of Pretoria as a senior lecturer in physiology. While there, she helped to run osteoporosis clinics and undertook two

commercially funded studies into the effect of essential fatty acids on bone health as well as being part of multi-centre clinical trials to evaluate the effectiveness of trans-dermal oestrogen replacement.

It was in 1999, while at Pretoria, that she saw a vacancy for a bone physiologist based at Massey. "So I decided that was me!" says Kruger with a laugh.

In the years since arriving in Palmerston North, Kruger has risen to head the substantial enterprise that is Massey's human nutrition and health cluster – though that hasn't stopped her from continuing to teach, or from pursuing the research which is the favourite part of what she does.

Kruger also acts as consultant to companies such as Fonterra and New Zealand King Salmon.

To think of bone is usually to think of something dead, bleached and hollowed: bone as seen in one of those articulated laboratory skeletons or among the driftwood on a beach.

But bone *in situ* – the bone in your body – is a living organ, a composite of small crystals containing calcium and phosphate bound to a protein matrix and populated by a community of specialist cells: osteoblasts constantly laying down new bone in orderly layers; osteoclasts constantly removing bone by dissolving the mineral and breaking down the protein matrix; and osteocytes, a network of sensor cells buried in the bone matrix.

Working in tandem the osteoblasts and the osteoclasts replace – or 'remodel' – your skeleton in its entirety every few years, depending on your age, making good damage and deformities and replacing older and hence less resilient bone.

They also help regulate your blood level of calcium, an element that performs a multitude of physiological functions beyond being a component of bone mass. Calcium is essential to muscle contraction – including heartbeat – nerve transmission and to blood clotting.

To work properly, the body must keep the blood level of calcium within a narrow range. As calcium is needed it is withdrawn from the stores in the bone, and, when calcium is surplus, bone is where it is accumulated.

The good oils

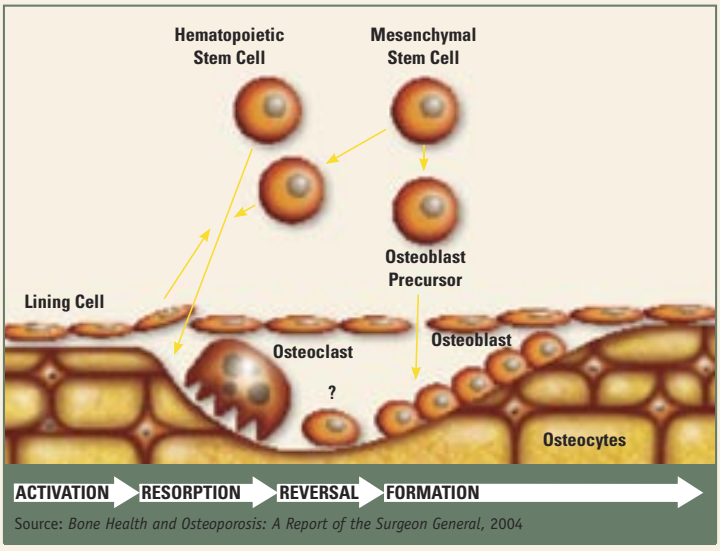
In recent times many people will have heard of the health benefits associated with omega-3 fatty acids. Omega-3 fatty acids are found in fish, flaxseed and canola oils, and some nuts.

Diets rich in omega-3 fatty acids have been shown to cut cholesterol, hypertension, and the risk of heart attack and stroke. There is also evidence that omega-3 may provide protection against a host of other ills including ADHD, arthritis, depression, diabetes, and – yes – osteoporosis.

Omega-3 fatty acids, studies suggest, help increase levels of calcium in the body, deposit calcium in the bones, and improve bone strength.[1]

The omega-3 fatty acids eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA) can, to a limited degree, be metabolised from alpha-linolenic acid, one of the essentials in your diet. However, it is easier for the body to directly get EPA and DHA from fish oils, bypassing the need to metabolise them from alpha-linolenic acid.

Does EPA have a role as a bone health supplement? Together with Raewyn Poulsen, her postgraduate student, Kruger conducted a trial in which female ovariectomised (OVX) rats were fed pure EPA as a portion of their diet.[2] (Female ovariectomised rats are used as the model for post-menopausal osteoporosis.) The study found that the rats fed 1g/kg EPA lost more bone than OVX rats. However, a lower dose of 0.1g/kg seemed to prevent bone loss. Another of Kruger's students has shown that arachidonic acid (one of the omega-6 fats), oestrogen and parathyroid hormone affect osteoblasts in culture in different ways, thereby controlling bone formation and resorption selectively.[3]



Cells of the bone-forming osteoblast lineage, either on the bone surface or in the marrow, act on blood stem cells to form bone-resorbing osteoclasts. The resorption process may take place under a layer of lining cells, as shown here. After a brief reversal phase, the osteoblasts begin to lay down new bone. Some of the osteoblasts remain inside the bone and become osteocytes, which are connected to each other and to the surface osteoblasts. The resorption phases last only a few weeks; the formation phase takes several months to complete as multiple layers of new bone are formed by successive waves of osteoblasts.

Although the process of bone remodelling continues throughout life, there are identifiable phases in skeletal development. Adolescence is particularly critical in laying down reserves of calcium. As much as 80 percent of adult bone mineral – an amount sometimes referred to as the 'calcium bank' – is deposited during this time.

During the young to mid-adult years the ledger for bone formation and resorption is generally in balance. Then, usually at some point past the age of 30, the account begins going into deficit, with both men and women gradually losing bone mass.

It is with the onset of menopause in women that the fortunes of the sexes dramatically part ways – at least for a while. Oestrogen, a group of hormones found in women in significantly higher quantities than in men, is the reason.

Oestrogen determines a woman's secondary sexual characteristics and her menstrual cycle, but this is not all it does. Oestrogen also regulates the osteoclasts and osteoblasts, inhibiting bone breakdown.

In women the primary source of oestrogen is the ovaries. With menopause the ovaries shut down. This ends the reproductive years and has repercussions for bone health.

"Bone is being metabolised all the time," explains Kruger, "with formation and resorption going on in cycles. When a woman reaches menopause and her oestrogen levels drop, bone turnover is uncoupled and the process is less well controlled. For the first five years after menopause, even if she takes in two grams of calcium a day [almost double the New Zealand recommended daily allowance] or changes her diet, she may not be able to slow her bone loss. The effect of oestrogen deficiency is overpowering; a nutritional prevention or treatment strategy may not be enough."

Girls who exercise to the point of amenorrhea – where their oestrogen production plunges and their periods stop – experience the same phenomenon: a rapid loss of bone mass.

Men are better favoured. Testosterone, the dominant male hormone, has its own role in maintaining bone health – and with testosterone men experience nothing equivalent to the precipitous decline in oestrogen at menopause. In fact, oddly enough, because fat cells convert testosterone into oestrogen, older men have higher circulating levels of bone-protective oestrogen than do post-menopausal women.

How do you combat osteoporosis? The best strategies are preemptive and defensive. Build the highest bone mass you can during your formative years, maintain that bone mass during your adult years; and, as age begins to bite, minimise the inevitable losses. The two means available to you are exercise, which builds bone as well as muscle, and diet.

In diet, calcium is key; depending on your age and sex you must exceed a certain threshold of calcium intake if lack of calcium is not to be a limiting factor. Are you consuming enough calcium? Even if you pride yourself on a balanced diet, perhaps not. In the United States national surveys suggest that the average calcium intake of individuals there is far below the levels required for optimal bone health. In New Zealand the National Nutrition Survey of 1997 found 24 percent of Māori males and 34 percent of Māori females had an inadequate intake of calcium, as did 11 percent of European and other males and 22 percent of European and other females – as measured against our much lower recommended dietary levels.

The 2002 National Children's Nutrition Survey found that 29 percent of 11–14-year-old girls had an inadequate calcium intake.

The need for adequate calcium in the diet is complicated by the effect of dietary protein. A proportion of bone is protein, and some studies have shown that higher protein intakes may be associated with positive effects on bone. On the other hand, urinary loss of calcium has also been shown to rise with protein intake. In the absence of an appropriately high calcium intake, a high protein diet may do more harm than good. "There's a certain ratio you have to maintain of calcium and protein," says Kruger, who has recently authored a book chapter on the topic.[5]

A switch from a low- to a high-animal protein diet is one of the phenomena accompanying urbanisation worldwide. So too are dietary salt, saturated fat, carbonated drinks and a sedentary lifestyle – all of them bad for bone health.

In South Africa, Kruger has seen what happens first hand. She was one of the researchers in the THUSA (Transition and Health during Urbanisation of South Africans) study which looked at the health of South Africans moving from the countryside into suburbia. THUSA found a negative correlation between urbanisation and the bone markers for bone turnover.[6,7] The study also showed that African women suffer menopause induced bone loss similar to that of European women. At present African women have a substantially higher bone mass compared to European women but with time and urbanisation it may not be the case in about 20 years.

(At print, Kruger is in South Africa presenting the findings of the THUSA study in a keynote address to the conference of the International Union of Nutritional Sciences in Durban.)

In Hong Kong, a conurbation representing decades of urban drift, there has been a steep rise in the number of hip fractures.

Sooner or later, like Hong Kong, those other areas of the world experiencing mass urbanisation – Africa, Asia, Latin America and the Middle East – can expect to see substantial increases in osteoporosis too.

Could part of the answer lie in milk? Very likely. Milk products, says Kruger, are rich sources of calcium, phosphorus, magnesium, potassium, zinc and protein. New Zealand's 1997 National Nutrition Survey found that almost half the population's calcium intake came from milk (37 percent) and cheese (11 percent).

But in many circles milk and its products have fallen from favour. In the 1950s, in what would become the foundation of many a public health campaign, US researcher Ancel Keys found that the low-saturated-fat diet of southern Italy – lean meat once or twice a week, butter a rarity, milk something to be had when an infant, or, as an adult in coffee, but never otherwise – seemed to be associated with lower cholesterol and better coronary health. As a consequence, dairy products were demonised, equated with unhealthy levels of saturated fat.

But milk and many other dairy products now come in an array of low-fat alternatives. Lactose intolerance – that other justification given for steering clear of dairy products – is no good reason for forgoing milk either.

Lactose intolerance does exist: 90 percent of Asians, 70 percent of blacks, 50 percent of Hispanics and 15 percent of people of Northern European descent are lactose intolerant: they lack the enzyme lactase, which makes the milk sugar lactose digestible.

Even so, people who are lactose intolerant can usually cope with a glass or two of milk. Many dairy products other than milk are low in lactose, and lactose-hydrolysed milk is arriving on the supermarket shelves.

As for those who earnestly avoid dairy products in the quest to lose weight, there is evidence they are in error. Some studies have shown that high-calcium dairy-rich diets are

a path to weight loss. "It has been shown that more than three servings of low-fat high-calcium dairy a day help to reduce body fat in obese people. Especially abdominal fat," says Kruger. Calcium deficiency may in fact lead to the synthesis of fat. And milk is a very good source of calcium. Calcium is essential for building and maintaining bone and intake should be sufficient to support bone growth till early adulthood and slow bone loss which occurs from the age of 40 onwards. Calcium is also essential in rebuilding bone when a person has suffered a fracture or if a person has been immobilised for a long period of time. Kruger has established a model at Massey in which bone recalcification can be investigated.[8]

If osteoporosis sits somewhere well behind heart disease and cancer in the public consciousness of health issues, it is easy to see why. For one thing, although a hip fracture can be the trigger for a dramatic decline in health and quality of life, osteoporosis is a disease people generally die with rather than of. (Though after a hip fracture almost one-in-three victims will die within a year.) For another, osteoporosis is a 'silent' disease: by the time it announces its presence by way of a bone fracture, it is usually well advanced.

It is also largely invisible. The last officially collated statistics for hip fractures date back to 1994, when New Zealand recorded 3,039 hip fractures in people over the age of 65; around 571.5 per 100,000 women and 318 per 100,000 men.

And while the figures for hip fractures leading to hospitalisation might, with some effort, be collated, the figures for most common forms of osteoporotic fracture – spinal and low trauma wrist fractures among older women that do not lead to hospitalisation – are not available in a collatable form.

The economic cost? Again turning to badly outdated figures, in 1996 the estimate was NZ$33,887 for the first year for a woman over the age of 60. The loss in quality of life cannot, of course, be quantified.

In the decades ahead the number of osteoporotic fractures and the associated costs will soar. The reasons? Poor diet, lack of exercise and, most significantly, old age: osteoporosis is an age-associated condition. Currently, once past the age of 60 around 56 percent of New Zealand women will suffer osteoporosis, and around 20 percent of New Zealand men. Population-wise we aren't getting any younger. Soon a wave of baby boomers will enter their retirement years.

But the news is not all bleak.

For the dairy industry opportunities await in the form of functional foods pitched at a world market.

For researchers like Kruger, osteoporosis is wide open. It is only in the past decade that the mechanisms that control such things as the genesis and death of osteoclasts and osteoblasts have come to be understood.

For the individual, the good news is that the times are changing. For millennia the manifestations of osteoporosis have been seen as one of the inevitable and unremarked accompaniments of old age. Our literature, fairy stories and myths are stocked with stooped elderly women: women who exhibit the multiple vertebral fractures of the 'dowager's hump'.

Today osteoporosis is recognised for what it is – diagnosable, increasingly treatable, and largely preventable.

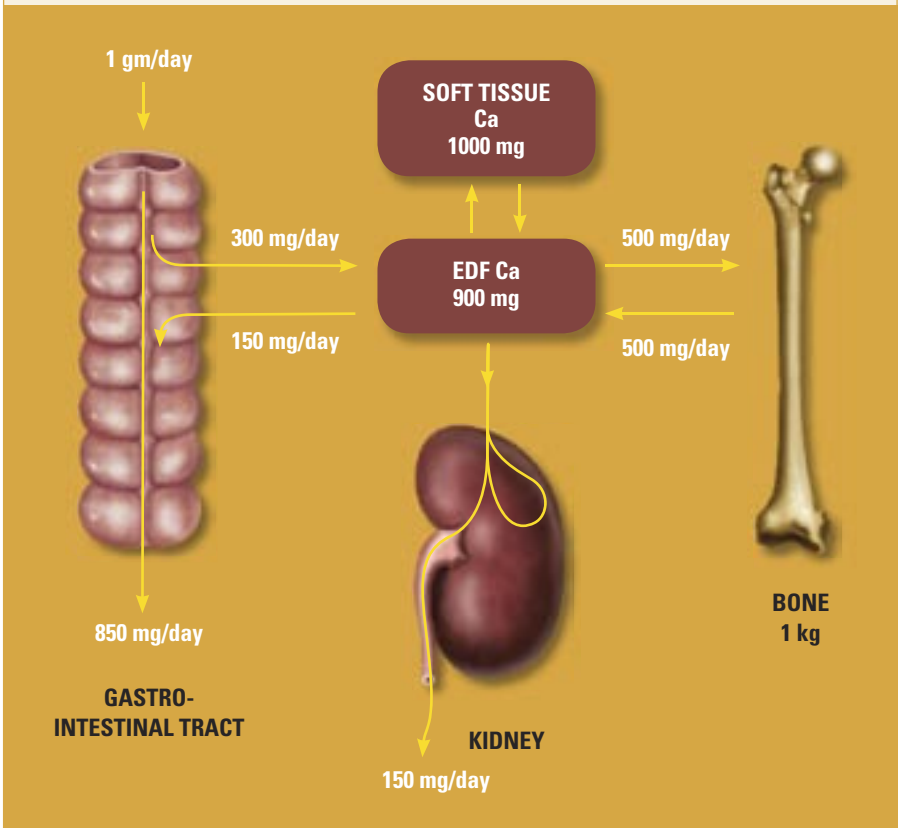
Calcium absorption

Only a part of the calcium that is available to the body through diet is absorbed in the intestine. Moreover, some of the calcium circulating in the body is lost through secretion into the intestine and part of the calcium that enters the kidney is lost rather than recycled. These movements and others within the body are regulated by hormones, particularly parathyroid hormone and calcitriol, the active form of vitamin D. The constant level of calcium in the extracellular fluid is essential for normal cell function and for maintaining the correct amount of calcium inside the cell.

Most dietary calcium is absorbed in the small intestine, but given the right circumstances it can also be absorbed elsewhere in the gastrointestinal tract; several 'prebiotics' are now being added to such foods as yoghurt and calcium-fortified fruit juices to stimulate bacterial action promoting calcium absorption.

Omega fats in the diet can increase calcium absorption by changing the intestinal membrane properties.[3,4]

Factors in the diet that may decrease the absorption of calcium include protein, fibre, phytate (a naturally occurring component of plant fibre found in breakfast cereals), and saturated fat.



Source: *Bone Health and Osteoporosis: A Report of the Surgeon General*, 2004

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8. R Lentle, MC Kruger. Changes in the mineralization and biomechanical properties of tibial metaphyseal bone in rats after three weeks immobilisation in a functional position without compression. *Journal of Applied Physiology* (2005) 99: 173-180.

Recommended Reading

Bone Health and Osteoporosis: A Report of the Surgeon General. 2004. Department of Health and Human Services. Available from: www.surgeongeneral.gov/library

Bone: an owners guide to care and maintenance

Calcium intake

Calcium is a 'threshold' substance: if enough is being ingested to optimise bone mass, taking in levels of calcium beyond this serves no purpose. But where does the threshold lie?

The British, New Zealand and US recommendations differ substantially. The highest of them, those from the US, are the most recently revised. New Zealand is currently revising its nutritional guidelines.

Recommended Daily Allowances	
Girls (New Zealand/Australia)	
8–11	900 mg
12–15	1000 mg
Girls (United States)	
9–18	1300 mg
Women (New Zealand/Australia)	
19–54	800 mg
54+	1000 mg
Women (United States)	
19–50	1000 mg
51–70	1200 mg
70+	1200 mg
Men (New Zealand)	
All ages	800 mg
Men (United States)	
51–70	1200 mg
70+	1200 mg

Approximate calcium per average serving of unfortified food (mg)	
Milk, 1 cup	300
Cottage cheese, 1 cup	138
Tinned salmon, 100gm	93
Spinach, cooked, 1 cup	291 *
Broccoli, cooked, drained, 1 cup	62
Cauliflower, cooked, drained, 1 cup	20
Baked beans, canned, 1 cup	154
Bread, 4 slices	108
Soy milk , 1 cup	93
Almonds, 30 gm	70
Green peas, cooked, 1 cup	94
Figs, 4	124
Cereals – oats, cooked with water	19
Rhubarb, cooked, 1 cup	348*

* *contains oxalic acid which will reduce absorption.*
Source: US Dept. of Agriculture
<http://nal.usda.gov/fnic/foodcomp/Data>

Vegetarians who avoid dairy products will need to take particular care to build enough calcium into their diets.

For women, pregnancy and lactation and the demands they place on the body's calcium stores are naturally a concern. However, the recent evidence is that if a woman's calcium intake is adequate, pregnancy and lactation, while they will draw on her bone reserves, need not have lasting effects on her bone health.

Vitamins D and K

Vitamin D is pivotal to the absorption of calcium from diet as well as its deposition to bone.

The main source of vitamin D is its metabolisation through the action of sunlight on the skin. With New Zealand's year-round relatively temperate climate and outdoors lifestyle, vitamin D is not something most of us should generally worry about.

Most of us, but not all of us. Vitamin D deficiency has been reported in Australia and New Zealand with dark-skinned and veiled women, and older people living in institutions, who are identified as particular high-risk groups.

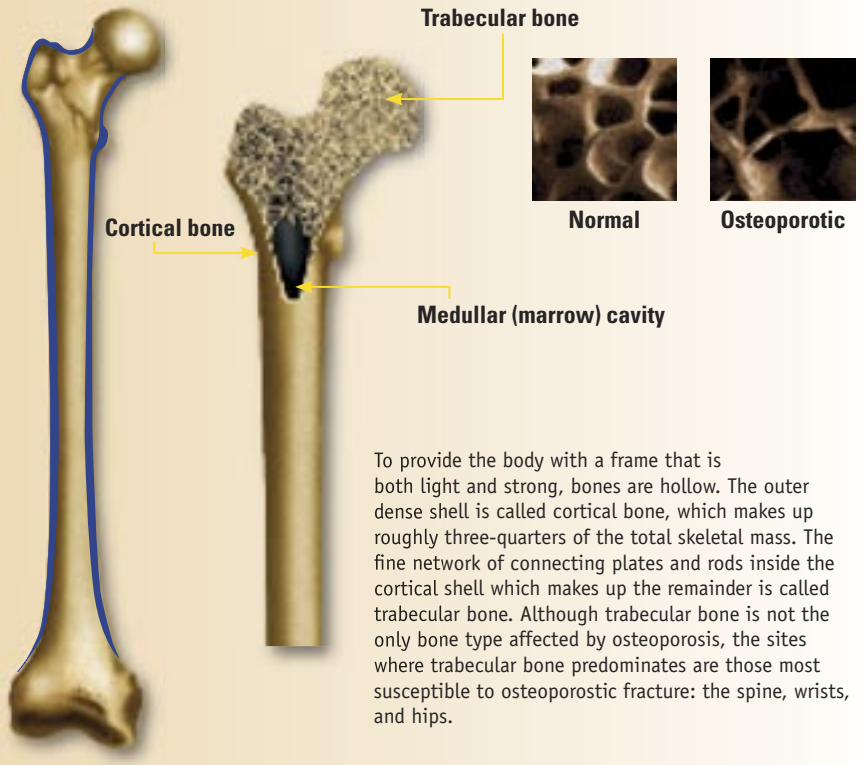
With ageing, the kidneys also become less efficient at converting vitamin D into its active form, 25 hydroxy-Vitamin D3, also known as calcitriol.

The few dietary sources of vitamin D include fatty fish, meat, dairy products, vitamin-D-fortified margarines and eggs. Since vitamin D is a fat-soluble vitamin, its available levels will be lower in a low-fat diet.

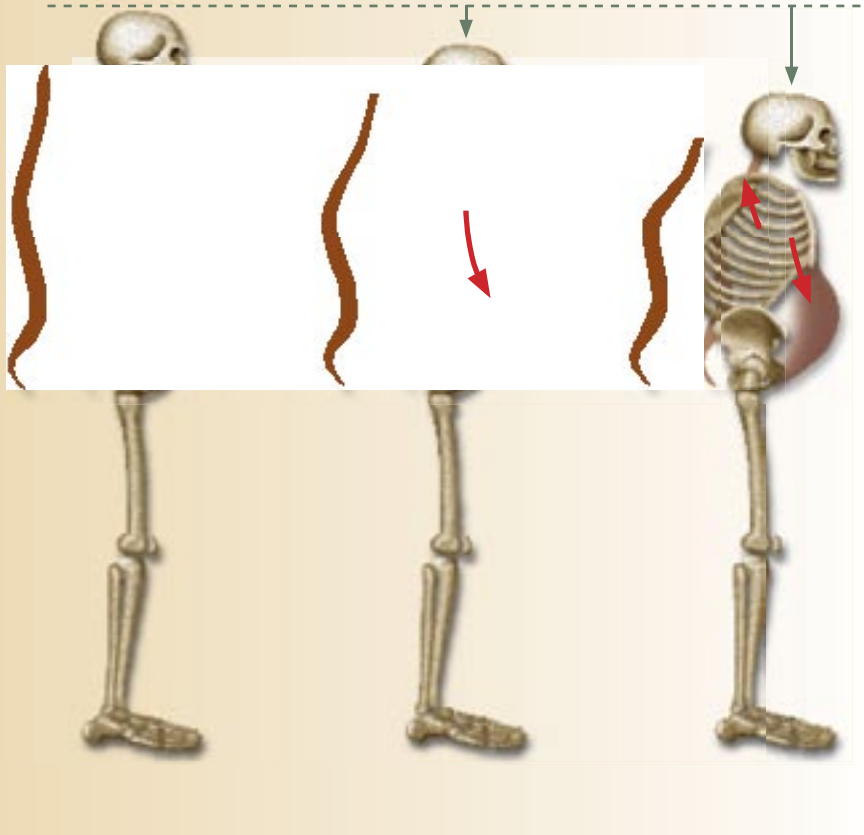
Calcium and vitamin D supplementation has been shown to reduce fracture risks and optimise bone density among the elderly.

However, care must be taken: large doses of vitamin D can do damage. If you are worried about your vitamin D intake, speak with your doctor.

Vitamin K adds chemical entities called carboxyl groups to osteocalcin and other proteins that build and maintain bone. Phylloquinone, the commonest form of Vitamin K is found in some oils, especially soybean oil, and in dark-green vegetables such as spinach and broccoli.



To provide the body with a frame that is both light and strong, bones are hollow. The outer dense shell is called cortical bone, which makes up roughly three-quarters of the total skeletal mass. The fine network of connecting plates and rods inside the cortical shell which makes up the remainder is called trabecular bone. Although trabecular bone is not the only bone type affected by osteoporosis, the sites where trabecular bone predominates are those most susceptible to osteoporostic fracture: the spine, wrists, and hips.



Risk factors

Previous history of fracture
Female
Family history of osteoporosis
Age 50 or older
Past menopause
Ovaries removed or menopause before 45
Low level of calcium in diet – less than four servings of dairy products a day
Less than 30 minutes outdoors in sunlight every day
Thin, 'small boned'
White, Caucasian or Asian ancestry
Smoker
Alcohol drinker
Long-term use of certain medications including steroids (e.g. cortisone and prednisone) and anticonvulsants

Source: Osteoporosis NZ

Physical activity

Weight-bearing activity is good for your bone health no matter how old you are. Activities that generate relatively high intensity loading forces, such as gymnastics and high-intensity resistance training, increase bone mineral accumulation in children and adolescents and there is evidence that this persists into later life.

For children and adolescents the American College of Sports Medicine (ACSM) suggests 10 to 20 minutes of high-intensity impact activities such as gymnastics, plyometrics or moderate weight training at least three times a week to build bone mineral density. Sports like soccer that involve running and jumping also find favour.

For adults, whose aim should be to maintain bone, the ACSM suggests weight-bearing activities such as tennis, stair climbing and jogging three to five times a week, and weight training two to three times a week. Brisk walking is also a good form of exercise for maintaining bone health. Thirty to 60 minutes a day should be spent in exercise.

Thanks to nutritionist Suzi Penny and to exercise physiologist Jacques Rousseau of the Institute of Food Nutrition and Human Health.

Among the believers

By Katherine Findlay

Dr Peter Lineham's fascination with the intertwining of history and religion has its roots in his own background. The Associate Professor of History in the School of Social and Cultural Studies at the Auckland campus was born and spent his early years in Karamea on the West Coast. The Lineham family were members of a Brethren community that Lineham describes as "kind of in between the exclusive and open brands of Brethren." In this small South Island community, religion was an integral part of life rather than a Sunday 'add-on'.

Conventional psychology might predict that someone who had grown up in an almost closed sect might remain there all his life or spurn religion altogether. Lineham has done neither. His upbringing, he says, didn't feel different or restrictive – in fact almost the opposite. It seems to have given him the ability to mix easily in extremely wide circles, while maintaining and broadening his Christian beliefs. He feels it has also given him a bit of a professional edge. "Most historians come from the mainstream Protestant background," he says. "Many don't understand that New Zealand is a culture of extremes."

Commenting and writing on those extremes has seen Lineham increasingly in demand as a media commentator on religion and its place in our lives, most recently on the death of the Pope, the rise of the Destiny Church and the increasing 'public relations' approach to marketing religion. "God," he laughs, "is definitely not dead. But I think at times God is a little bit frustrated because of some of the mad stuff that is 'authorised' in his or her name!"

A self-confessed hoarder of books, Lineham has a collection representative of his eclectic historical interests. In 1998 when he made the move from Palmerston North to Massey at Albany it took two lorries to transfer the 350 cartons that contained the Lineham library. His office is jam-packed and his Grey Lynn 'house of books' lists a little under the tonnage of tomes that extends into the laundry. His Brethren family encouraged reading. "I grew up in a house where we had few books but were taught to love reading. As a boy I read Enid Blyton, A.A. Milne and everything in the school library," he says.

His parents also placed a huge value on education and in 1965 the family moved to Christchurch to ensure the young Linehams got a good secondary education. Lineham's father took a menial job lubing cars, a sacrifice rewarded by the fact that all five sons went on to obtain university degrees.

For Peter Lineham, doing Religious Studies at Canterbury University may have seemed like the obvious choice. But, despite the family's attitude to education, he knew this would not be acceptable because of the belief that religion could not be

studied academically. However, as he puts it, "Brethren carry history in their bones." So he opted for history and in 1975 completed an MA (Hons) with a thesis on the campaign to abolish imprisonment for debt in England. In the nine months between finishing his master's and taking up a prestigious Commonwealth scholarship in England he wrote his first book, *There we found Brethren: a history of the New Zealand Brethren Assemblies* which was published in 1977.

"I was intrigued that the Brethren as a whole were successful as dairy farmers," he says.

"They were 'do-it-yourselfers' both in religion (they hated the clergy) and they didn't want to be told what to do with their lives. This kind of motive made them very successful farmers as well as successful in their religious attempts to convert communities. It all suddenly made sense and it is exciting when you see that social explanations don't cut out religious explanations, but that they work together."

He has continued to write prolifically with major publications on the Bible Society in New Zealand, a history of the Scripture Union, and a bibliography of the religious history of New Zealand. He has contributed several entries to the Dictionary of New Zealand Biography, written book chapters, articles and reviews for academic, religious and popular publications and created *A Child's View of New Zealand History*, a series of eight half-hour audio taped programmes.

His research interests have been largely divided between the history of sectarian Protestantism and evangelical movements in the eighteenth and early nineteenth centuries, and patterns in New Zealand history including Māori missions, sectarian groups, smaller Protestant groups, Methodism, patterns of religious change and the impact of religion in our society.

He chose the University of Sussex for its strong emphasis on social history to do his doctoral research in the late 1970s. His thesis topic was the Swedenborgians, another very small religious movement that, like the Brethren, went very much against the grain of the 18th century society in which it emerged. "I think doing this thesis taught me the need for compassion and understanding when you go into somebody else's world," he says. "I knew that often wasn't the case in the Brethren world I had come from – where things make sense within your own framework. People often assume that you're persecuted and frustrated, but often these sects are very secure and safe places in some respects. What's interesting is that most people in those frameworks can't recognise the social factors that influence them and they tend not to extend the same charity that they want from others, to others." He has, for example, done a lot of study on the Latter Day Saints and is supervising a Mormon student's thesis. She writes historical novels for her church which incorporate tales of their history. "People with backgrounds like this can potentially feel uncomfortable or isolated in the University, whereas I kind of intuit what their world is like and try to encourage them," he says.

This intuition, combined with a robust sense of humour and seemingly boundless energy, makes Lineham a popular lecturer, supervisor and public speaker, as well as a researcher and writer. Keen to put the 'story' into 'history' his current teaching includes the religious and social history of New Zealand as well as eighteenth and nineteenth century European and British history. Asked about the relevance of history in the modern world his response is to the point: "When you come into a movie halfway through you like to know what's already happened, or else you won't understand what's going on."

Lineham is an inveterate joiner and is, or has been, on practically every committee within the University. "I guess part of what inspires me is that the more you're connected with people and with institutions the more you understand people and institutions," he says. He recalls once doing a personality test where he emerged at both ends of the scale as someone with a strong emphasis on people and a strong emphasis on tasks. More usually it's either/or. "That's probably why I tend to be over committed and enthusiastic about everyone and everything," he adds cheerfully.

In 1989 Lineham added a Bachelor of Divinity degree from the University of Otago to his qualifications and has subsequently been a voluntary assistant chaplain at both Manawatu and Paremoremo prisons. He says the experience has considerably extended his sense of compassion as well as his circle of acquaintances. He's also the current chair of the Auckland Community Church at St Matthew-in-the-City, and he also attends an eight o'clock service in another church each Sunday, followed up by alternating between a Brethren or a Baptist Church, or maybe somewhere else where he has been invited to speak.

This year he will take study leave to bring together the strands of individual studies and papers he has written over the past few years and weave them into a book on religion in public life in New Zealand. "What I theorise is that New Zealanders, including most Christians in New Zealand, accept the notion of a secular society and state," he says. "What we don't realise is that religion has kind of tangled itself in different ways into that story, but often in disguise, following the rules that you mustn't bring your partisan religious position into public life. That's been true since the very beginning of New Zealand society, so I'm trying to explore how that works and how people think about how it works."

The other work reflecting his research interest in sectarianism is still waiting to be written. It will be about the way that New Zealand is a much more sectarian place than we've ever admitted. "I'm fascinated that New Zealanders, who are in a sense a rather dull people, also accommodate an extraordinary range of wackiness," he says. "And it isn't just a religious question, except that religion is often the best safeguard you build around your wackiness." What intrigues him is that New Zealand, with its highly individualised culture and people not pressured by an authoritarian state about what to think - or if they were pressured, they'd soon tell it where to go - can believe in a range of "extraordinarily exotic" things, yet continue to behave conventionally.

"It intrigues me –because it's a very hard one to make sense of – that this is a country of great individualism and great conformity at the same time. So I'm working on breaking that riddle."

Channelling Bartók

Incomplete at the time of his death in 1945 Bartók's *Viola Concerto* in its various incarnations has spawned controversy and intrigue ever since. Professor Donald Maurice has chronicled the Concerto's tangled history and helped bring an arguably more authentic version to a world audience. Malcolm Wood meets Professor Maurice in Wellington.

I am very glad to be able to tell you that your viola concerto is ready in draft so that only the score has to be written, which means a purely mechanical work.

These words of reassurance written on September 8 1945 by composer Béla Bartók to William Primrose, who had commissioned the work, now read almost as a taunt.

Bartók would die on September 26, in a New York hospital, an exile from his native Hungary and with the concerto unfinished. It would fall to Bartók's friend, colleague and fellow Hungarian Tibor Serly, to complete. It was a task that would turn out to be anything but "purely mechanical".

Would I like to see what Serly had to work with, Professor Donald Maurice asks.

He steps across the room to sort among the manuscripts and books piled against the wall awaiting the arrival of shelving. To one side is a battered grand piano of Victorian vintage; atop the piano rests a sitar alongside a viola in a battered case. From another wall a mullioned window overlooks the chasm of the Great Hall of Massey's Wellington campus.

With an "ah-ha", Maurice finds his quarry – a facsimile sent to him anonymously in the 1980s – and Serly's problems announce themselves. Pencilled arpeggios spider on to and off the staves. The viola line leaps pages with abandon, sometimes flipping orientation as the composer has flipped pages. The orchestration is scanty or absent. And, perhaps most poignantly, on the upper margin of one page you can see the temperature readings tracking the progress of the composer's fever.

Serly, with Primrose's collaboration, did what he thought best – including making extensive changes to the pitch, timing and orchestration – and a first performance of what is now the most-performed viola concerto of the latter half of the twentieth century was held in Minneapolis in 1949.

But did it sound right?

Many musicians have had their misgivings. This was not Bartók as they knew him.

Donald Maurice found his 'voice' when he was 15. A violin player, Maurice picked up the viola to help his violist-free school enter a quartet in a national competition. First he restrung a violin, then he borrowed an instrument.

Perhaps, he speculates, it was the timbre of the instrument that appealed. Perhaps it was his sense that here was an instrument that encouraged its player to strive more for beauty of sound than for pyrotechnical virtuosity. Whatever the appeal, he knew he had found his instrument and his vocation. "I had only been playing the viola for a couple of weeks when I said 'yes, this is me'."

But it was another instrument that first paid his way. Maurice's was a musical family. His mother played the piano; his father was a jazz trumpeter; his brother a jazz bass player. To be able to play with his brother and father, Maurice picked up the banjo.

"It turned out to be very lucrative. We got a job playing at a pub three nights a week. From the age of 15 I became self-supporting by playing gigs."

Banjo playing helped subsidise Maurice's viola tuition, and when at age 19 he headed to Britain, where he would study for four years at the Guildhall, banjo earnings and a stint of truck driving paid his way.

In 1977, after London, Maurice went to the United States to study with Donald McInnes in Washington, "and then, in the second year I was there, I went to Banff in Canada for a summer school, and Primrose was the artist in residence".

The William Primrose: the world's pre-eminent violist and the man who had commissioned the Viola Concerto from Bartók.

"He wasn't officially there to teach," says Maurice. "He was fairly elderly then, with his career behind him. I was introduced to him in the first few days and he asked me if I would come and play for him.

"So I did. I went and played one of the pieces I had prepared for the summer course and he gave me a lesson about things to do. I thought that would be the end of it. But at the end of the session he said, 'Well what are you bringing me tomorrow?'"

This became a pattern, says Maurice. "I had gone to Banff with around half-a-dozen works prepared for the six weeks, and he didn't want to hear anything twice. So at the end of a week I had no more repertoire."

On his mettle, Maurice began to work frantically for many hours a day preparing new pieces to stay ahead of Primrose's demands. It was, he says, the hardest he had ever worked in his life *and* the best thing that had ever happened to him.

"This went on for two or three weeks and I started to get really exhausted. He was seeing how hard he could push me. On the day I was going to announce I can't come tomorrow because I haven't got any more material prepared, he said, 'Tomorrow you don't need to bring anything. I just want to talk.'"

That day Primrose took Maurice through his new viola transposition of the Bach cello suites, playing alternative interpretati ons and asking for his opinions.

"It was very interesting to see how he thought, how he worked from inside," says Maurice. In the days that followed the two

dispensed with violas altogether. Primrose, a heavy smoker who suspected he did not have long to live, wanted to talk.

Maurice also attended a Primrose lecture devoted to the Viola Concerto.

"He would say, 'Well this is the way I recorded the piece back in 1950 and I have played it all my life, but as I have gotten older I think there are things we can do to improve this piece.' He was suggesting note changes here and changing the timing there. And I was thinking, what authority does he have to be doing this? I was somewhat dismayed," says Maurice.

And intrigued. Maurice needed a topic for his master's thesis. Why not make it the authenticity of the Bartók Viola Concerto?

Many of the finest pieces in classical music were unfinished at the time of their composers' deaths. Witness Bach, Puccini, Mozart and Mahler: all left unfinished works that would be concluded by the hands of others.

But Bartók presents special difficulties, says Maurice. His highly individual style, part abstract, part peasant folk, sits largely outside any mainstream musical tradition and he has had few obvious musical heirs.

What is more, at the time of his death Bartók's compositional style was actively evolving. His most abstract phase had been in the late 1920s and 1930s; now his work was becoming almost neo-classical. "It wasn't that he was getting old," says Maurice. "He was moving to a new style of writing."

With Serly and Primrose's edition of the Concerto being generally deemed to be a departure from Bartók's oeuvre, might it be possible to reconstruct something more true, to 'channel' Bartók, so to speak?

In the years after the first publication of the Concerto two sets of difficulties beyond the musicological asserted themselves.

The first was the whereabouts of the original manuscript, which was reported lost by Bartók's son, Peter Bartók, in 1953. After Serly's death in 1978, however, two photocopies appeared, one sent to Brigham Young University library by Serly's widow and another somehow arriving at the Bartók Archives in Budapest.

With the reappearance of the original manuscript it was only a matter of time before musicians – particularly viola players – would try their hand at reworking the Concerto.

One was Donald Maurice, the other the Hungarian violist virtuoso Csaba Erdélyi.

In 1992 both had new versions of the Viola Concerto. Maurice had played his within the confines of a conference in Chicago; Erdélyi had given a public performance "of Bartók's notes only" in Budapest.

The second set of difficulties revolved around copyright.

In 1992 Hungary's copyright law was in some confusion – the country had yet to accept the copyright law common to the European Union which would extend copyright from 50 to 75 years – and although the Erdélyi performance fell within the 50-year stricture there was, apparently, "no prohibition for this performance to take place".

However, Hungary would soon subscribe to the 75-year standard, and any illusions Erdélyi may have nurtured that Peter Bartók would look on his efforts with fond approval were dashed, when a good-natured letter he wrote to him after the Budapest performance brought a swift reply threatening legal action.

Neither Erdélyi nor Maurice had been aware that the other was at work on the Concerto – there was no cross-contamination as Maurice puts it – yet they had largely come to similar conclusions about what should be done.

In 1994 Maurice attended a master class Erdélyi was conducting. Maurice presented him with his thesis and Erdélyi set to work on a new revision – even though the workings of international copyright would prevent him performing it in Europe or America until December 2024.

But New Zealand and Australia had refused to extend the period of copyright from 50 to 75 years after an author's death; in these countries the Bartók Viola Concerto would enter the public domain in 1999.

"And then this magical thing happened," says Maurice. "We were granted the hosting rights to the 2001 Viola Congress. So I wrote to Csaba and said, 'Here is your chance. You can perform with the New Zealand Symphony Orchestra and hopefully you'll get a recording out of it.'"

So it happened that as the climax of the successful 2001 Viola Congress in Wellington, New Zealand, Erdélyi performed and recorded a new edition of the Bartók Viola Concerto with the NZSO. This would be his definitive statement.

In 2004 Maurice made his. In the 36 years since the Banff summer school – during which time he had freelanced in Europe (motorbiking between assignments with major orchestras) and taught viola at the universities of Cambridge, Otago and finally Massey – his interest in Bartók and the Viola Concerto had been a constant. He had devoted his masterate and later his doctoral thesis (completed in 1996 at Otago) to the topic. Now he would issue his last word: *Bartók's Viola Concerto: The Remarkable Story of His Swansong*, a book published as one of the Oxford University Press's series of studies in musical genesis and structure.

In it Maurice explores the tortuous history of the Concerto and the people who had a hand in it, strips away the many revisions to reveal the composer's intentions, and suggests how it can be more authentically reconstructed and interpreted.

His verdict today on the place of the Concerto within the viola repertoire and as part of Bartók's output?

"If we look at viola concertos available to us it is one of the best, even if it is obviously not as polished compositionally as some other works. Out of Bartók's total output it is not outstanding. He wrote some true masterpieces, which are refined and polished in every way. The *Concerto for Orchestra, Music for Strings, Percussion and Celeste* is one of the greatest works of the twentieth century: aesthetically, mathematically, structurally."

Maurice now finds the Primrose/Serly edition of the Bartók Viola Concerto, with its overlay of romanticism, almost unlistenable.

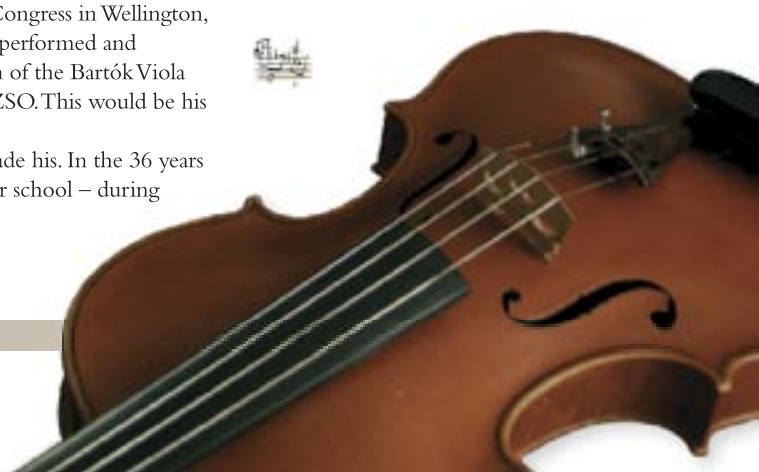
"I just hear lots of wrong notes. There is not enough of the folk music influence coming through."

Erdélyi's version is better: "You hear the folk element. There's something raw and earthy about it.

"But I think he took some liberties that go beyond what Bartók would have been happy with."

But that is the way of it, says Maurice. The one true version may never be realised. Except, perhaps, in one place.

"In my head," he says, "I have the version that is perfect."



Fostering community

David Balham talks to Professor Robyn Munford

"Academics might be accused of being removed and distant. And I think the only way you can deal with that is to be actually doing the kind of research where you're alongside practitioners and consumers."

Professor Robyn Munford is an advocate of 'action research'– academic research that supports practice; practice that supports academic research.

"Academics are sometimes accused of being removed and distant. And I think the only way you can deal with that is to be actually doing the kind of research where you're alongside practitioners and consumers."

Munford knows what it is to be a practitioner. On graduating from New Zealand's first ever social work degree in 1979 she ran an IHC residential home for two-and-a-half years.

From the IHC, Munford travelled to the University of Calgary in Alberta for her master's degree. Then there was a period of globe-trotting, followed by a PhD at Massey in Palmerston North, where as Head of Sociology, Social Policy and Social Work, Munford now teaches community development and disability studies, supervises postgraduate students and maintains a heavy commitment to research.

Professor Munford's PhD thesis was a study of 30 women care-givers of disabled children. Working with disabled people led Munford to broader research into families. She is co-director of a Foundation for Research Science and Technology funded project looking at people's experience as teenagers and raising teenagers. She also works with the Italian-based International Association for Outcome-based Evaluation and Research on Family and Children's Services, set up by Professor Anthony Maluccio.

The association brings together researchers from New Zealand, Australia, Europe, the United Kingdom, North America and Israel to share findings. Social conditions in these countries may be very different, but, says Munford, the basic needs of families – and the ways of keeping them safe – are similar. Along with fellow Massey social researcher Jackie Sanders, Munford is studying how vulnerable families can be supported to avoid stepping on to the treadmill of state intervention.

"It's an exciting piece of work: we look at the nature of neighbourhoods and communities, and what they are doing to provide really good localised services for families: good medical services, early childhood facilities, schools that have a commitment to working with families as a whole, community centres where families can go if they have issues."

The findings have been presented nationally and internationally.

Munford believes strongly – on the basis of her research – that real social progress can be made. As evidence of this, she points to areas such as acceptance of impairment. "It's wonderful to see disabled people living within our communities," she says.

But New Zealand still has a long way to go. "I don't think we accept difference, and I don't think we always do well at supporting disabled people in living full lives in our communities, but we're a lot further ahead than we were." She'd like to see the same strides made with children.

"We will be doing well when every child grows up in a non-violent household, when every child or young person has access to the resources that enable them to learn, when there are no longer health issues to do with poverty and poor housing.

"If we can solve major issues in other areas we should be able to solve this for our children."

The challenge, Munford says, is to ensure that every family or whanau member has equal citizenship rights – the access to the material, physical or emotional resources they need. "Research can tell us who lacks access and why."

And while action research is Munford's predilection, she acknowledges the value of theoretical research. In Munford's view, the social sciences should be valued for the insights they deliver. "While we're living life we need a commentary – we need to be able to understand why we're living it in particular ways.

"And that is why I find the social sciences exciting."

Ion man

Professor John Ayers's work with ion exchangers has been worth tens of millions of dollars to the dairy industry, writes Malcolm Wood.

There was a time, not so long ago, when the dairy industry turned out a nicely defined range of products – cream, butter, milk, cheese, casein (curds) – and one waste product: whey. The clear liquid left over after cheese making was at best pig food and at worst a form of effluent.

Not any more. Like milk, whey can and is being broken down into its high-value constituents.

Whey protein in particular is known for its muscle-building qualities – qualities that make it a key ingredient in expensive body-building supplements, sports drinks and nutrition bars.

It is also a food technologist's dream ingredient; like egg white, which it closely resembles, whey protein can be whipped or gelled. Mild and pleasing in flavour, it lends thickness and smoothness to sauces, and 'mouthfeel', texture and shelf-life to baked goods.

Whey protein is found in reduced-fat candies, low-fat salad dressings, infant formulas, yoghurts and dips. Around half of all supermarket food products contain it.

All this from a liquid that once used to go down the drain.

How is whey protein harvested? No one knows better than Associate Professor John Ayers. The story of his involvement with the whey protein industry began more than 30 years ago, not with whey, but with the effluent from a meatworks, and in a project that was ultimately unsuccessful.

It is a story that tracks the changing complexion of New Zealand's dairy industry and the history of New Zealand's research and development environment – an alphabet soup of organisations that have come and gone.

Ayers holds 12 patents and a number of awards and medals – the most recent being the Thomson Medal presented to him by the Royal Society of New Zealand in 2005. The worldwide use of the cellulose ion exchange resins developed by Ayers generates about a quarter of a million dollars in royalties to Massey annually.

And Ayers himself seems at ease with life. Trim and energised, the now semi-retired organic chemist is spending a day a week at Massey; other interests and working on his son-in-law's farm consume much of his time.

But there is a certain wistfulness and frustration at work in Ayers as well. Much of what he accomplished was ahead of its time. The ion exchange resins he developed could have been used to achieve much more.

They still could.

John Ayers began working with ion exchangers in 1971. At the Gear Meatworks in Petone plans were afoot to recover the blood proteins from slaughterhouse effluent. The mechanism was to be a regenerated cellulose ion exchanger; the protein product would be stock feed. Ayers, newly returned from two-and-a-half years in the United States working with cellulose and lignin, was asked to help out.

"My bosses [Professors Dick Batt and Geoff Malcolm] said, 'We have this group in Wellington trying to make ion exchangers from cellulose. Why don't you come with us when we next visit and see if you can help?'" Ayers recalls.

Cellulose ion exchangers have been around since the mid-1950s, says Ayers. These first exchangers used cellulose in a fibrous form, and like paper the exchangers tended to fall apart when wetted and used repeatedly. In the laboratory a process like this using the exchanger only once might be acceptable; in industry, unless the proteins were of extraordinarily high value, it would not.

But cellulose comes in other forms, one of them regenerated cellulose – a substance perhaps more widely recognised in the form of rayon, viscose or a kitchen sponge. Regenerated cellulose is tough: tough enough to stand the physical stresses of stirring and the assault of pH changes and caustic cleaning agents.

Although efficient enough with low-molecular-weight proteins – it would achieve success in purifying rennet – the regenerated cellulose ion exchanger used at Petone had problems with holding or 'adsorbing' useful amounts of higher-molecular-weight proteins. These problems had to do with the exchanger's limited surface area and poor porosity.

In the early 1970s Ayers began exploring processes that might improve the exchanger's efficiency. Most of those that worked degraded the exchanger and reduced its useful life, but in 1975 he had what he wanted: a chemically modified regenerated cellulose matrix that would hold 10 times more protein than the original.

Otherwise things were much less propitious. Ayers had a technical breakthrough, but there didn't seem to be anything he could do with it.

Ayers had worked on the ion exchanger in a collaboration with the Department of Scientific and Industrial Research (DSIR), which had developed the exchanger, and with Tasman Vaccine Laboratories (TVL), which had the licence to manufacture it.

But the process and the product were a mismatch from the beginning, says Ayers. Before being put through the ion exchanger the effluent first had to be cleaned – something TVL was soon able to do to the point where there was no need for the exchanger – and even if the exchanger had been a part of the process,

it's unlikely that the value of the stock feed would have justified the costs. By the time of Ayers's breakthrough the project had been abandoned.

The DSIR now had no interest in it. Nor did TVL, a funder of Ayers's work, which had undergone a sequence of commercial takeovers and ceased manufacture.

Ayers had a breakthrough without an application and without a source of funding.

"So there was a period from about 1976 to 1978 when no one was interested," says Ayers, "and then I got the DFC [the Development Finance Corporation of New Zealand, which had inherited the patents on the original resins from the Inventions Development Authority] behind me."

What Ayers and the DFC needed was a protein purification application that was large enough to make the manufacturing of ion exchangers in New Zealand viable.

They chose the extraction of whey protein from whey.

Whey, which is produced in large volumes when cheese and casein are produced, is largely water, with protein at a concentration of around five or six grams per litre. In Wales there had already been trials extracting protein from whey with another proprietary ion exchanger, CMVistec. Whey protein, being fit for human consumption, promised to be high-value. It was the ideal candidate.

Ayers was soon able to show that his latest ion exchanger, high capacity INDION CM, greatly outperformed CMVistec, and he could see there was room to do better still.

The 'CM' in both 'CMVistec' and 'INDION CM' stands for carboxymethyl (cellulose-O-$CH_2CO_2^-Na^+$), the weak-acid (pKa = 3.4) chemical group that is used in the exchanger to attract and hold proteins. These weak-acid properties have implications for the production cost of recovering proteins.

Under strongly acidic conditions all proteins are present as cations (positively charged). Under strongly alkaline conditions they are present as anions (negatively charged). To desorb the adsorbed protein from the CM ion exchanger would require the pH to be shifted from an acid pH 3.3 to an alkaline pH 9 and back again, with each cycle consuming costly quantities of alkali and acid.

If Ayers could replace the weakly acidic carboxymethyl group with a strongly acidic ion-exchange group then less alkali and acid would be required and the costs of the process would drop. In the early 1980s he managed this using sulphonic acid as the exchange group. Now he had an exchanger that held more protein, consumed affordable amounts of chemicals, and had a recycle time far in advance of its rivals. All he needed was a chance to put it into action to see if it was commercially viable.

Around 1979, Ayers and the DFC approached the New Zealand Dairy Board only to be stymied: the board was committed to a membrane-based process it had spent 10 years developing.

So Ayers looked further afield, turning again to Wales, where a small group of industrial scientists funded by the Welsh

Development Agency were trying to develop a profitable method of extracting whey protein using CM Vistec in a pilot plant.

They were almost his last hope, he says, and he was almost theirs: "If they didn't get something going they were out of business."

Back in Palmerston North Ayers worked frantically, first to build a pilot plant for producing the exchanger and then to produce 40 kilograms of the exchanger itself. Increasingly desperate 'where-is-it?' phone calls from Wales compounded the stress.

It worked. Forty kilograms of Ayers's new sulphonic acid (SP) exchanger was sufficient to substitute for 200 kilograms of the exchanger the Welsh had been using.

In short order the Welsh group floated a public company, Bio-Isolates, which built a small protein production plant in Carmarthan, Wales, and then struck up a partnership with Ireland's largest dairy co-operative to construct a full-scale commercial plant capable of 300 tonnes of protein from waste whey a year.

Bio-Isolates was formed right at the start of the biotechnology revolution, and with these developments their share price increased dramatically. In 1984 the new plant was in production and a year later a similar-sized plant came on line in Minnesota. (Minnesota-headquartered Davisco Foods, which uses Ayers's ion exchanger, currently claims to account for 65 percent of whey protein isolates – a highly-refined whey protein called WPI – sold worldwide.)

What of New Zealand and its dairy industry?

In the mid 1980s – as Ayers would later learn – the New Zealand Dairy Board trialled the process using his ion exchanger they had sourced independently from the manufacturer, only to deem the process uneconomic. It was not until the early 1990s, after Ayers had further improved his exchangers, that an arrangement was reached to re-evaluate them.

"That was through the Dairy Research Institute (DRI) under Dr Geoff Page, who had come from Massey and was much more in favour of fundamental research," says Ayers.

"After a collaborative research effort we

finished up with a process that was much more efficient than the one that had been developed and used in Wales, Ireland and the United States. And it fitted in with what the dairy industry was already doing. It combined both the membrane process, which produces a relatively impure whey protein concentrate, with my ion exchangers, which produce a very pure WPI."

The particular challenge was to produce a whey protein product that was pure enough to use in acid beverages, such as sports drinks, without the clouding that even a slight amount of fat and unstable protein would impart. In the late 1990s the group had just that: a product called ALACEN 895, which would win Ayers and his colleague David Elgar, Mark Pritchard from DRI, the Dairy Board and Kiwi Dairy Co. the ANZ award in the National Food Awards. They also won the TRADENZ major award for the most systematic team approach to successfully develop, manufacture and launch a product in an export market.

Today the ion exchangers are manufactured by Invitrogen (NZ) Ltd and sold worldwide. It is for this achievement that Ayers has received his Royal Society of New Zealand awards.

A success, then, one that others might look to and envy. Yet much more could be done. One of Ayers's frustrations is that in many instances it is not the limits of technology that apply but the readiness of the market to take up new products and the caution of industry.

Whey protein is itself a mix of biologically interesting and separable proteins and peptides. More than half of whey protein is a protein called beta-lactaglobulin – a protein with the whipping and gelling properties dear to food technologists.

The second major component is a protein called alpha-lactalbumin, "and that's of special interest to baby food manufacturers", says Ayers. Human milk, he explains, doesn't have beta-lactaglobulin; it has mainly alpha-lactalubumin. "So baby food manufacturers would love to get their hands on alpha-lactalbumin, but they don't want to pay more than they do for WPI." For the moment the market is largely unwilling to pay for alpha-lactalbumin to be produced.

Similarly, another molecule, glycomacropeptide, has been shown to be good for teeth. "It has interesting properties as an anti-decay, anti-caries component. We know how to make that, but you need to find a way of making it cheaply enough to get it into toothpaste," says Ayers.

If firms are enjoying good margins from the range of products they already produce,

Blood work

Ion exchangers can be used for a multitude of processes. During the 1970s Ayers developed an ion exchanger system that could selectively bind lipoprotein from blood serum, and in particular separate high-density lipoprotein [HDL] or 'good' cholesterol from low-density lipoprotein [LDL] or 'bad' cholesterol.

"That was way ahead of its time. To do that in the 1970s required an expensive ultra high-speed centrifuge that would float the lipoproteins to the surface," says Ayers.

Ayers envisaged two possible applications: one in the form of a medical laboratory system of automated analysis for blood testing; the other, more ambitiously, for cleaning a patient's blood of 'bad' cholesterol in a process much like kidney dialysis.

The idea never progressed beyond a proof of concept.

"We made some ion exchanger in the lab and sent it to Hammersmith Hospital in London, but I don't think they used it."

In another innovation, Ayers devised a tablet that would selectively adsorb bile acids. With bile acids being the product of the conversion of cholesterol, this would serve to lower blood cholesterol. Although it worked as well as existing pharmaceutical drugs, nothing came of it.

Such stories of breakthrough technical successes occurring in advance of the market's willingness to adopt are far from unusual, says Ayers philosophically.

then there is little incentive to explore new possibilities or 'added value' products unless the margins are likely to be greater.

Ayers's history also illustrates that while good science is one thing, getting the support to carry it out and finding firms who are willing to adopt it are something else.

When Ayers began working on ion exchangers, universities did not make it a practice, as they do now, to harbour expertise in commercialisation. (To this day Ayers regrets not having patented the most innovative and potentially lucrative of the applications he identified.)

Throughout his career the technical difficulties Ayers has overcome have been at least matched by the difficulties he has faced in finding support and putting what he has learnt into practical applications.

Turbulence has not helped. TVL was bought out. The DFC collapsed. The DSIR was broken into several Crown Research Institutes. The dairy industry has been massively reorganised.

Nor does there seem to be much truth to the rumour that building a better mousetrap will have the world beating a path to your door. Ayers has built that legendary mousetrap – his use of ion exchangers to measure blood cholesterol (see sidebar) was better than anything else available at the time – but no one took it up.

Will today's research and development environment do better by New Zealand's scientists and the application of their work?

One can only hope so.

What is an ion exchanger?

An ion exchange resin is an insoluble matrix – often in the form of tiny beads – which is tailored to remove certain ions or molecules when a solution or suspension is passed through it. On the surface of the matrix are charged sites. The positively charged sites attract and hold negatively charged ions and molecules; the negatively charged sites attract and hold positively charged ions and molecules.

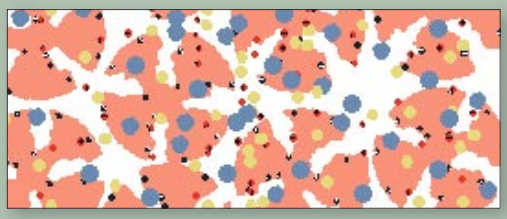
The most common use of ion exchangers is in softening hard water: the sort of water that stops soap from lathering and puts a scale on the inside of your kettle. Hard water is 'hard' because it contains high concentrations of dissolved calcium (Ca^{2+}) and magnesium (Mg^{2+}) ions.

In this instance the ion-exchange resin, which is high in negatively charged attachment sites, will begin by being charged with sodium (Na^{+}) ions. When hard water is passed through the exchanger, these sodium ions are lost from the attachment sites and replaced by calcium and magnesium ions until an equilibrium is reached. The resin is then recharged with sodium ions, usually by washing it with a solution of purified common salt (NaCl). The calcium and magnesium ions migrate off the resin, being replaced by sodium ions from the solution until a new equilibrium is reached and the resin is ready for reuse. The process can just as easily be tailored to remove negatively charged ions, or, in a mixed-bed of two ion exchangers, to remove both negatively and positively charged ions.

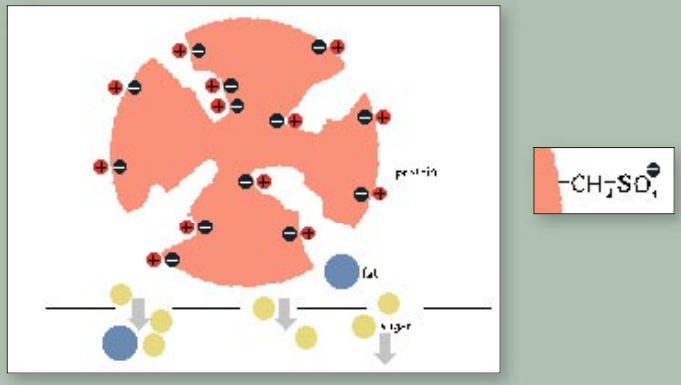
The use of an ion exchanger to harvest proteins from a liquid works along the same lines, but with two significant differences. The first is size: while ions are tiny, proteins are larger, so an ion exchanger for proteins has to allow for the passage of larger molecules within its structure. The second is charge: ions have an inherent charge, while proteins can either take a positive, negative or neutral charge, and this state can be changed by altering the pH of their surrounding environment.

So charging or discharging a protein ion exchanger usually means employing quantities of acid and alkali.

Ion exchange harvesting of whey protein isolate

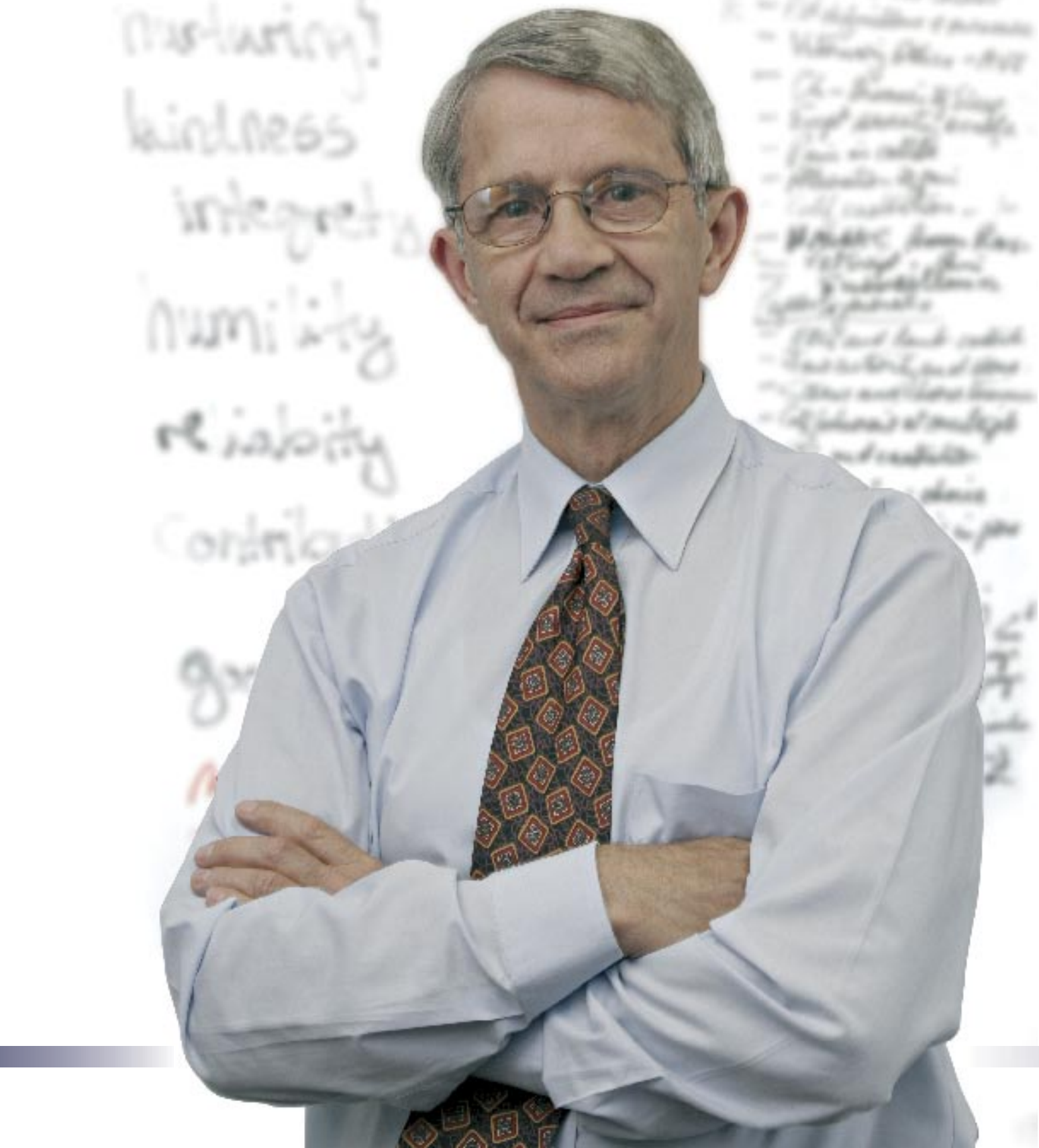


As the whey is passed through a beaded ion exchange resin, positively charged proteins are attracted and held – or 'adsorbed' – by negatively charged attachment points. When fully charged with protein, the resin will then be discharged – or 'eluted' – by flushing it with an alkaline solution, which changes the charge of the proteins allowing them to float free.



Striking a balance

James Gardiner meets bioethicist and animal physiologist Professor David Mellor



As a launching pad for a glittering academic career, David Mellor's schooling did not get off to an auspicious start.

Until he was diagnosed with mild dyslexia there were concerns he might be intellectually handicapped, and an attack of glandular fever put him a year behind his twin brother at school in Melbourne.

But paradoxically these problems helped set young Mellor on the path that has seen him gain international recognition in his fields of fetal physiology, animal welfare science and bioethics. This year he was elected an Honorary Associate of Britain's prestigious Royal College of Veterinary Surgeons.

In 1955 his parents spent a year overseas, leaving their four sons behind. David and his younger brother spent that year on an uncle's sheep farm in the Barossa Valley, South Australia.

"That's probably why I'm here really," says the 63-year-old professor, who is currently a principal in the Riddet Centre and distinguished scientist of the University's Institute of Food, Nutrition and Human Health.

"From that time I wanted to do something to do with agriculture. I just loved it."

On the farm he learnt to shear sheep, ride horses and manage animals. Back in Melbourne he began to thrive academically thanks, in part, to three years of remedial teaching from a retired headmistress from his primary school.

"Schooling changed from being a terrible struggle to something I could manage reasonably well.

"When I got to university I used to write to her every year and tell her that I wouldn't be here if it wasn't for her."

Mellor found ways to overcome his dyslexia, though even today spelling can occasionally pose a problem. If he knows the first two letters of a word he can usually look it up. Failing that he telephones a colleague and asks.

It does not appear to have held him back. His career revolves around vast amounts of reading and writing and he has produced more than 350 publications.

Mathematics and sciences at secondary school (Melbourne's Carey Baptist Grammar) led to the University of New England at Armidale, northern New South Wales, and the rural science degree his early farming experience had drawn him to.

But after two years of that he switched to the science faculty and physiology.

"I was really glad to be at the university. I wanted to be there. And I knew that I had study difficulties and I wasn't sure how I would stack up against people at the university, so I just worked really, really hard.

"I must have been a pain in the neck for my contemporaries because I would start studying on the first day of term and I had a very carefully organised schedule because I had each hour of the day scheduled for what I would do, but I had a full day off on Saturday."

Mellor credits the man who set up New England's rural sciences degree, Professor Bill McClymont, as a particular inspiration. The degree was relatively new, involving integrated agricultural ecology, considered far-sighted for the early 1960s, and McClymont was inclined to integrate and draw things together rather than narrow his specialist field, a style that Mellor felt came naturally to him then and since.

When he switched to science, the physiology professor, Jack Evans, had a similar approach – "someone who also seemed to reach widely around the topic".

Although he had the option of going back to rural science and ending up with that degree as well as a BSc in physiology, Mellor opted instead to do honours in physiology.

Evans nurtured the small group of about a dozen postgraduate students with regular tutorials at his home every Tuesday and Thursday evening.

"One of the students would present something and the rest of the gathering would tear it to shreds. That was absolutely fantastic training, inspiring. He [Evans] didn't like it when I presented one of his papers and we all tore it to bits, but that's what happens when you're a professor. You have to accept that others will come along and maybe find that what you think is not quite as brilliant as you think."

Mellor graduated in 1966 with a BSc with first-class honours and a university medal. By then he was at the Moredun Research Institute in Edinburgh, working towards an Edinburgh University doctorate in fetal physiology under the supervision of Professor Arthur 'Hugo' Huggett, whose health, it became apparent to Mellor, was failing.

Huggett started out dating his memoranda to Mellor with the previous year, 1965, then worked backwards.

"By the time he died 15 months later he was dating them 1955 and it was as if no work had been done from the date of his memo and he was trying to get me to do the work that he had done the year following. This was fairly challenging."

Only later would Mellor learn that the university heads had been aware of the predicament and were waiting for him to approach them.

"But if you're a green Aussie PhD student you're not going to go up against a university professor to say he's not up to scratch."

His PhD work involved five species of animal – rats, rabbits, guinea pigs, sheep and goats – and the human female.

"That got me into the link between animals as models of what's going on in human beings as well as studying animals for their own sake.

Close to completing his PhD in 1969, Mellor learned that the Moredun Institute was considering shutting its physiology department because it had no replacement for Professor Huggett. Mellor stepped in to the position on a trial basis for a year, and stayed for 18.

Mellor was primarily a research scientist, but found supervising PhD students a satisfying part of his work and towards the end of the 1970s he began looking for a post where he could both teach and research.

Then came devastation – the death of his wife, Gourie Nag, in 1982. They had met as PhD students in 1967. She was a literature and philosophy student from India, and was, he says, hugely influential in helping him see how individuals build meaning into their lives; she also stimulated his interest in bioethics.

Throughout his life, Mellor says, he has benefited from the "benign input" of many people, opening his horizons to the way others perceive life, their expectations and priorities.

"What I try to do in my teaching activity is to show that anything you do as a learner is something that's informing your whole life, not just giving you a fact to pass a particular exam. I try to show the relevance."

In 1984 he began looking for fresh challenges and three years later he was

appointed professor and head of department of physiology and anatomy at Massey's veterinary facility, a role he took up the following year.

He describes it as another beginning. By then he had been made an honorary life member of the Moredun Foundation for Animal Health and Welfare in the UK for his work with farm animals up to 1987. His writing had been recognised in the *British Veterinary Journal* with the prize for best article in 1983.

In 1991, completing this new beginning, he married Lynda Randle, an English veterinarian he met shortly before coming to New Zealand. As a veterinary journalist and teacher she and Mellor have parallel professional interests, but much more important, he says, together they have built and share a happy family life with their son Thomas, now 13-years-old.

Mellor helped to establish the Australian and New Zealand Council for the Care of Animals in Research and Teaching, was a member of the National Animal Ethics Advisory Committee for six years, and has been chairman of the National Animal Welfare Advisory Committee (NAWAC) for a similar period. He also established Massey's Animal Welfare Science and Bioethics Centre, which he directs.

Although he has not courted controversy, working at the cutting edge of biology and its practical application has occasionally put him in the spotlight.

NAWAC has been the target of animal welfare campaigners critical that it has not moved far or fast enough to recommend improvements to the conditions in which livestock are farmed.

Mellor does not accept the committee is unsympathetic to the goals of such groups and points out that at times there have been equal measures of criticism from some in the agricultural industries who feel – or felt – that the committee would be stacked with animal welfare lobbyists or academics who ignored the economic reality of farming.

He feels a lot of criticism, while sincerely motivated, is due to lack of understanding. Urbanisation has meant New Zealanders increasingly have little experience with animals other than household pets.

"When people's only experience with animals is with their dog or cat and they apply the sort of standards they would apply to the dog or cat to sheep and goats and cattle and pigs and so on, then they can get it quite seriously wrong.

"A sheep is not a woolly cat. It is not a woolly human being. It is a sheep and it has its own biology and it interacts with the world in relation to its biology."

In his research work, his recent re-evaluation of existing findings relating to unborn babies not being able to feel pain has raised challenging issues for obstetricians, paediatricians and midwives alike.

The evidence shows that fetuses are unconscious before birth and although able to react to touch and sound, and to be affected by them, have no ability to actually suffer pain until born and breathing.

Based on studies of sheep fetuses, this observation questioned the widely held belief that newborn babies recognise their parents' voices or particular music through consciously hearing them before birth, but Mellor says it actually confirms what specialists in his field had long believed.

"Of course, the critics say that these studies were in sheep. What is not very well known, perhaps, is that the sheep fetus, for at least the past 50 years, has been the preferred model for understanding human pregnancy and management of human infants," Mellor says.

World-renowned fetal physiologist Sir Graham 'Mont' Liggins, a pioneer in the treatment of premature human babies, made major discoveries in sheep during the 1970s and '80s, the principles of which he applied to humans, with life-changing and life-saving results.

Liggins' breakthroughs related principally to the fetus starting its own birth, not the mother as had been thought, and how preparation of the lungs for breathing after birth is controlled by the fetus.

"Just about everything you do with animals in an area like this has the potential for application in human beings," says Mellor. "Likewise, anything that is found uniquely in human beings has the potential for application to animals.

"The engaging thing about operating at this interface is that I have been fortunate enough to retain interests in both areas and I find that really very satisfying and quite exciting, because it opens up more opportunities for application within my areas of physiology, animal welfare science and bioethics."

Professor David J Mellor
BSc (Hons), PhD, HonAssocRCVS

- New England University: BSc 1965, BSc (Hons) 1966
- Edinburgh University: PhD 1969
- Head of Physiology Department Moredun Research Institute 1969–1988
- Professor and Head of Massey's Department of Physiology and Anatomy 1988-1997
- Distinguished Scientist, Institute of Food, Nutrition and Human Health 1998–present
- Professor of Animal Welfare Science 1998–present
- Professor of Applied Physiology and Bioethics 1998–present
- Director, Animal Welfare Science and Bioethics Centre 1998–present
- Principal, one of five, in the Riddet Centre 2004–present
- Executive Vice-Chairman of ANZCCART 1992–1998
- Member of National Animal Ethics Advisory Committee 1993–1998
- Chairman of National Animal Welfare Advisory Committee 1999–present
- George Fleming Prize, British Veterinary Journal 1983
- Honorary Life Member, Moredun Foundation for Animal Health and Welfare 1987
- New Zealand Science and Technology Silver Medal 1999
- Elected an Associate of Australian College of Veterinary Scientists Animal Welfare Chapter 2003
- New Zealand Veterinary Association President's Prize 2004
- Honorary Associate of the Royal College of Veterinary Surgeons 2005

Good Health

Professor Sally Casswell, who heads SHORE, the Centre for Social and Health Outcomes Research and Evaluation, is best known for her work on alcohol and drug use, writes Di Billing.

Professor Sally Casswell has been tirelessly charting this country's relationship with alcohol and drugs for more than three decades, developing a formidable reputation as one of New Zealand's leading authorities on drug and alcohol abuse. Today she heads the Auckland-based Centre for Social and Health Outcomes Research and Evaluation (SHORE), which joined Massey in July 2002.

Her most recently published research – a collaboration with Taisia Huckle and Megan Pledger – is an assessment of alcohol-related harms and offences in New Zealand from 1990 to 2003, a period of alcohol liberalisation which included the lowering of the purchase age from 20- to 18-years in 1999. One disquieting finding was that the lowering of the drinking age may have led to an increase in drunk driving and consequent injury and death among 18- to 19-year-olds. The finding came during a period of public debate about the appropriate purchase age, with a private member's bill proposing to raise it to 20 once more.

Casswell became a leader in her field as a 21-year-old postgraduate student at the University of Otago. The young Englishwoman had arrived by ship to do postgraduate study at the urging of an early mentor, psychologist Dr Jim Hodge. At Otago she chose the effects of cannabis for her thesis and acquired the first 'licence' to legally administer cannabis in New Zealand.

With a freezer full of cannabis, she announced her plan to analyse the cognitive effects of the drug on volunteers. It caused a media stir.

When she moved on to do her PhD at the University of Auckland she shifted her attention to alcohol use among New Zealanders. It was a timely move. After the establishment of the Alcohol Liquor Advisory Council in 1976, funded research was proposed. Casswell won research contracts and set up her alcohol research unit, at that stage, at Auckland University.

Today the Massey-based SHORE has more than 20 social science researchers and works in partnership with the Māori research group Te Rōpū Whāriki.

Casswell is an advocate of what she terms 'multi methods'. "You never stick to one approach. You take an issue, which may be an important problem for New Zealand, and apply as many research methods as necessary to solve it."

She sees how society handles the question of access to alcohol as symptomatic of wider social, political and ideological trends. "For example, when New Zealand moved to neo-liberalism in the 1990s, laws on alcohol were also liberalised including the review of the Sale of Liquor Act. Debate shifted, deregulation was discussed, then there was wine in supermarkets, the lifting of restrictions on television and radio advertising."

What drives her? Is it the desire to make a difference, to change minds and policy and improve outcomes? Or is it the research itself, the lure of discoveries waiting to be made. "I ask myself that, too. On the one hand, there is nothing quite like the arrival of a new set of statistics with new data to analyse. It's a fresh pleasure and the tricky bits are great fun. But I couldn't imagine doing it, for example, to sell a product. It wouldn't fit what I see as my purpose in life, to contribute to the community."

SHORE and Te Rōpū Whāriki maintain a well trained (and appropriately paid, says Casswell) field team of multi-lingual survey interviewers who operate a computer-assisted telephone interviewing (CATI) laboratory. The system allows high-quality social and health survey data to be collected from a range of population groups.

Casswell particularly values SHORE's partnership with Te Rōpū Whāriki. Helen Moewaka Barnes, who heads Te Rōpū Whāriki, says it is important to ensure you are accountable, that the people you have worked with are among the first to learn the results. Casswell adds that she has learnt much from Barnes's group about ensuring that research on delicate social issues is rigorous but also respectful of people. "We know that Māori, for example, have sometimes felt 'over-researched'."

Casswell is Chair of the World Health Organisation Alcohol Policy Strategy Advisory Committee, and SHORE researchers have managed WHO projects. She was appointed to the Marsden Fund Council in 2002.

Treading with respect

Ko tāu hikoi i runga i ōku whāriki
Ko tāu noho i tōku whare
E huakina ai tōku tatau tōku matapihi

Your steps on my whāriki, your respect for my home, open my doors and windows

Helen Moewaka Barnes heads Te Rōpū Whāriki, the country's largest Māori research unit. Adam Gifford meets her in Auckland.

Back in the 1980s, Helen Moewaka Barnes spent time on the stage: Auckland Youth Theatre, Summer Theatre, an employment project doing drama in schools, a cabaret act with her sister, Angela, and singing in cafés.

It turned out to be a handy foundation for her current role as director of Te Rōpū Whāriki, the country's largest Māori research unit.

"Those skills help with presenting," says Moewaka Barnes, who has an English degree, a diploma in drama and a master's in public health from Auckland University.

They weren't what set her off on a research path though. That came at the start of the 1990s through another job scheme, this time working in the transport division of Auckland Regional Council helping with road safety campaigns around the introduction of compulsory breath testing.

That brought her into the ambit of researcher Paul Stanley, who was then working with Sally Casswell at the Alcohol and Public Health Research Unit in Auckland University's medical school.

"Paul organised for me to go to Huakina and Waipareira, who were doing drink–driving projects," Moewaka Barnes says.

From left: Liane Penney, Victoria Jensen, Helen Moewaka Barnes, Belinda Borell and Tim McCreanor

"The person doing the process and impact evaluation round those projects left about the time my Taskforce Green job came to an end, so they asked me to take over.

"I started part time and in three weeks I was working to three in the morning.

"There was a conference ar ound the alcohol advertising review, and I was asked to do a report. I said 'what does a report look like?' and sat up to three in the morning writing the reports.

"It was sink or swim, and I managed not to sink."

An earlier artists-in-residence job with her sister and making videos for Northland communities on issues like smoking and teenage drinking proved valuable experience.

"Doing a research project wasn't that different. It was going out and talking to people, then putting together a report in writing rather than a visual form," Moewaka Barnes says.

As other researchers went on to other projects and careers, Moewaka Barnes, who has Ngāti Wai, Ngāti Hine, Ngāti Manu and Cornish descent, carved out a niche doing Māori research.

When Casswell came over to start SHORE, the Centre for Social and Health Outcomes, Research and Evaluation, within Massey's School of Public Health, Moewaka Barnes and several colleagues came too to form Te Rōpū Whāriki.

Moewaka Barnes says while no institution is perfect, the consensus among the team was that Massey would be a better place for Māori researchers to do social research.

"We find here we always get to talk to someone about issues. Whatever decisions are made, we are able to discuss them, to negotiate them, to know on what basis they are made, so you get a sense you are valued," she says.

Whāriki and SHORE's relationship is a work in progress and an experiment. "We say there is a process of partnership. SHORE manages some projects, Whāriki manages some projects, and there are projects we work on together. It comes down to goodwill, just trying to work together."

Māori research is an evolving discipline. Indeed, the doctoral thesis Moewaka Barnes is working towards is on research methodology.

"We don't attempt to define 'Māori researcher'. You are a Māori researcher as opposed to a researcher who happens to be Māori, so when you work in Whāriki it does carry with it certain commitments, certain responsibilities and people have expectations of you," she says.

"We have whakapapa and whanaungatanga links with people we work with, people see us as a Māori group, and so they have expectations of us as well.

"The critical issue is workforce. We have a group of people and we are able to create our own culture in the way we work, the way we operate together, the environment we create.

"There are enough problems and issues and difficult things out there in the world to deal with, so if we can feel good about the people we work with, it makes the other stuff easier to deal with."

Moewaka Barnes says that means an environment of laughter and social interaction and doing things together, talking to each other in a particular way.

"We respect non-Māori values in this society. We take them as a given, but when we actually create Māori environments, putting in place Treaty-based policies and practices, people see that as something Māori which is taking something away from someone else. It is not."

The workforce also determines the work. "We don't get a job and hire someone to do it, we get people and build to their passions.

"None of the research is stuff we sit here and dream up. It always comes out of a number of different relationships, different hui, different discussions, and then gets built into projects we may or not find funding for."

It took almost four years to put together Te Mauri o te Ū-Kai-Pō, a three-year study of intergenerational experiences of environments and wellbeing, which came out of an approach from Northland iwi Te Rarawa. The study has just been funded by the Health Research Council to the tune of $878,401. The project team includes Moewaka Barnes, Belinda Borell, Wendy Henwood, Liliana Clarke and Otto Huisman.

Of particular interest are questions of identity – Borell has just completed a study of identity with South Auckland Māori youth.

"We are looking beyond what can be considered traditional markers. Sometimes things can become ossified. People are told these are the authentic markers of knowledge, or markers of how we do things – tikanga – or markers of identity. So what does that mean to us today? Does that mean if I do quantitative research it is not my knowledge, it is not Māori knowledge? What are we giving away?" Moewaka Barnes asks.

For Māori today, being Māori may not be about things such as visiting marae or speaking te reo Māori, but about other parts of their lives.

"There is work we do with young people where they say 'I'm Māori but I was not brought up Māori.' They will have specific things that they think it means."

For Māori today, being Māori may not be about things such as visiting marae or speaking te reo Māori, but about other parts of their lives.

"There is work we do with young people where they say 'I'm Māori but I was not brought up Māori.' They will have specific things that they think it means."

Whāriki works across a range of projects, including evaluation and methodological development. It has done significant work on heart disease. A current project has worked closely with the health sector in Northland to identify and address barriers to Māori getting proper and timely treatment.

SHORE and Whāriki researchers have developed a sophisticated understanding of the way alcohol is marketed, including the way marketers now try to get young people to identify with a particular product or brand.

Much of Whāriki's quantitative research is driven out of a computer-based telephone interviewing system, which allows it to generate large databases for analysis.

Moewaka Barnes says that when assessing projects, Whāriki is looking for research that leads to useful and valuable knowledge.

"Some of the information we are interested in may not be particularly innovative, but it is important and timely. We are also interested in looking at how we do research, the methodology, the assumptions on which we base it.

"As Māori we need to look at research, we need to question our practice, we need to try new things and work in new ways. It is important that we have the opportunities to develop that knowledge base and a way of working that works for us. I'm not saying there is one way. There are diverse ways and so it is important we do have a lot of space and innovation," Moewaka Barnes says.

Anatomising drug use

What are the patterns of illicit drug use in New Zealand? Dr Chris Wilkins assesses the evidence. Malcolm Wood writes.

The Socio-Economic Impact of Amphetamine Type Stimulants (ATS) in New Zealand

In May 2003 the Police contracted Massey's SHORE Centre (the Centre for Social and Health Outcomes Research and Evaluation) to conduct a study of the socio-economic impact of the increased use of amphetamine-type stimulants and in particular methamphetamine. The team was led by Dr Chris Wilkins.

In the course of the study Dr Wilkins and his team:

- reanalysed the results of the 2001 National Drug Survey
- surveyed frequent methamphetamine users in Auckland
- conducted key informant surveys of drug enforcement officers, drug treatment workers and regular methamphetamine users outside of treatment
- piloted a New Zealand Arrestee Drug Abuse Monitoring System at the Papakura Police Station, over a period of three weeks interviewing and drug testing 62 arrestees
- interviewed key informants from drug treatment, drug enforcement and frequent methamphetamine users
- drew on the results of an annual alcohol and drug treatment workers' survey conducted by the National Addiction Centre in Christchurch. (The survey asks workers about the two most recent patients they have seen.)

The report was published in September 2004. This and other publications are available for download from www.shore.ac.nz

Dr Chris Wilkins at the SHORE Centre in central Auckland

Global ATS abuse

In 2003 the United Nations' Office on Drugs and Crime estimated the production of ATS (Amphetamine Type Stimulant) drugs at 500 tons a year, with more than 40 million people having used them in the past 12 months. In the decade from 1990/91 to 2000/2001 seizures of ATS drugs rose from about four tons to just less than 40 tons. Seizures of precursors rose by 12 times. The pattern and prevalence of ATS drug use varies considerably from nation to nation. In Europe, in particular, the place of methamphetamine is taken by its less powerful relative amphetamine. In 2001, Australia – the neighbour against which New Zealand often compares itself – had the highest level of ecstasy abuse worldwide and was second only to Thailand in methamphetamine abuse.

Ecstasy and Amphetamines: Global Survey 2003
United Nations Office on Drugs and Crime (2003)

Stephen Williams, who killed his six-year-old stepdaughter, Coral Burrows. William Bell, who beat three people to death with the butt of a shotgun during a robbery. Ese Faleali'i , who shot two people during a rampage. Antonie Dixon, who took to two women with a sword and later randomly shot and killed someone he saw in the street. In all of these violent, senseless, sometimes bizarre, luridly mediagenic crimes methamphetamine use was a feature.

These crimes, these perpetrators, all seemed very distant from middle New Zealand. Williams, for example, had a long criminal record and was in and out of work.

But methamphetamine use is more mainstream than you might think.

In fact the evidence, drawn from the 2001 National Drug Survey by Dr Chris Wilkins and his team, is that the users of amphetamine type stimulants – the category of drugs that includes amphetamine, methamphetamine and MDMA/ecstasy, among others – are more ordinary than not. They have high levels of full-time employment, come from a range of occupational backgrounds (including professionals), earn mid-level incomes and have high levels of educational achievement.

And the use of ATS drugs is widespread. The 2001 survey, which interviewed 5,800 people aged 13 to 45 nationwide, found that 12 percent of New Zealanders aged 13 to 45 years had tried amphetamines and 5 percent had used amphetamines in the past year.

Drugs like methamphetamine and MDMA/ecstasy are not new, and neither is their use as recreational drugs. But in New Zealand there has never been anything approaching the current explosion in their use.

Wilkins puts the timing of the shift at some time between the mid to late 1990s, when he was finishing a PhD thesis on the economics of cannabis markets, and 2000, when he returned to New Zealand after a stint in Britain to join SHORE's predecessor (the then Alcohol and Public Health Research Unit).

His PhD thesis involved developing a model of how cannabis markets work and then validating it using interviews with cannabis users and dealers. The interviews were also revealing of other facets of the drug scene.

Methamphetamine was around then, he says, "but it wasn't big and there was nothing like today's level of awareness". MDMA/ecstasy was present, too, a part of the dance scene, though interdiction at New Zealand's borders had made it far harder to get hold of and much more expensive than in Europe.

But two years later, when Wilkins returned from working in Britain, it was very apparent to him that "something seemed to have happened".

Something had happened – and it was continuing to happen. In 1996 1.3 kilograms of ATS drugs were seized. In 2001 the figure was 76.9 kilograms. In each year since the indices for ATS drug use – laboratories busted, drugs intercepted, arrests made – have lurched upwards.

In May 2003 the New Zealand Police wanted information that they and other agencies could use in taking an evidence-based approach to the rise in ATS use. Hence their decision to contract the SHORE Centre to conduct a study of the socio-economic impact of the increased use of amphetamine-type stimulants, and in particular, methamphetamine.

Wilkins would lead the team.

That year Wilkins set out to interview a sample of high-frequency methamphetamine users in Auckland. Coming in the wake of a number of high-profile homicides, the proposal caused some consternation in the University Ethics Committee, which helped formulate and approve a set of sensible protocols. "There was a concern that we might come across psychotic and violent users and that there would be risk to interviewers and the public," says Wilkins.

In Australia the community sampling of illicit drug users had been going on since the early '90s, says Wilkins. Those surveyed were generally heroin users, but there were also methamphetamine users, "and when you looked through those studies at the sample characteristics, the participants tended to be intravenous drug users and to have really high rates of unemployment – something like 90 percent of the sample – with all of the problems associated with that".

Wilkins's sample, which he arrived at using a mix of community advertising and referrals from those interviewed, had a quite different profile. It included students, mothers and business people. "We were interviewing people you wouldn't associate with methamphetamine."

But they were often involved in the wider drug economy. One-third of the methamphetamine users had sold methamphetamine, and about one in five had manufactured methamphetamine or exchanged it for stolen property at some time.

The correlation between methamphetamine and crime was given some credence in Wilkins's next major study, which took him to the holding cells at the Papakura Police Station to interview arrestees about their drug use. Over a period of three weeks in mid-2004 Wilkins and a team of interviewers were based in the cell block. Again there was some trepidation.

"I had to employ interviewers over three shifts, one of them from midnight to 6.00 in the morning. I was concerned that once I explained what was involved in the study to the prospective interviewers I would lose them," says Wilkins, whose fears were unrealised.

The arrestees – assured of anonymity – were interviewed away from the presence of the police and were asked to supply a urine sample for drug testing. Forty-one percent had used amphetamines and a quarter of those who had recently used amphetamines considered that their use had played a major part in the activities for which they were subsequently arrested.

Amphetamines are now also significant drugs of addiction. National surveys conducted by the National Addiction Centre in Christchurch show one in five patients now citing amphetamine, alone or in combination with other drugs, as their main substance abuse problem.

Why these particular drugs and why now? Wilkins can provide some explanation. Amphetamines fit well with current socio-cultural norms which place a high value on productivity and achievement – both at work and socially.

"I think one of the really dangerous things about methamphetamine and the amphetamines in general is that they are very instrumental drugs," says Wilkins. "If you take heroin you sit there in a semi-conscious stupor, and likewise cannabis impairs work effectiveness and social attentiveness. But amphetamine is a type of performance enhancer – you can do lots of productive things – and it's a social drug, you become very talkative and very confident and this is part of amphetamine's allure."

Studies overseas, he says, have shown methamphetamine is often used to enhance social confidence or to get mundane or challenging tasks done in short time frames. This is not 'being wasted' in the old sense. Methamphetamine can help you do the chores, work longer hours and go on to party into the small hours. "The paradox of amphetamine use is that as the negative mental and physical effects of use accumulate, they eventually substantially damage the user's ability to work, perform and socialise. Addicted users find their work performance impaired, relationships damaged and their desire to seek out others' company curtailed."

Society's views on taking drugs – legal and illegal – have changed too. This is an age when drugs are increasingly accepted as a means of enhancing life as well as treating ills. There are pills to make you happier, to boost sexual performance, to avoid hair loss. There are pills offering so-called legal highs. Why not add a few others to the personal pharmacopoeia?

Wilkins also sees a society that is refusing to age. "Ecstasy use by men goes all the way up to 40 or 45," says Wilkins. "You are young all the way up to 35 or so. People are marrying later and having children later."

Australia and New Zealand – two countries closely linked geographically and culturally – make an interesting contrast. New Zealand has a lower use of heroin and cocaine than Australia, but a higher use of LSD.

The likely explanation is the success with which drugs are intercepted coming into New Zealand and the effectiveness of internal drug enforcement. Being a small and remote nation with no land borders has some advantages. LSD, the argument goes, became popular because it is a comparatively easy drug to conceal and smuggle.

Those advantages remain. In 2003 a record 266,000 MDMA tablets and 830,000 capsules of ephedrine and pseudoephedrine – the precursor drugs used in the manufacture of methamphetamine – were seized by Customs officers, as well as 748g of methamphetamine itself. In 2004 a remarkable 17.5kg of crystal methamphetamine were seized at New Zealand's borders.

Even if the seizure rate is unlikely to approach the quantities of drugs making it into New Zealand – Wilkins has estimated the rate for amphetamine in 2001 to be 2 to 7 percent and the rate for MDMA/ecstasy to be 5 to 17 percent – these successes and the associated prosecutions are still a significant deterrent to traffickers.

As a further discouragement, in 2004 ephedrine and pseudoephedrine were elevated to the status of Class C controlled drugs to provide the Police and Customs Service with more powers to respond. People illegally importing these substances now face up to seven years in prison.

New Zealand pharmacists maintain a register of people who buy over-the-counter medications containing pseudoephedrine (a decongestant) and restrict the number of the tablets they will sell. More generally, a national Methamphetamine Action Plan is in place setting out how agencies should work together.

Policing methamphetamine brings particular challenges. This is a highly clandestine market. The survey of arrestees at Papakura Police Station showed that about half of the amphetamine sellers contacted their buyers by mobile phone and texting, and all of the amphetamine sellers reported selling only to close friends and family members.

New Zealand motorcycle gangs with affiliations to criminal networks overseas are thought to have played a leading role in establishing the domestic manufacture of methamphetamine in New Zealand, and although they may no longer hold a monopoly, they remain dominant suppliers.

The revenues from methamphetamine may be a major source of funding for organised crime. Wilkins estimates the retail market for amphetamine at $122.5 million in 2001, with a further $45.8 million spent on MDMA/ecstasy. These sums of money flowing into organised crime are part of the justification for the Government's plans to strengthen the existing Proceeds of Crime Act with a broader 'civil forfeiture' regime.

Wilkins believes – and the evidence would seem to support him – that law enforcement is getting better at stopping methamphetamine manufacture and MDMA/ecstasy smuggling. "Agencies have gone through a learning curve identifying methamphetamine labs and precursor sources, and they now have teams dedicated to that task. My feeling is that the law enforcement effort against methamphetamine has steadily become more effective over the past two or three years. This is a tribute to the efforts of individual officers and the seriousness with which the Police as an organisation have taken this problem," says Wilkins.

In the end, however, enforcement and other measures may only do so much, says Wilkins. "Trends in drugs tend to be powered by the macro forces of youth culture and they are difficult things to impact.

"A lot of drug trends just happen. The ability of the authorities to stop a drug trend using enforcement, education and supply-side or demand-side policies is more limited than some people may suppose. But good policy and timely response can significantly limit the damage and the duration of the trend."

Eruptions of drug use, such as that of methamphetamine, usually follow a predictable pattern, says Wilkins. "Young people discover a 'new' drug which may fit the prevailing music or lifestyle trend. The cool part of the demographic try it, enjoy it, they tell all their friends and they tell theirs. Then some of the originators become heavy users and experience ill effects – like psychosis, mental breakdowns, violence and addiction – the bad things about the drug become more widely known, and eventually use falls away as new recruits decline in numbers. So the use of a drug can spread very quickly until a social or group understanding of the downsides develops within the youth population."

Crack cocaine, a drug in many ways similar to methamphetamine, was just such a phenomenon. In the early to late '80s crack was a big problem in the United States, says Wilkins. "But in the late '90s and into this century use has greatly declined . It is no longer as widely used. The users that remain are often the older addicted users from the original spread of use. The decline in crack has happened not only through dedicated law enforcement or increased productivity in intercepting cocaine coming into the country. Part of the explanation appears to be that people have simply become tired of crack. Young people have seen their older brothers and sisters waste their lives on the drug. A social consciousness has emerged that crack is a bad drug to get involved in and not a cool thing."

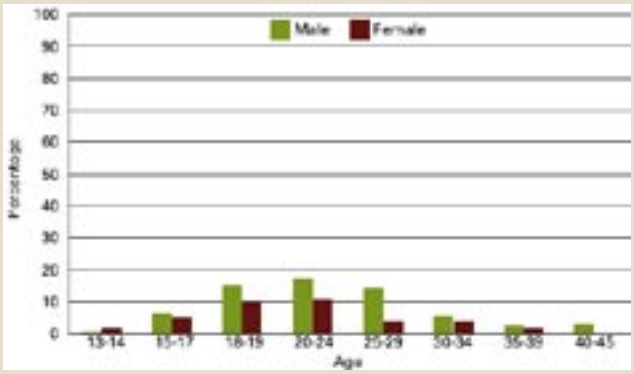
So sooner or later the methamphetamine epidemic, like epidemics before it, will peak and begin to decline. In this sense the stories like that of Steve Williams and Coral Burrows, deeply appalling though they are, will do some good by hastening a shift in cultural perception.

The next update on what is happening with methamphetamine in New Zealand will come from the analysis of the Ministry of Health-funded 2003 Health Behaviours Survey – Drugs (which has replaced the previous National Drug Surveys), on which Wilkins is currently at work.

The prevalence of use

Among the New Zealand population in 2001:

A comparison between the level of last year use of ATS in New Zealand and Australia in 2001 indicates that New Zealand generally had lower levels of use. This was particularly so of ecstasy. But the levels of amphetamine use are much closer, and in one group – men aged 15 to 19 – the New Zealand use of amphetamine appears to be higher. (This is, unfortunately, the period during which drug use is mostly likely to disrupt education and damage future life prospects.) In total, one in ten New Zealanders aged 18 to 29 had used an ATS drug in the last year.



ATS use by age and sex

Disproportionately more ATS users lived in urban settings, in the upper half of the North Island and in Auckland.

Northern Region
Proportion of all people 13–45 36%
Proportion of ATS users 47%

Midland Region
Proportion of all people 13–45 17%
Proportion of ATS users 12%

Central Region
Proportion of all people 13–45 24%
Proportion of ATS users 24%

Southern Region
Proportion of all people 13–45 24%
Proportion of ATS users 17%

The scale of the market

Dollar value of the ATS market 2001

	Amphetamine	Ecstasy	Cannabis
Annual individual expenditure*	$1,000	$600	$450
Annual total market value (million)	$123	$46	$169

**For users of these drugs.*

Patterns of use

Among frequent methamphetamine users:

65 percent reported binging in the last six months. The average frequency of binging was approximately once a fortnight.

20 percent thought their methamphetamine use was 'often' or 'always' out of control.

One in five had injected methamphetamine in the last six months.

Among arrestees:

The typical dollar amount spent on amphetamines was $350, as against $20 for cannabis.

Damage to health

Among frequent methamphetamine users

Most reported harms from methamphetamine use

Physical Problems	% sample
Poor appetite	83
Trouble sleeping	77
Loss of energy	57
Skin problems	51
Poor concentration	51
Heart palpitations	51

Most reported psychological problems from methamphetamine use

Psychological Problems	% sample
Anxiety	70
Mood swings	66
Short temper	62
Paranoia	60
Depression	60

Addiction

Among patients receiving treatment for addiction:

One in five cite amphetamine, alone or in combination with other drugs, as their main substance abuse problem.

Among frequent methamphetamine users:

Eight percent described giving up methamphetamine as 'very difficult or impossible'.

The clandestine market

Among arrestees:

Whereas about half of arrestees purchasing cannabis did so through public 'tinny' houses, only 5 percent of arrestees purchasing amphetamine did so through 'tinny' houses.

Among frequent methamphetamine users:

All of the amphetamine sellers interviewed reported selling only to close friends and family members. About half of amphetamine buyers contacted their buyers by mobile phone or texting.

New user groups

Among key informants:

About 50 percent of user key informants, 60 percent of enforcement key informants and 33 percent of treatment key informants had noticed new groups of people using methamphetamine in the past six months. The new user groups most commonly reported by all three key informant groups were 'teenage users' and 'business people'. User key informants also noted more 'young women', 'lower socio-economic' and 'Māori/Polynesian' users. Treatment key informants commonly noted more 'young women'. 47 percent of user key informants and 24 percent of drug enforcement key informants reported the repackaging of methamphetamine into smaller weights and lower prices.

Crime and social harm

There are a number of ways in which methamphetamine use is associated with serious and particularly violent offending. The first is where an offence takes place because someone is under the influence methamphetamine; the second where someone engages in crime to obtain the money for drugs; the third, where violence is employed as part of the process of carrying out business in the drug market.

Among arrestees:
- 63 percent had used cannabis in the last year
- 49 percent had used amphetamine in the last year
- 11 percent had used ice (crystal methamphetamine) in the last year
- 7 percent had used ecstasy in the last year
- 21 percent had used amphetamines in the last month
- 9 percent had used amphetamines just before an offence.

About a quarter of those who had recently used amphetamines considered that their use of these drugs had played a major part in the activities for which they had been arrested. Three quarters perceived the market for amphetamine to be very violent.

Reported effect of drug on the likelihood of getting angry

Drug type	Much less likely	Less likely	No effect	More likely	Much more likely
Alcohol	32	15	28	16	9
Cannabis	46	29	18	1	6
Amphetamine/Methamphetamine	18	16	33	8	24
Ice (crystal methamphetamine)	0	19	30	51	0
Ecstasy	77	0	23	0	0
Hallucinogens	34	29	37	0	0

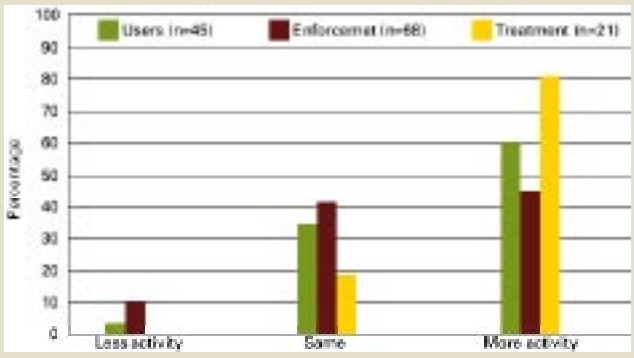
Among frequent methamphetamine users:
One third were often involved in other illegal activities such as drug dealing and drug manufacture. One third had sold methamphetamine and one in five had manufactured it or exchanged it for stolen property. The average amount earned from illegal activities was $24,000.

Among key informants:
About one third of user and treatment key informants indictated that there had been changes in the type of crime committed by methamphetamine users. All three groups of key informants were most likely to report increased 'violent crime' and increased 'property crime'.

Law enforcement

The highly clandestine methamphetamine market presents special challenges for law enforcement.

Among frequent methamphetamine users:
Sixty percent noted more law enforcement activity directed against methamphetamine in the past six months.
A third reported more arrests of other users they knew.
Eight percent thought that increased law enforcement had made it more difficult to get methamphetamine in the last six months.



Change in level of law enforcement activity noted by key informants

Among key informants:
51 percent of user key informants rated the availability of methamphetamine as 'very easy'.

Among arrestees:
About one half described purchasing ecstasy, amphetamine or heroin as 'very risky'.

The economics of illicit drugs

Properly speaking, Dr Chris Wilkins is best described not as an illicit-drug researcher, but as a New Institutional Economist with a particular interest in stateless economic systems such as illicit drug markets.

New Institutional Economics (NIE) studies the role institutions play in economic behaviour and performance.

"NIE looks at the institutional context of economic behaviour," explains Wilkins. "It looks beyond the workings of demand, supply and pricing to examine how institutions, property rights, social convention and transaction and information costs affect the decision-making of economic actors and the performance of economic systems."

New Institutional Economics is particularly suited to the study of 'stateless economies': economies where there is no state to enforce contracts or property rights, and this includes illicit drug markets.

In his PhD thesis Wilkins looked at the workings of cannabis markets, finding them typified by generally reliable transacting between buyers and sellers. The reason, says Wilkins, lies in the search and information costs associated with these exchanges.

"In the clandestine illicit drug market it can be quite difficult for buyers and sellers to find one another. It takes some effort even for experienced buyers to assess the options available in the market. This means that in cannabis markets both the buyer and the seller make a significant time investment in the exchange relationship, and that constrains cheating to some extent. If a cannabis seller cheats a customer, then that customer won't return, and that's potentially a big loss."

In a recent paper, Wilkins and Professor Sally Casswell explore the role gangs play in outdoor cannabis cultivation in New Zealand. Their analysis suggests that gangs are unlikely to have complete monopoly control of cannabis cultivation – cannabis is too easy to cultivate and rival cannabis cultivators and cannabis crops too hard to deter and detect – though Wilkins is quick to say this does not mean the gangs do not have persuasive advantages elsewhere in the cannabis market, or when it comes to other drugs.

Methamphetamine does much better than cannabis at satisfying the conditions under which an illicit drug market favours the involvement of organised crime: cost advantages from larger-scale production; a need for specialised skills, capital equipment or large amounts of start-up capital; and visible targets for violence aimed at discouraging competition.

One of the flow-on effects of the rise in the use of methamphetamine may be to extend the power and influence of New Zealand's gangs, in much the same way that Prohibition once strengthened the hand of the Mafia in America. If this is happening then it will mirror international trends. A report by the United Nations Office of Drugs and Crime has noted a shift away from "a loose network of independent laboratory operators towards larger organisations able to produce more and better drugs at lower costs. The larger groups are more flexible, and are able to identify and exploit any lucrative business opportunity, as well as any flaws in law enforcement efforts. They assist each other to more efficiently produce, market and distribute their products".

Wilkins is the current recipient of a Fast Start grant from the Marsden fund to investigate which illicit drug markets nurture the development of organised crime.

Readings

Distinguished Professor Bill Tunmer has spent years studying how children acquire literacy. His verdict on New Zealand's learn-to-read programmes? Could do better. Jane Tolerton writes.

Professor Bill Tunmer is about to head up a brand new master of literacy education programme. This first stand-alone master's degree programme in literacy education in New Zealand is built on years of research by Tunmer and his colleagues – which is changing the way our children are taught to read.

But Tunmer began his academic career in the sciences rather than the arts – and this background has been a vital key to the success of the reading research projects. His first undergraduate degree was in petroleum engineering at the University of Texas. Then he switched to cognitive science and did a PhD in experimental psychology, specialising in psycholinguistics.

He made the leap to literacy on a post-doctoral fellowship at the University of Western Australia, in a joint psychology and education project on the connection between metalinguistic abilities and learning to read and write.

"Metalinguistic skills, it turns out, are crucial in learning to read – because the task the child faces is to figure out how to map print on to his or her spoken language," says Tunmer, who came to the University as a professor in the education faculty in 1988, and is now distinguished professor of educational psychology based at the Palmerston North campus.

"Over the course of my career I have applied the principles of cognitive science to the questions of how children acquire literacy skills, why some don't – and what can be done about it. It is one of the goals of the programme to bring scientific research on literacy development to the classroom – to apply the research to instruction at school so that children derive maximum benefit from classroom activities.

"It used to be thought that children who have problems with reading and writing have problems with visual discrimination. For a long time that seemed to make sense. But around the late 1960s it became clear that wasn't the explanation for reading difficulties. It was clearly related to aspects of language development, particularly metalinguistic abilities."

One important question Tunmer and his colleagues have done a lot of work on is: what are the key strategies children use

when they come across words they don't know?

What teachers tell children to do when they come across an unfamiliar word is very important. Says Tunmer, "In the last couple of decades, the prevailing view in New Zealand has been that you use the context to predict what a word is. You have an idea of what's coming, and bang – you know it.

"So the Ministry of Education has advocated telling the child to use language context as the principal source of information to identify unfamiliar words. So a teacher might say 'read to the end of the sentence and put in a word that makes sense' or 'look at the picture'. The information in the word – like letter sounds – was just back-up information to support guesses.

"Our view from the large amount of research we have done suggests the opposite – that the first thing a child should do is look at the most valuable source of information, which is in the word itself even if it is an irregular word and you initially read it incorrectly; for example 'stomach' read as 'stow-match'. Then context should be used to correctly identify the word; e.g. 'The football hit him in the stomach'."

Tunmer remembers grappling with this himself. In the Californian school in which he began to learn to read, he followed the gentle adventures of Dick and Jane – the American equivalents of Janet and John. "They were using what was called the 'whole word' method, a precursor of the 'whole language' approach which came to be used in New Zealand. No phonics, no emphasis on letter sound. I was struggling. It just wasn't clicking."

Then the family moved to Cheyenne, Wyoming, and Bill was confronted by a different form of reading tuition in the person of the "very strict and traditional" Mrs Anderson, who taught by the phonics method. "It fell into place with Mrs Anderson."

Tunmer believes that without Mrs Anderson, there is a chance he might have been one of those children who confront difficulties and are put off reading.

The Massey research has had some influence on the Ministry of Education, but not enough yet, says Tunmer, who was a member of the group of experts established to advise the Literacy Taskforce.

"The school system needs to change. Our recommendations have had some impact, but we still differ with the approach recommended by the Ministry. The Ministry's position now is that there should be an equal emphasis on text-level and word-level cues. Our position is that word level information is primary.

"In one study we tracked children from their first to their third year of schooling. At the end of the first year of their schooling we asked children what they did when they saw a word they didn't know. We categorised children according to the strategies they used, and found that the children who said they used word-level strategies to figure what they didn't know did much better than those who said they guessed, read to the end of the sentence or looked at the picture."

"The school system needs to change. Our recommendations have had some impact, but we still differ with the approach recommended by the Ministry. The Ministry's position now is that there should be an equal emphasis on text-level and word-level cues. Our position is that word level information is primary."

Tunmer's most recent work has been on one of the big mysteries about reading in this country. "International studies have shown that New Zealand ranks fairly well in reading, and our average is at an acceptable level. But we have a large gap between the good readers and the poor ones. Some children do really well, others do really badly. This is regarded by researchers and policymakers as one of the biggest problems to overcome. From our research, we believe it has to do with the reading method – the heavy reliance on the 'whole language' approach, which is based on theories shown to be incorrect.

"The 'whole language' approach assumes that since we are not explicitly taught spoken language, we can pick up written language in the same way. If that was the case, we'd put children in a rich print environment and they would just pick up reading. But it doesn't work that way for printed language."

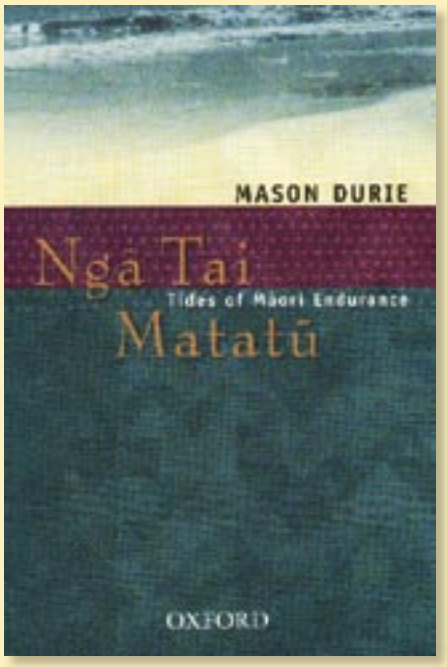
It particularly doesn't work for children who arrive at school without good language skills. "It's like throwing children off the end of the pier and expecting them to swim – learn by doing. They need more explicit instruction. And without it they may fall further behind and not catch up without intervention.

"It's like two children who can't swim, but one child played round the pool, put his head under, felt comfortable in the water. The other child didn't go near the water. The one who had activities related to swimming will do much better. It's the same thing with reading. It's particularly problematic if you make the assumption that all children have had the same activities by the time they reach school."

Giving all children 'whole language' instruction often results in what's termed 'the Matthew Effect' (as in the rich get richer and poor get poorer) because it benefits those children who have had a lot of literacy-related activities before starting school. They get further ahead and the least prepared fall further behind. "There are only slight differences at the beginning, but these become bigger over time.

"The key is differential instruction from day one, recognising differing levels of skill and taking them into consideration. You need a research-based conceptual framework to guide how practitioners assess children's skill levels and then recommended strategies for dealing with difficulties, activities you can carry out in the classroom to strengthen areas of weakness."

Tunmer's research work, with colleagues James Chapman, Keith Greaney and Jane Prochnow, who are all involved in the new master's programme, is focusing now on the most effective intervention strategies for preventing at-risk children from experiencing literacy learning difficulties and helping children with persistent difficulties.



Ngā Tai Matatū: Tides of Māori Endurance

by Professor Mason Durie
Oxford University Press, NZ $49.95
ISBN 0195584686
Reviewed by Shannon Pakura (Te Atihaunuiapaparangi), General Manager of Development Services, Child, Youth and Family, Head Office, Wellington.

"A highly recommended read for decision makers, researchers and policy analysts."

The final paragraph in the preface of *Ngā Tai Matatū: Tides of Māori Endurance* in my view captures the heart, soul and essence of Professor Durie's work. In great humbleness, Durie says "In writing about endurance, I had in mind our mokopuna, our grandchildren and our belief that they should be able to grow up as Māori, as healthy New Zealanders, and as global citizens." What could be more important?

Ngā Tai Matatū provides us with one lens from which we can view the journey navigated by Māori from the Pacific to Aotearoa, to these contemporary times. It tells us eloquently of the endurance, resilience and infinite patience required by our people to ensure that they retain the right to enjoy our own traditions in a way that makes sense to us.

Chapter 7, 'Papaki Rua Ngā Tai – Tide of Confluence: Māori and the State', reflects how Māori have held steadfastly to a principle that demands recognition of indigeneity, and therefore challenges those who champion equality to distinguish it from the creation of homogeneity or sameness. In the run-up to the 2005 election it is of great interest to listen to the political commentary on equality, sameness and indigeneity and to measure the words against other promises made as far back as 1840.

The impacts of public sector reforms on Māori over the years have been significant. This chapter highlights the strength, persistence, tolerance and courage of Māori throughout the centuries. Durie articulates the relentless determination to assert our right to be recognised as the indigenous people and for self-determination. The chapter weaves us through the political eras, provides commentary on significant social policy and key strategies that led Māori to be where we are today. The tides of state intervention, devolution, integration and deregulation take us through the rapids of time. The policy makers of today must read this book. They must turn their minds to the possibility that Māori leadership may be about co-existence with others rather than about control or power, and that determining a future for our mokopuna – which allows the essence of Māori to exist – is critical.

Māori are major players in service delivery. Māori have not only shown a capacity to engage; in most cases they have been able to provide services that are holistic. The nature of some of the contracts has not recognised this unique attribute and the performance indicators have failed to reflect the Māori world view or endorsed Māori aspirations for an integrated approach to social, cultural and economic development. Durie has provided an exceptional opportunity to government departments to reflect on the impact of some of the past strategies and learn from the positive and unintended consequences of public policy. Contract specialists, organisation approval standards and relationship managers would benefit from taking some time to read the impact of the changing tides on our people. What a difference it would make if the public sector were humble in their deliberations with Māori and understood that our world is not more right than theirs; it is just different.

Ngā Tai Matatū is a compelling read. This book is a must for researchers, managers, service delivery organisations, policy makers and analysts. September 17, 2005 will have determined whether Māori have a new tide to navigate.

Shannon Pakura has an MBA, a postgraduate diploma in public policy and social work and is currently studying towards a master's in social work.

The Great Wall of Confinement: The Chinese Prison Camp through Contemporary Fiction and Reportage

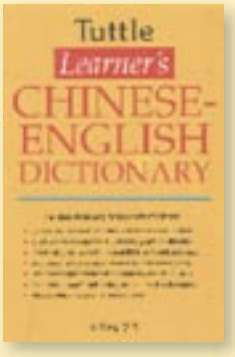
by Professor Philip Williams and Professor Yenna Wu, University of California Press
US$21.95 paperback, US$55 hardback
ISBN 0520244028

A comprehensive study of the People's Republic of China's prison camps, *The Great Wall of Confinement* draws from a wide range of primary sources, including compelling literary documents, to illuminate life inside the prison camps and provide a new perspective on human rights in China. China is the only major world power to have entered the twenty-first century with a thriving prison camp network – a frightening, mostly hidden realm known since 1951 as the laogai system.

Philip Williams is head of the School of Language Studies and a Professor of Chinese Literature. His four previous books include the monograph *Village Echoes: The Fiction of Wu Zuxiang* (1993).

Yenna Wu is a Professor of Chinese and Director of Asian languages and Civilisations at the University of California.

"[The authors] are careful scholars with a deft touch… How the prisoners have lived and died, adapted or failed to adapt, what they have eaten and how – as in the Soviet Gulag, food has been used as a weapon – how filthy they are, how bad their medical treatment, and how some prisoners exploit and persecute others, are all well shown here." Jonathan Mirsky, *Times Literary Supplement*

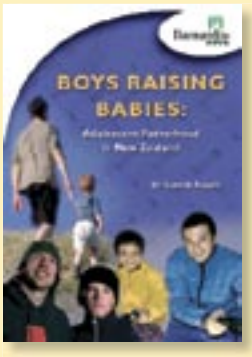


Learner's Chinese–English Dictionary

by Dong Li, Tuttle Publishing
US$27.95, ISBN 0-8048-3552-7

Dong Li of the School of Language Studies has updated and extended his first dictionary, the *Beginner's Chinese Dictionary*. This version is a specific dictionary for elementary and intermediate learners of Chinese. It covers the 4,800 most commonly used Chinese vocabulary items, including all 3,000-plus items prescribed for levels A and B of the internationally recognised standard test of Chinese language proficiency, the Hanyu Shuiping Kaoshi (HSK).

Entries are arranged alphabetically according to the standard pinyin transliteration system. An analysis of word formation is provided for most words of two or more syllables to aid memory and understanding of meaning, as well as to reinforce learning of individual characters. Many entries contain cultural and usage notes giving essential information on cultural context, pronunciation, grammar and usage to help the student use the words in a correct and idiomatic fashion. One or more sample sentences for each word help the student learn how to use important Chinese words in everyday communication.



Boys Raising Babies: Adolescent Fatherhood in New Zealand

by Gareth Rouch, Barnardos, NZ$65

Adolescent fatherhood made a dozen young New Zealand men strive for a better life, according to *Boys Raising Babies: Adolescent Fatherhood in New Zealand,* a new book written by psychology researcher Gareth Rouch.

"Teen fathers – like teen mothers – are often an implicitly and unfairly maligned group in our society," says Stuart Carr, Associate Professor at the School of Psychology. "In fact, teenage fatherhood can, under the right circumstances, lead to resilience building. It is an opportunity for 're-scripting', not simply being 'written off' – both for the father and the family unit as a whole.

"However, obstacles to developments like these are the prejudices of others to the inclusion of the father in the lives of the children and partner."

In in-depth discussions with each of the 12 young fathers Rouch found that parenthood had been a transformational experience. The young men aspired to create a better life for the child they fathered and wanted to overcome the obstacles created by their youth, often disadvantaged socio-economic backgrounds, limited educations and social prejudice.

Globalization and Culture at Work: Exploring Their Combined Glocality

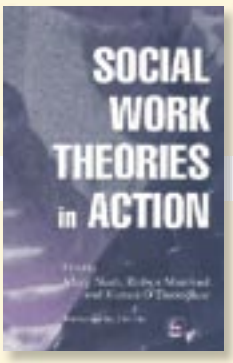
by Stuart Carr, Kluwer Academic Publishers
US$89.95, ISBN 1402078455

In *Globalization and Culture at Work: Exploring Their Combined Glocality*, organisational psychologist Dr Stuart Carr takes a close look at how globalisation affects us locally in work and business.

There are, says Dr Carr, two schools of thought: that 'one size fits all' – that you can transplant a working model from one place to another and it will still work – or that 'one size only fits some'.

Both concepts have their place, he says. "But you only have to travel to see how often things fall over when a model from one place won't work in another. The question is, how do we get smart about this?"

Also off the presses

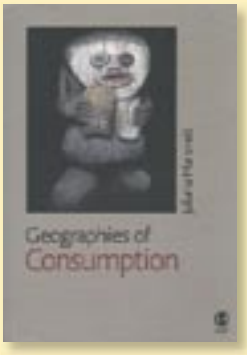


Development and Ethnocide: Colonial Practices in the Andaman Islands

By Sita Venkateswar, IWGIA
US$16, ISBN 8791563046

Dr Sita Venkateswar, from the School of People, Environment and Planning, examines the links between colonialism and development under British and Indian administrations of the Bay of Bengal islands. She analyses how the different indigenous groups (the Andamanese, the Onge, the Jarawa and the Sentinelese) have responded differently and been affected in different ways by colonisation, and looks particularly at the present situation of the Jarawa, a people who until recently were known to avoid contact with the surrounding society.

George Weber of the Andaman Association describes the book as a gem: "Venkateswar has managed that most difficult of feats: she has written a book that gives a lot of new data to the specialist, while at the same time entertaining and educating the interested lay person."



Geographies of Consumption

by Juliana Mansvelt, Sage
US$33.95, ISBN 076197430X

Dr Juliana Mansvelt's new book defines the geography of consumption as the way relationships between people, things and places are constituted around the sale, purchase and use of goods and services.

"Consumption," says Dr Mansvelt, a senior lecturer in the School of People, Environment and Planning, "is fundamental to how geographies are made and experienced in contemporary society."

Contributing editors Professors Kerry Howe and Noel Watts, with Emeritus Professors Glynnis Cropp and John Dunmore.

Pacific Journeys: Essays in Honour of John Dunmore

edited by Glynnis M. Cropp, Noel R. Watts, Roger D.J. Collins & K.R. Howe
Victoria University Press
NZ$39.95, ISBN 0864735073

Distinguished historians and academics have contributed essays to a book in honour of Emeritus Professor John Dunmore, who is internationally recognised for his lifetime of research into the French exploration of the Pacific.

Pacific Journeys: Essays in Honour of John Dunmore is a collection of 15 essays. Three of the book's editors are Massey academics: Emeritus Professor Glynnis Cropp, Professor Kerry Howe and Associate Professor Noel Watts. The fourth is Roger Collins, an Honorary Research Fellow in Art History at Otago University.

Professor Dunmore's latest book, a biography of Louis de Bougainville, is *Storms and Dreams*.

Teachers' work in Aotearoa New Zealand is the result of a collaboration between more than 20 staff from across the College of Education and was edited by **Paul Adams** and **Cushla Scrivens** from the Department of Social and Policy Studies in Education, and **Kathleen Vossler** from the Department of Learning and Teaching.

Research in Mathematics Education in Australasia 2000–2003 is co-authored by **Associate Professor Glenda Anthony** with Bob Perry and Carmel Diezmann.

Mathematics Education within the Postmodern by **Dr Margaret Walshaw,** is a volume in the series *International Perspectives on Mathematics Education*.

Cybercells – Learning in Actual and Virtual Groups, co-authored by **Dr David Stewart** and Professor Ken Stevens, examines how teachers and principals can use ICT to enhance learning in schools.

Understanding Critical Social Psychology by social psychologist **Dr Keith Tuffin** introduces innovative developments in social psychology research. The textbook is aimed at second-year social psychology students and provides a bridge between traditional social psychology and newer critical approaches to the discipline.

Social Policy in Aotearoa New Zealand: A Critical Introduction, now in its third edition, provides a context for understanding and assessing the changing nature of social policy, and the direction of future policy development. Authors **Dr Christine Cheyne** in the School of Sociology, Social Policy and Social Work and **Associate Professors Mike O'Brien and Michael Belgrave** in the School of Social and Cultural Studies, examine and critique the social policy framework of the past five years with new material on changing responses to the Treaty of Waitangi, the growing political interest in sustainable development and the emphasis on 'managing for outcomes'.

Social Work Theories in Action gathers expert contributions concerning the cultural issues involved in the practical application of social work theories. Edited by **Dr Mary Nash**, **Professor Robyn Munford** and **Kieran O'Donoghue** from the School of Sociology, Social Policy and Social Work, the book covers four key theoretical approaches to social work: ecological systems, community development, strengths-based approaches, and attachment theories. Individual chapters include questions for reflections, references and a guide for further reading.

Farm Management in New Zealand, co-written by **Nicola Shadbolt**, a senior lecturer in farm and agribusiness management in the Institute of Food, Nutrition and Human Health, and **Dr Sandra Martin** from Lincoln University, focuses on the state of farm management in New Zealand through case studies and scenario-based approaches. The authors consider general management principles and practices and how they apply to the business of farming.

Massey University Postdoctoral Fellowships

A project led by **Associate Professor Eric Ainscough** and **Professor Andrew Brodie** will synthesise and characterise novel phosphazene molecules. These can be used as the 'backbone' on to which 'hooks' are placed that bind to several metal atoms in close proximity, creating what is referred to as a multimodal ligand. These ligands are then used to construct supramolecular assemblies, collections of molecules bound to several metal atoms. "This project offers us a unique opportunity to explore a virgin research area. No other research has been carried out using linear phosphazenes as a backbone for multimodal ligands. The potential to lead to the discovery of exciting new materials is very high," say the researchers.

After being almost wiped out by introduced predators, many native birds are being reintroduced to mainland areas or being managed to enable an existing low-density population to recover. **Dr Doug Armstrong**'s project will use data from existing bird populations, such as those on offshore islands, to develop models of how these new populations can be expected to grow. These models will be continually updated using a Bayesian approach as actual data from the new populations is collected. "Given the overwhelming impact of introduced mammalian predators, the proposed research will provide models that New Zealand conservation mangers can apply to maintenance of endangered populations under predator control," he says.

Dr Russell Death's research will provide resource managers with an easy-to-use computer tool allowing them to rapidly and accurately predict the current state of ecosystem integrity in rivers and streams, identify potential causes of those patterns, and examine the outcome of differing management scenarios on river biodiversity and ecosystem integrity. "Regional council staff and even the general public will have ready access to information on the ecosystem integrity of any river or stream they are interested in, as an easily interpreted map. Regional council staff will also be able to play out particular activities and easily interpret the effects of those activities via the decision support system," he says. The project will collect information from current databases on how the biological measures relate to an established environmental hierarchy and will then model the relationships between ecosystem integrity and the environment.

Associate Professor Mike McManus will investigate the regulation of an enzyme involved in the biosynthesis of a key plant hormone. His research group has already obtained preliminary evidence that the enzyme's activity is controlled by the addition and removal of phosphate groups. The postdoctoral fellow will work to provide conclusive evidence of this method of regulation and investigate the physiological factors that influence it. "If confirmed this will be the first demonstration of such a control mechanism in this group of plant enzymes and will influence both fundamental questions and biotechnological applications," he says.

Natural products derived from fungi are a rich source of new compounds for treating infectious diseases, cancer and a range of other human disorders. A team led by **Professor Barry Scott** has been investigating the chemical, biochemical, and genetic basis for the diversity of structures seen in one particular class of fungal natural products, the indole-diterpenes. The team has so far identified a small set of genes, common to several species of fungi, that is required for the synthesis of a core indole-diterpene skeleton. This new project will investigate the genes and enzymes that modify this core skeleton to create the diversity of structures seen in filamentous fungi. "These experiments will allow us to predict the enzyme biosynthetic pathways for indole-diterpenes, as well as designing platforms for the synthesis in vivo of new biologically active derivatives."

Dr Christine Stephens will employ a postdoctoral fellow to study the importance of the family to older people as they adjust to retirement or lifestyle changes. This will complement work to be undertaken as part of a Health Research Council funded project studying the health of older adults in the transition from work to retirement. The postdoctoral research will focus on the importance of families to the social identity, wellbeing and independence of ageing people. It will include an analysis of current literature and popular media representations of older people and their families, as well as data from interviews with people aged from 60 to 75.

Associate Professor Peter Xu leads a multidisciplinary team constructing a robotic jaw, the first of its kind worldwide. The postdoctoral fellow's research will help enable the robotic jaw to adaptively mimic human chewing behaviour. "One challenge is to have the robot learn variations in food properties and adapt its chewing behaviours accordingly." The project brings together biorobotics, food sciences and biomedical engineering. It is likely to have applications in food science, to analytically characterise food dynamics, and, in dentistry, to quantitatively assess masticatory efficiency of restored dentition.

Electronic devices on semiconductor chips are becoming so small that quantum-physical effects start to dominate charge transport. As it is impossible to circumvent quantum physics, current research in nanoelectronics is focusing on exploiting such effects for a possible new electronics paradigm. One such research area is spin electronics (known as spintronics), which investigates the effect of the tiny intrinsic magnetic moment (due to the spin) of electrons on their motion. **Dr Ulrich Zuelicke** is already established as a leading researcher in the field of spintronics and with the help of a postdoctoral researcher he will advance a number of important projects. "I am building up a new research group, focusing on the theoretical studies of the interplay between the magnetic moment of charge carriers and electric transport through small circuits," he says.

Massey University Postdoctoral Fellowships recognise researchers with established research records, enabling them to either take on young postdoctoral researchers to carry out research or to undertake the research themselves.

Massey University Technicians Awards

Associate Professor Jeroen Douwes, Centre for Public Health Research, is studying asthma causation, mechanisms and prevention. Several studies have shown that environmental endotoxin exposure in childhood is associated with a reduced risk of allergies and asthma. The underlying immunological mechanisms are unclear, but may be the result of an endotoxin mediated up-regulation of T-helper 1 cell and a down-regulation of TH2 immunity. Dr Douwes is currently conducting two studies on the protective effects of bacterial endotoxin on allergies and asthma. The Centre for Public Health Research has established a laboratory and purchased equipment. This award will support a technician to carry out developmental work for specific analyses focusing on the immunological mechanisms underlying the protective effects of endotoxin. Dr Douwes plans to test emerging new hypotheses regarding the causation and mechanisms of asthma. He will investigate in two populations (800 infants and 120 adults) the effect of endotoxin exposure on allergy and asthma with a specific focus on the underlying immunological mechanisms.

Dr Kathryn Stowell, senior lecturer, Institute of Molecular Biosciences is studying the molecular genetics and biochemistry of malignant hyperthermia in New Zealand families. Malignant hyperthermia is a life-threatening and acute pharmacogenetic disorder, developing during or after a general anaesthesia. It affects one in 50,000 people. Recently returned from a sabbatical at the Department of Pharmacology at the University of Oxford, she will apply her skills in fluorescence microscopy using calcium indicators with muscle cells in culture. Her research aims to establish primary muscle cell lines from affected and unaffected individuals, and to develop and implement calcium release assays. The award will fund a technician to assist with the development of tissue culture conditions and assay systems. The new techniques and assay systems will provide new projects for graduate students and new directions for research into malignant hyperthermia.

Massey University Research Fellows

Professor Anne Noble, School of Fine Arts, receives her Research Fellowship for her project, *Antarctica: From place to place*. An inquiry into the re-presentation of the Antarctic landscape, the work is a global photographic project. It comprises photographs of Antarctic landscapes made in countries that have established a relationship to Antarctica through exploration, adventure, and science. These photographs of 'real' and imagined landscape images are the reference for a series of photographs of Antarctic tourist sites that have been selected for presentations to tourists during a package tour of the Antarctic Peninsula.

The Fellowship will fund a book and exhibition. Themes to be explored include a study of the conventions of depiction of the Antarctic landscape; and an investigation of the idea that the tourist experience of Antarctica is a constructed cultural experience. The project aims to unsettle the visual narratives of heroism and adventure that are played out in a 'picturesque wonderland'.

Professor Michael Roche, School of People, Environment and Planning, receives a Research Fellowship for his project, Environmental Imperialism in New Zealand. Professor Roche's research topics include an historical geography of discharged soldier settlement after WWI; forest management; the growth of the frozen meat industry; and the early use of chemical sprays in horticulture. The fellowship will fund the completion of research into discharged soldier settlement after WWI. This will re-examine contrasting social and economic notions of what constituted success and failure. The soldier settlement scheme was, in effect, a large scale social experiment which might be labelled unsustainable in today's social, economic and environmental terms. The fellowship will also fund an historical-geographic study of the literature on environmental transformation, sustainability and conservation. It will aim to enrich New Zealanders' understanding of the role played by the social transformation of environments in the making of their places and pasts.

Massey University Research Fellowships provide up to $20,000 to the recipient's department, institute or school to free him or her from some normal teaching and administrative duties so that a current research programme can be completed or documented.

University Women's Awards

Averil Coxhead is a lecturer in the School of Language Studies and is the principal researcher carrying out an investigation of the collocations and phrases of words that commonly occur within academic context. The Academic Word List – an internationally used list of common academic words in written academic texts – is the primary subject of her investigation. Findings from the research are intended to be made available to English teaching staff, students, and materials developers, as well as other researchers in this field. This is the first work to be undertaken in this particular area of lexical knowledge. Ms Coxhead has also been commissioned by the University of Michigan Press to write a book on her research findings for researchers and teachers. She is joined in this project by two researchers from Georgia State University and the international collaboration will draw a wider audience for her findings.

Dr Meredith Gibbs has had six articles published on her PhD research into Treaty of Waitangi settlements. Her case study "Are Treaty of Waitangi settlements achieving justice? The Ngai Tahu settlement and the return of pounamu (greenstone)" was conferred in May 2002 and is now a project which involves the preparation of a book manuscript. The project will extend Dr Gibbs' PhD research into an international context, assisting greatly in developing her international reputation for expertise in the field of historical injustice and indigenous rights to natural resources. Dr Gibbs is a lecturer in the School of People, Environment and Planning. She has also worked professionally in both New Zealand and Australia as a solicitor, resource management lawyer, policy analyst and consultant in commercial legal practice, for a non-profit organisation, and an iwi authority.

Maddie Leach is a lecturer in the School of Fine Arts and her work *My Blue Peninsula* is the third in a series of projects she has developed for exhibition in the context of public galleries and museums in New Zealand. In *My Blue Peninsula*, Ms Leach's intention is to present a significant visual arts research output that solicits debate around the nexus of contemporary art and its audience; productive relationships between art and design cultures; the institution of the museum and its role in our 'leisure industry'. The project is a temporary site project commissioned by Te Papa Tongarewa/Museum of New Zealand for exhibition in early 2007, and consists of a fully functional 4.9m plywood-construction sailing boat.

Dr Emily Parker is working closely with one of her third-year PhD students to ensure the production of work suitable for publication, and to seed future requests for research funding. Since arriving at the University, Dr Parker has set up a multidisciplinary research team working at the interface between chemistry and biology to investigate enzyme-catalysed reactions. She is a member of the Centre for Molecular Biodiscovery and hopes to pinpoint the details of the mechanisms that govern control of enzyme activity, and will facilitate design of inhibitors for type II DAH7P synthases that may be suitable as lead components for the development of novel antibacterial drugs. Dr Parker is a senior lecturer in the Institute of Fundamental Sciences.

Dr Suzanne Phibbs is a lecturer in Health Sciences and with Associate Professor Cheryl Benn is currently interviewing participants in the 2004 MURF funded excessive breast milk supply research project, and is to write up the results of this research for publication. Dr Phibbs's doctoral thesis in sociology provides an original contribution to theory and research in the area of gender, identity and embodiment and has been well received by external examiners. She has also been invited to publish an article from her doctorate, by members of the editorial board of the journal *Health*. Dr Phibbs is the coordinator of the research discussion days for postgraduate master's and research students in the Department of Health Sciences.

Dr Kathryn Rountree is a senior lecturer in the School of Social and Cultural studies and intends to embark on new research in Malta among people who identify as 'neo-Pagan', and constitute one component of a global new religious movement which venerates the Earth. Dr Rountree's previous work includes research on the Pagan community in New Zealand, and she has published a book *Embracing the Witch and the Goddess: Feminist Ritual Makers in New Zealand*, as well as a number of articles. Her book was nominated for the Katherine Briggs Folklore Award awarded by the Folklore Society of London, and she organised the recent visit of feminist theologian Carol P. Christ to New Zealand – which included two research symposia and a series of public lectures. Dr Rountree was a guest editor for *Women's Studies Journal*, and was Chair of the Qualifications Review Panel for Nursing and Midwifery courses.

The University Women's Awards enable women researchers to take time from heavy administrative and teaching workloads to either write up research results for publication, or to collect and analyse further data.

Top Achiever Doctoral Scholarships

Three of four doctoral students who applied to the Government-funded Top Achiever Doctoral Scholarships have been successful.

Lorena Gibson, a PhD student in the School of People, Environment and Planning, will conduct a comparative study of non-governmental organisations (NGOs) and grassroots development initiatives among the urban poor in Kolkata (India) and Lae (Papua New Guinea). Under the supervision of Dr Sita Venkateswar, Ms Gibson will analyse the origins and impacts of the NGOs and initiatives aimed at alleviating poverty and improving women's wellbeing in the urban slums of the two regions. She says that for those living in urban slums, everyday life is a fight for survival. Women are the most vulnerable, struggling for basic resources to feed their families. Yet despite their poverty – indeed, surprisingly, because of it – some groups of women in both Kolkata and Lae have found the hope and determination to organise various individual and community development initiatives, enabling them to combat the cycle of poverty. Ms Gibson will determine the conditions that have led to the empowerment of some of these people, and verify the short and long term consequences of these development initiatives on the women involved, their families and the larger communities in which they live.

Michael Anderson, a PhD student in the Institute of Natural Resources, will study the vocal behaviour and breeding biology of the grey warbler (*Gerygone igata*) and the shining cuckoo (*Chrysococcyx lucidus*) under the supervision of Associate Professor Dianne Brunton. The warbler is a widespread and abundant native species passerine, yet there has been relatively little research done. Previous studies that have investigated the vocal dialects of native passerines (such as the saddleback and bellbird) have done so on species that are geographically isolated. Mr Anderson's research aims to investigate the causative factors responsible for the development and maintenance of song dialects in a species that does not consist of geographically isolated populations. This is the first study of its type in New Zealand. Mr Anderson will also study brood parasitism between the warbler and the shining cuckoo. Brood parasitism has received considerable attention by researchers internationally, yet there has been little research on this particular relationship.

Diem-Thu Trinh, a PhD student in the Department of Information Systems, will examine the design and restructuring of Extendable Mark-up Language (XML) database schemas. XML is similar to Hypertext Mark-up Language (HTML) used for World Wide Web databases. A schema determines the way in which the database is organised. Ms Trinh's research will develop a framework to foster collaboration in evolving global XML schemas. There are currently many initiatives to develop application-domain specific global XML schemas. These standards enable the exchange of data on the web between many data users and data providers and users of the standards are free to extend or restructure the global XML schemas to suit their individual needs. This is likely to lead to a proliferation of independently evolved local schemas, which need to be integrated at some later point in time in order to develop an up-to-date standard. Under the supervision of Associate Professor Sven Hartmann, Ms Trinh will: develop a theoretical model of a global XML schema; identify semantically desirable properties of XML schemas; develop a system that can be used to restructure a global schema; validate the suitability of this system of design primitives when applied to performing typical design tasks, and identify ways that enable collaboration during schema evolution.

Each PhD student will receive $29,599 a year for three years.

Māori Research Awards

Interiors in Acculturated Landscapes: **Amanda Yates** (Ngāti Rangiwewehi, Ngāti Whakaue, Rongowhakaata, Te Aitanga a Mahaki). Ms Yates is a registered architect and lectures in interior design at the Wellington campus. She has a strong interest in traditional Māori spatial design which led to her receiving a Massey University Māori award. "The Award has helped me develop architectural and interior design that engages with Māori spatial practice via the exploration of contemporary architectural work and traditional Māori landscaping," says Ms Yates. "The research contributes to expand the knowledge of and sensitivity to traditional and contemporary Māori spatial practices within the university setting as well as externally." Kaiwhakaahua at the College of Creative Arts, Ross Hemera says Ms Yates's work is unique and important to the development of Māori design "because it links customary Māori works with interior design practice. It's going to pave the way for some exciting developments in contemporary Māori design." Ms Yates has her own architectural company, Archiscape. She has had more than 10 years' experience in the industry working on a range of projects including swimming pool and leisure complexes, restaurants and bars, apartments, house alterations, homes, luxury housing complexes, furniture and set designs for Taki Rua Theatre. She has a Bachelor of Architecture, a Bachelor of Building Science and a Bachelor of Arts.

Whakatangata Kia Kaha: **James Graham** (Ngāti Kahungunu, Ngai Te Whatu i Āpiti). Mr Graham is a lecturer in Māori education within Te Uru Māraurau at the College of Education based at the Ruawharo campus in Napier. The award will assist in his doctoral research work exploring the role of Te Aute College and its contribution to Māori development. "The research will explore Te Aute College's contribution thus far as well as the role it might play in shaping the future for Māori. I hope that the findings will make a contribution to the greater understanding of the nature of Te Aute College and for all our communities of interest in contributing to Māori advancement in the twenty first century," he says. Mr Graham is a former Te Aute College student and has ancestral links to the Hawkes Bay. The approach to the research will come under the growing field of Māori-centred research. In looking at the multiple layers of Te Aute College, Mr Graham will use a whakapapa (genealogical) approach that places Māori at the centre of the research as well as at the periphery; that is, all parts of the research will have a special link that in Māoritanga indicates notions of kinship, whanaungatanga and whakapapa. Mr Graham has a Bachelor of Arts and a Masters in Education. He presented a paper at the Indigenous Knowledge Conference 2005 that explored the notion of whakapapa as providing a legitimate research framework for engaging in research with Māori communities.

PROFESSOR ROBERT BROOKS
– BIOGEOCHEMIST EXTRAORDINAIRE –

Professor Robert Brooks, who died in January 2001, is remembered by his colleagues not only for his ceaseless energy and knack of finding new applications for his scientific skills, but also for his sense of humour and fund of anecdotes, particularly those he told against himself.

Born and educated in Britain, he served with the British Army in the Middle East and East Africa from 1944 to 1948. To his delight this entitled him to government-funded study at the University of Bristol, from where he graduated in chemistry in 1952. A spell as an analytical chemist in the zinc-smelting and printing industries was followed by study for a PhD at the University of Cape Town with the noted geochemist Louis Ahrens, working on ion-exchange separations and emission spectrographic analysis. This work formed the foundation for his later teaching and research. In 1960 he took a lectureship in chemistry at Massey University, where he was based for the rest of his career. Although nominally retired in 1991, he continued his research for a further nine years as Professor Emeritus and Honorary Research Fellow.

Throughout the 1960s Professor Brooks developed his interest in elemental analysis, and applied his knowledge to practical problems including archaeology, mineral exploration, environmental pollution, the study of meteorites, and the uptake of trace elements by plants and animals. An article on metal accumulation in shellfish organs became a Current Contents "Citation Classic", and his 1972 book *Geobotany and Biogeochemistry in Mineral Exploration*, updated in 1983 as *Biological Methods of Prospecting for Minerals*, was literally and figuratively groundbreaking work. Visits to Dun Mountain in New Zealand, to Western Australia and New Caledonia, stimulated research into serpentine floras that tolerate and accumulate certain metals; these plants grow on soils that are hostile to other species because they contain high concentrations of nickel, magnesium and chromium. Analysing and identifying these metal accumulating plants is helpful because prospectors can make use of the knowledge to locate sources of minerals without needing to dig or drill. Professor Brooks's book *Serpentine and its Vegetation* (1987) and his edited *Plants that Hyperaccumulate Heavy Metals* (1998) are standard works in the field, and he and his colleagues at Massey were responsible for establishing about 85 percent of the world's 330 known nickel hyperaccumulating species. In recent years these metal accumulating plants have been used for solving metal-contamination problems caused by industries such as mining and smelting. In an application known as 'green remediation', crops of hyperaccumulating plants are grown on metal-poisoned soil in order to remove the toxic element over a period of years. The crop is then burnt to produce an ore-like ash.

Some 300 publications, including 10 authoritative books, testify to Professor Brooks's productivity, and his fluency in several languages enabled him to maintain links with a wide circle of scientists, collating, reading, interpreting and summarising the literature. His international contributions to science were recognised by the award of a DSc in 1977, a personal Chair in Geochemistry in 1987, and a Fellowship of the Royal Society of New Zealand in 1996.

WHO MADE IT INTO THE WORLD TOP 200?

Harvard University
University of California, Berkeley
Massachusetts Institute of Technology
California Institute of Technology
Oxford University
Cambridge University
Stanford University
Yale University
Princeton University
ETH Zurich
London School of Economics
Tokyo University
University of Chicago
Imperial College London
University of Texas at Austin
Australian National University Australia
Beijing University
National University of Singapore
Columbia University
University of California, San Francisco
McGill University
Melbourne University
Cornell University
University of California, San Diego
Johns Hopkins University
University of California, Los Angeles
Ecole Polytechnique
Pennsylvania University
Kyoto University
Ecole Normale Supérieure, Paris
Michigan University
Ecole Polytechnique Fédérale de Lausanne
Monash University
University College London
Illinois University
New South Wales University
Toronto University
Carnegie Mellon University
Hong Kong University
Sydney University
Indian Institute of Technology
Hong Kong University of Sci & Technol
Manchester University and Umist
School of Oriental and African Studies
Massachusetts University
University of British Columbia
Heidelberg University
Edinburgh University
Queensland University
Nanyang University

Tokyo Institute of Technology
Duke University
Université Catholique de Louvain
Brussels Free University
RMIT University
Adelaide University
Paris VI, Pierre et Marie Curie University
Sussex University
Purdue University
Technical University Berlin
Brown University
Tsing Hua University
Copenhagen University
Erasmus University Rotterdam
Georgia Institute of Technology
Wisconsin University
Auckland University
Macquarie University
Osaka University
St Andrews University
Paris 1 Sorbonne
University of California, Santa Barbara
Northwestern University
Washington University
Boston University
Curtin University of Technology
Vienna Technical University
Delft University of Technology
New York University
Warwick University
Yeshiva University
Minnesota University
Eindhoven University of Technology
Chinese University of Hong Kong
Gottingen University
Rochester University
Trinity College, Dublin
Case Western Reserve University
Malaya University
Alabama University
Bristol University
Lomonosov Moscow State University
Hebrew University of Jerusalem
Vienna University
Technical University Munich
Western Australia University
Kingís College London
Amsterdam University
Munich University
Queen Mary, University of London

Oslo University
National Taiwan University
Bath University
Tufts University
Texas A&M University
Iowa University
Colorado University
Massey University
Washington University, St Louis
Chalmers University of Technology
Sains Malaysia University
Glasgow University
University of Technology, Sydney
Otago University
Brandeis University
Michigan State University
North Carolina University
Virginia University
Seoul National University South
Utrecht University
Paris XI, Université Paris-Sud
Royal Institute of Technology
Maastricht University
Stuttgart University
Humboldt University Berlin
Birmingham University
Aarhus University
Durham University
Helsinki University
Penn State University
Leiden University
Strasbourg University
Leeds University
Maryland University
Bonn University
Stony Brook, State University of NY
York University
Dartmouth College
Stockholm University
Uppsala University
Utah University
La Trobe University
Waterloo University
Toulouse 1 University
Technical University of Denmark
Rice University
Hamburg University
McMaster University
Kiel University
Sheffield University

Liverpool University
Karlsruhe University
Tohoku University
China University Sci & Technol
Montpellier 1 University
Vanderbilt University
Frankfurt University
Israel Institute of Technology
Madrid Autonomous University
Korea Advanced Institute of Sci & Tech
Tasmania University
La Sapienza University
Pohang University of Sci & Technol
Innsbruck University
Georgetown University
[illegible]rta University
[illegible] University
Du[illegible]iversity
Wür[illegible]versity
Nottin[illegible]ersity
Lund Ur[illegible]
TH Darms[illegible]
Emory Unive[illegible]
Indiana Univers[illegible]
University of Calif[illegible]
Helsinki University o[illegible]
Université de Montréal
Freiburg University
Newcastle upon Tyne
University of Southe[illegible]
Lancaster University
University of Califor[illegible]
Arizona University
Aachen RWTH
Queenís University
Bologna University
Norwegian Univers[illegible]
Tulane University
Leicester University
Rutgers State Unive[illegible]
Nijmegen Universit[illegible]
Nanjing University
Southampton Unive[illegible]
Aberdeen University
National Autonomou[illegible]
Fudan University
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Virginia Polytechnic In[illegible]
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Massey University is the second-highest placed New Zealand university on the United Kingdom-based The Times Higher Education Supplement World University Rankings for 2004, one of only three New Zealand universities who made the top 200 list at all. At #108, we sit alongside excellent institutions like Texas A&M University, and ahead of good universities like the University of Birmingham and the University of Southern California. So what does the list mean? Quite a lot. The survey is global, thorough, and reflects the three most important aspects of a university – strength in teaching, research and international reputation – or, to sum up, excellence. Massey University has always been driven by the spirit of exploration and discovery. We continually grow our investment in research and research-training to attract the curious, talented individuals who will be the discoverers of new areas of knowledge, essential to New Zealand's competitiveness. As a forward-thinking and ambitious university, we're pleased when such investments pay off – for everyone.

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