UNDER THE SURFACE
Photographs by Wayne Barrar

OBESE CITY
Is urban planning at fault?

THE NEW BLACK
The promise of biochar

Massey

definingnz

News from Massey University | Issue 15 | **September 2010**

Revolutionary movements

The science of cycling

+ CAN'T BELIEVE YOUR EYES: EXPLAINING OPTICAL ILLUSIONS

MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA

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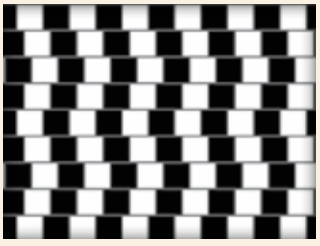

Site specific

WEB VIDEO **Under the Surface** A conversation with Associate Professor Wayne Barrar about the photographic research project, *Subterra*, which took him from World War I tunnels in France to Coober Pedy in Australia to a nuclear waste repository under the New Mexico desert.

http://mediasite.massey.ac.nz

VIEWPOINTS

DEPARTMENTS

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FROM THE VICE-CHANCELLOR

Men mark midlife in different ways. One of them is that impulse purchase. For some this is the sports car or high-power motorcycle. For me, the midlife lash-out was a cheap mountain bike.

For a decade, beginning in my late 20s, I was a runner. Half marathons were my thing. But I grew stale and I began to accumulate injuries. Mountain biking, I decided, would be my new challenge.

With that mountain bike I took myself off racing and promptly came to an inglorious end: I came off, was hospitalised, and the bike shop gurus told me my bike was unsuited to the use to which I was putting it. Their advice: pay them another visit.

So, when my wounds and ego had healed, that was what I did. The new bike was a thing of beauty. It became the first in a succession of mountain and road bikes to occupy my garage, and what space remained I attempted to fill with biking accessories that suddenly seemed essential. I had become a cyclist, a member of the lycra and baggy shorts brigade.

I discovered the pleasures of the world at bicycle speed. Scenery that I had once sped past held unexpected enchantments. It was fun to be out in the open air physically engaged with going somewhere.

I was not alone. The world seemed to be taking to two wheels. Between 2000 and 2008, SPARC activity figures show an 81 percent increase in the number of people cycling, and this phenomenon was across all age groups over 25 years of age.

When Prime Minister John Key suggests a national cycleway, we rally behind him. When Julian Dean pushes on – despite being head-butted by opponents – towards a podium finish in the Tour de France, I know I am not the only Kiwi cheering him on. These are signs of the times.

So too is the emphasis given to the science of cycling. At Massey, we are fortunate to have three remarkable sports scientists who are also cyclists and who happen to be the subject of our cover story: Associate Professor Steve Stannard, Dr Philip Fink and Dr David Rowlands.

Dr Fink is currently working on the biomechanical problem of whether a competitive cyclist is best served by standing on the pedals when attacking a hill climb or remaining seated. Back in the days when I had competitive aspirations, this was information I could have used.

When I say I became a cyclist at age 40, in some senses this isn't strictly true. I cycled when I was a schoolboy, but for my generation a bicycle was how you made your way to school and not a form of self-definition.

This is how it remains in other arguably more civilised countries. In the Netherlands the family bicycle – probably a heavy-but-elegant sit-up-and-beg affair – is how you do your shopping or visit friends. It is transport, not a conspicuous form of recreation. But the Netherlands makes proper provision for cyclists. There are dedicated cycleways. Our urban and transport planning is predicated around cars, trucks and buses. Green lanes notwithstanding, cyclists get a raw deal.

One of Massey's alumni, comedian and celebrity speaker Jon Bridges, cycles everywhere in Auckland and swears by it. I describe him as brave and determined. But these qualities shouldn't be necessary. In particular, I don't think many parents want their children to be brave or determined cyclists; they want them to get home safely.

A lack of provision for cycling is just one of the flaws in our city planning identified by one of Massey's researchers, Karen Witten, who is interviewed later in this magazine. Cities built for motorists aren't necessarily good for people.

One in five Kiwis aged two to 14 is overweight; one in 12 is obese. Witten's prescription for better health is neither surgery nor self-denial. She advocates town planning that allows people to live, work and play within their neighbourhoods. Streets that are engineered to slow traffic. Safe places for children to walk, cycle and play.

The other benefit to cycling is, of course, sustainability – this is by far the most efficient form of transport – and sustainability is one of the themes running through much of Massey's work.

Around our campuses, researchers are working on such things as organic solar cells, new battery technologies, the use of biogas as a fuel source, and a multitude of ways of preventing or mitigating environmental harms.

Around our campuses, researchers are working on such things as organic solar cells, new battery technologies, the use of biogas as a fuel source, and a multitude of ways of preventing or mitigating environmental harms.

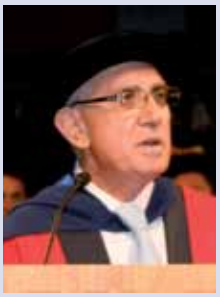
One of the major threats to our global environment is greenhouse-gas-driven climate change, and much effort is being expended on limiting emissions. But beyond this there may be ways of drawing down the existing pool of atmospheric CO_2. One is to use trees to take up carbon dioxide and then to bury the resulting carbon in the soil in the form of charcoal, or, as it has become known, biochar.

In recent years New Zealand's plantation forests have been a carbon sink, winning us carbon credits. In the 2020s the balance is likely to turn to deficit as the 600,000 hectares of forest planted in the 1990s begin to be harvested. This is when processing forestry wastes for biochar will, if the right economic mechanisms are in place, become important to New Zealand's carbon balance.

Will it work in New Zealand? Turn to the interview with Associate Professor Marta Camps to find out how matters are progressing.

Steve Maharey
Vice-Chancellor

Talking Points



Our top 10 technology companies export between them $4 billion per annum. And what do they make? Respiratory humidifiers. Crystal controlled oscillators for GPS systems. Computer graphics for Hollywood...

We have 10 companies exporting $4 billion. Why not 100? Then we will have matched Australia's per capita GDP with absolutely no environmental downside. 100 inspired entrepreneurs can transform this country into the creative, innovation dynamo of the Pacific Rim.

Professor Sir Paul Callaghan puts the case for investing in university-led science in his speech to graduands on accepting an honorary Doctorate of Science. *May 2010*

He was particularly stubborn in true kiwi form, and just sat there [as if saying] I am not going to do this. He'd bite a carer's hands when he got fed up with walking. But he's quite a tolerant little guy.

Dr Lisa Argilla of the New Zealand Wildlife Health Centre talks about Piwi the kiwi, who, recovering from breaking both legs, was prescribed a regime of treadmill workouts, massage and physiotherapy. *Manawatu Standard, July 2010*

Pango poto
Short black

Rāte
Latte

Kawhe tio
Iced coffee

He aha māu?
What can I get you?

He kaputino māku.
I'll have a cappuccino.

Noho mai, hari atu rānei?
Have here or takeaway?

Noho mai koa.
Have here thanks.

One more kapu kawhe for the road

A Māori language week event has added useful words to the lexicon. Words like moka (mocha) and rāte (latte). Staff member Lana Simmons-Donaldson came up with the idea of encouraging staff and students to order their daily caffeine hits by handing out cards showing the Māori words and phrases they would need. Kawhe was already in the dictionary, but other staples of café culture were not and had to be translated or transliterated from the English. Where words were disputed, the university's Māori Language Advisory Group led by Professor Taiarahia Black was the arbiter.

The feedback? For most people, it was just their kaputī.

For more information, including sound files, visit www.massey.ac.nz/massey/maori.

Cetacean CSI

When a dead dolphin was found at Matakana beach, two questions needed answers. First, was this really Moko, the dolphin that had charmed its way into so many people's hearts? And what was the cause of death? Bryan Gibson talks to veterinary pathologist Wendi Roe.

This was obviously a more high-profile case than usual.

It really was, because not only of the media coverage but also Moko himself. My two children swam with him in Mahia and I'd seen him myself off the coast of Gisborne. It's not often you work on an animal you've known. He obviously meant a lot to many people, especially on the East Coast, he was such an icon. We were privileged to be able to be a part of his story. But this is what we do: my colleague Stuart Hunter and I do this sort of work every day, so once we got to work it was business as usual.

Was it a difficult necropsy?

Yes, Moko had been dead for some weeks before he was discovered, so unfortunately the body was quite decomposed.

Did you come to any conclusion about why he died?

We were able to rule out boat strike and drowning through net entanglement as potential causes of death. There were no obvious signs of extensive bruising or of any skeletal fractures, making blunt trauma an unlikely cause of death, and none of the usual signs of drowning – from accidental capture in a net – were present. The only potential contributing factor we identified was evidence of liver disease; however, the specifics around the type and severity of this disease couldn't be identified owing to the degraded state of the dolphin's body.

Any good relationship requires perpetual negotiation. Take perennial ryegrass and the fungus that inhabits it. As long as they are talking to one another biochemically, both thrive. Block the communication, and things go amiss.

So when Professor Barry Scott, Dr Murray Cox (pictured from left) and Dr Carla Eaton knocked out the fungal gene for signal transduction, bad things happened: the grass was stunted and the fungus grew out of control.

The team then had the plant and fungal RNA sequenced, noting where changes had occurred. The result is the first-ever complete set of the RNA molecules involved in the plant-fungi relationship.

"It's a really fine balance," says Professor Scott. "If you change the relationship slightly it is enough to tip it over the edge. The fungi becomes a pathogen."

The research will appear in the August issue of *Plant Physiology*.

Wintering after a van der Velden study

This reworking of a historical painting in the form of a photograph won senior lecturer in photography Ann Sheldon the $10,000 Anthony Harper Award for Contemporary Art, with Lara Strongman, the competition judge, describing it as "a powerful, haunting image, whose economy of expression belies the conceptual richness of the work".

Massey's Centre for Defence and Security Studies is to offer postgraduate diploma study to members of the Royal Brunei Armed Forces under a three-year contract estimated to be worth several hundred thousand dollars. Pictured are Professor Graeme Fraser with, at left, Lieutenant Colonel Ward, and, at right, Colonel Bijay Wijat and Lieutenant Colonel Mohammed Sharif of the Royal Brunei Armed Forces.

The Centrepoint legacy

Centrepoint was meant to foster more honest relationships, including open sexual relations among adults and children.

They were the best of times for some, the worst of times for others, and for many a troubled mix of the two. No one template applies to what it was like to be a child at Bert Potter's infamous Centrepoint community.

For the children-now-turned-adults there are golden memories of freely roaming the idyllic rural North Shore property in the company of their peers, and, then again, for some, there are dark recollections of sexual abuse, parental neglect, drug and substance abuse, and psychological manipulation.

These are some of the findings in a new report, which provides insights into what it was like to be a child at Centrepoint and explores what happened in people's subsequent lives.

In a three-year period, psychologists Associate Professor Mandy Morgan, Dr Kerry Gibson and Cheryl Woolley interviewed 29 adults who had spent all or part of their childhoods at Centrepoint, which ran from 1977 until forced to close in 2000.

The resulting narratives are poignant and at times harrowing, and Morgan has praised the interview subjects for their courage, openness and willingness to give.

Centrepoint was meant to foster more honest relationships, including open sexual relations among adults and children. The actual effects? For many it has meant such things as a lack of career, financial and life skills, fear of social stigma, difficulties with intimacy and trust in close relationships and uncertainty about their perceptions of reality as they have adjusted to life outside the community.

Potter, who led the community, spent nine years in jail for sexual abuse and drug offences committed at the community. Now well into his 80s, he remains unrepentant.

The report was commissioned by the Public Trust, which administers the New Zealand Communities Growth Trust, which was formed after Centrepoint closed and controls the community's assets. The report will help the Trust decide how to allocate funding for support and rehabilitation.

A Different Kind of Family: Retrospective Accounts of Growing up at Centrepoint and Implications for Adulthood can be downloaded from www.massey.ac.nz.

Study authors Dr Kerry Gibson, Cheryl Woolley and Associate Professor Mandy Morgan

Skiers have quick-release bindings; why shouldn't wakeboarders have something similar? The thought came to Christchurch-based industrial designer Julian Schloemer after he injured his knee out on the water. His solution, a design called the Lucid, is this year's winner of the James Dyson Award. As part of the award, Schloemer, now a British Council New Zealand Design Ambassador, will travel to Britain to tour Dyson's research, design and development facility. $3000 towards travel and accommodation is included. Schloemer graduated from Massey's College of Creative Arts in Wellington in 2009.

Another finalist was Albany fourth-year industrial design student Nichola Trudgen for Wanderest, a detachable seat designed to be strapped to a lamppost as a resting perch for the aged.

REPORTING IN

Richard Sidey, expedition photographer

RICHARD SIDEY

A range of Richard's extraordinary work – including Aeon – can be viewed at www.richardsidey.com.

Right now I'm lucky to have an internet connection to send this. I'm in the midst of the Arctic summer, spending my days and nights in eternal daylight on the archipelago of Svalbard, which lies above Norway at around 80 degrees north. I'm working on board a 6000-tonne tourist expedition vessel, the Prince Albert II, as official photographer. I document the voyage, landscapes, nature and wildlife we encounter on our seven-to-10 day expeditions using photographs and video, which I then edit into a DVD compilation, which is sold to guests at the end of the voyage. The highlight of the Svalbard trips is sighting the 'king of the arctic', the polar bear.

In the past two weeks I have been fortunate to photograph 24 of them, with a number of close encounters. Some of the bears have been with first-year cubs; others with fresh kills on the ice.

Richard Sidey graduated with a Bachelor in Visual Communication and Design in 2005. His student project, the time-lapse short film Aeon*, has won several awards internationally, including 'best short film' at the Documentary New Zealand Film Festival in 2005.*

ON THE HORIZON

Sept | Oct | Nov | Dec



AUCKLAND

NZFOODAWARDS

IN ASSOCIATION WITH MASSEY UNIVERSITY

28 October 2010

The Massey Food Awards

The best of New Zealand food will be on show at this year's New Zealand Food Awards. Now known as the Masseys, the awards encompass the best in food and beverages and in innovation in packaging and marketing, with products from cereals to snacks, fast food to slow-cooked. The awards recognise industry leaders, the people and companies who inspire others to excel. Entries are in, with the winners to be announced at a showcase dinner at Auckland's Langham Hotel on 28 October. In the coming months, watch the supermarket shelves for products bearing the Food Awards mark.

ALBANY

MANAWATU

14 September, 2010

Ngā Kupu Ora Māori Book Awards

Marking Māori Language Day, the winners in the four categories of the Massey University, Ngā Kupu Ora Māori Book awards will be announced at the annual awards event. For more information, visit www.massey.ac.nz/massey/maori.

WELLINGTON

2 September 2010

Everyone Forgets: Understanding and Managing Memory Lapses

Worrying about forgetfulness is a common feature of everyday life. It affects everyone and is likely to become more apparent with increasing age. **Professor Janet Leathem** will speak about why we become forgetful, how memory changes over the years, the differences between normal and atypical memory lapses, and the research evidence for factors that can delay the onset of memory difficulty. 6.00–7.00pm, Museum Building (Block 10), Theatrette (10A02), Buckle Street entrance. Limited seating. RSVP by 31 August to m.buutveld@massey.ac.nz.

9 September 2010

Immersed in an Ocean of Light: Creative Interaction through Digital Artwork and Social Media

Associate Professor Chris Bennewith will showcase some projects undertaken as part of the international art and design collective – squidsoup – and introduce a new project in development by Massey as an exemplar of open systems that utilise audience intervention to produce engaging experiences and/or allow dynamic and creative interaction to take place. 6.00–7.00pm, Museum Building (Block 10), Theatrette (10A02), Buckle Street entrance. Limited seating. RSVP by 7 September to m.buutveld@massey.ac.nz.

30 September 2010

New Zealand SMEs, Future Trends and Some Policy Implications

Professor David Deakins will examine the characteristics of New Zealand's small and medium enterprises (SMEs) using panel data from the New Zealand School of SME Research (NZSMERC), which has conducted an annual survey of 1500 New Zealand SMEs since 2007, the BusinessSMEasure. 6.00–7.00pm, Museum Building (Block 10), Theatrette (10A02), Buckle Street entrance. Limited seating. RSVP by 28 September to m.buutveld@massey.ac.nz.

WELLINGTON

EVENTS

12 November and 13 November 2010

BLOW 10 Fashion Show

The Massey Fashion Show, a signature event in the Blow Festival, is a catwalk production bringing to life the skills and flair of graduating fashion students. Garments range from gowns to street wear, to wearable art. Three shows are held to meet demand. This is an inspirational and entertaining event. Tickets go on sale in October.

EXHIBITIONS

6 November – 20 November 2010

Exposure

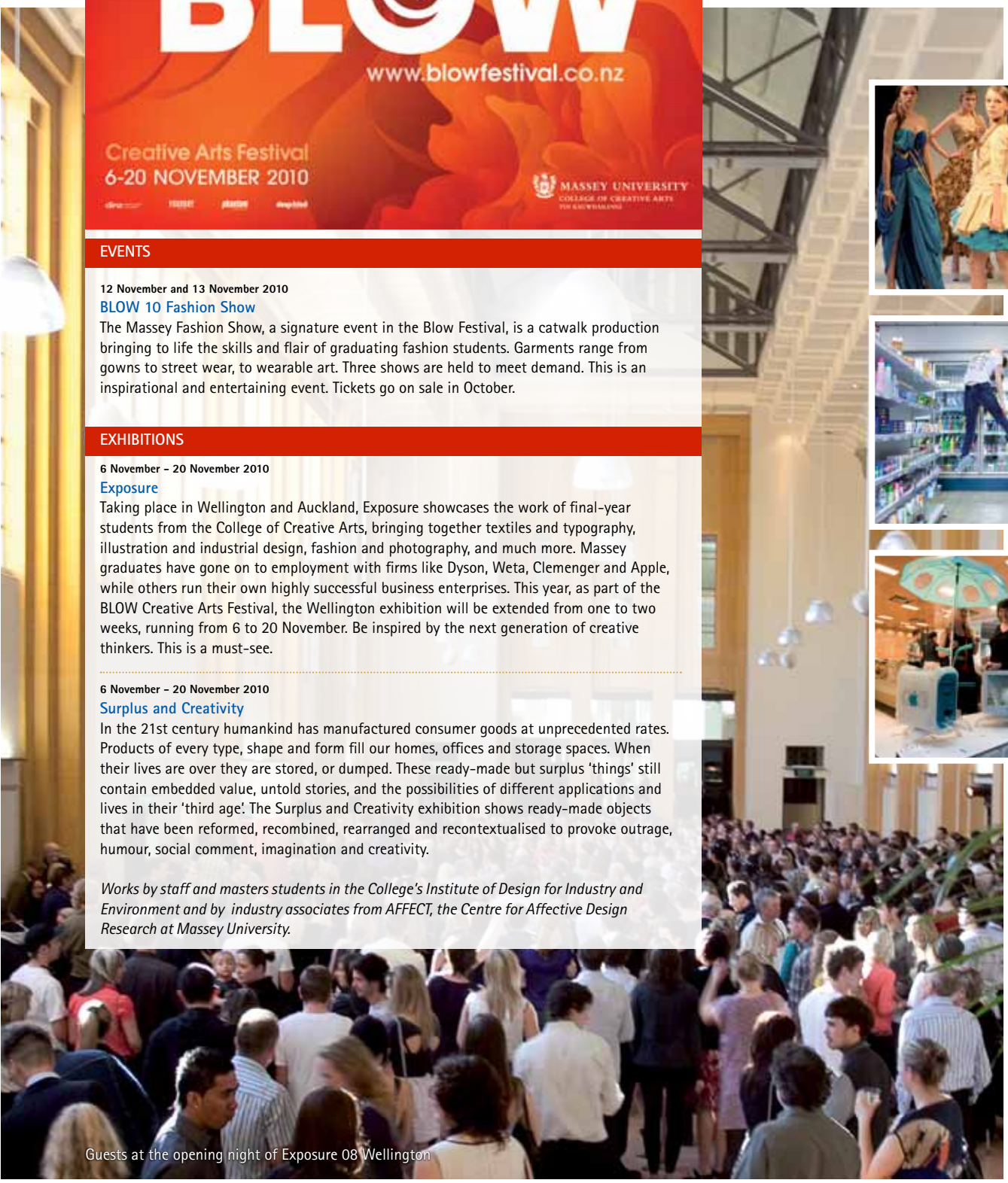
Taking place in Wellington and Auckland, Exposure showcases the work of final-year students from the College of Creative Arts, bringing together textiles and typography, illustration and industrial design, fashion and photography, and much more. Massey graduates have gone on to employment with firms like Dyson, Weta, Clemenger and Apple, while others run their own highly successful business enterprises. This year, as part of the BLOW Creative Arts Festival, the Wellington exhibition will be extended from one to two weeks, running from 6 to 20 November. Be inspired by the next generation of creative thinkers. This is a must-see.

6 November – 20 November 2010

Surplus and Creativity

In the 21st century humankind has manufactured consumer goods at unprecedented rates. Products of every type, shape and form fill our homes, offices and storage spaces. When their lives are over they are stored, or dumped. These ready-made but surplus 'things' still contain embedded value, untold stories, and the possibilities of different applications and lives in their 'third age'. The Surplus and Creativity exhibition shows ready-made objects that have been reformed, recombined, rearranged and recontextualised to provoke outrage, humour, social comment, imagination and creativity.

Works by staff and masters students in the College's Institute of Design for Industry and Environment and by industry associates from AFFECT, the Centre for Affective Design Research at Massey University.



Guests at the opening night of Exposure 08 Wellington

speechless

Does te reo have a future?

Massey alumnus and former staff member **Dr Rangi Mataamua** talks to **Sonia Yoshioka-Braid**.

If we don't get this right, we may have no Māori language by 2050.

We have Māori Language Week and Māori Television and radio stations – what makes you think that the language is in peril?

My doctoral thesis was on language, so I've been studying this for quite some time, and I have been working on various language research projects in the past few years, including recent work on the state of the language within Tūhoe. There is a misconception that with the advent of Māori Television and radio stations, the spread of kohanga reo, and the increasing number of bilingual schools, there is a resurgence in the Māori language. True, there are more resources, and more people are able to access them, but the quality of the language is declining. Fluent speakers are dying out, and they're not being replaced.

What do you mean by 'the quality is declining'?

I'm pretty hard line on this. I find I need to continually focus on the quality of my own language, and I am always learning. I went through the Panekiretanga o Te Reo Māori language excellence programme. Before going, I thought my language was fine, but I learned so much. I learned the proper grammatical structure of the language and the way it all works in together, and I am still learning. Unfortunately these kinds of resources aren't available to everybody, and I have heard things on Māori Television and on radio that are not entirely correct. They've thought of something in English and translated it into Māori, but it doesn't work like that – you're stepping into dangerous territory using one language to explain another language.

Doesn't that just mean the language is adapting, just as English has?

It is adapting, but it's not a positive form of adaptation. You're taking one language, with all its history and culture, and using the crude methodology of another language to describe or explain it. Things get missed – it doesn't quite match up – and the beauty of te reo is lost in that adaptation. The problem is that people learn that adapted style then teach it to others, so the errors are perpetuated and that becomes the direction the language takes. It doesn't have to be like that.

But surely the adoption of many Māori words into mainstream New Zealand language is a step in the right direction to bringing Māori language out of the cold and into daily usage?

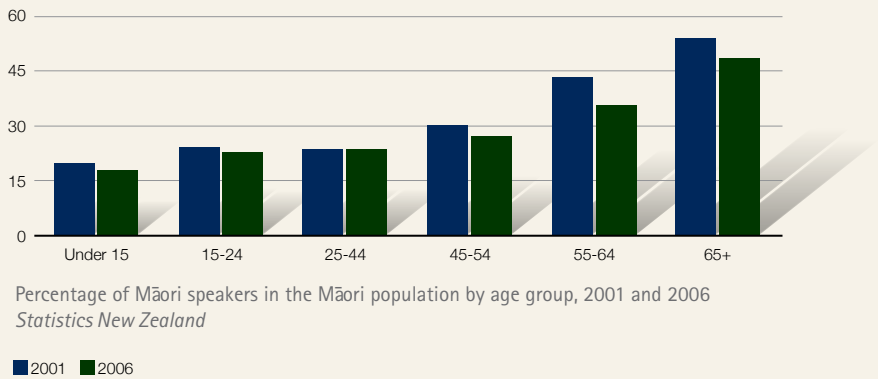
It is a step in the right direction, but we're in danger of making it just a party trick. There are three steps in the acquisition of language – the first is status, where people think it is important to use Māori. Step two is acquisition, where people actually learn the language, and the third step is use. That's where the struggle is. There's no point in Māori being some ceremonial thing we bring out and dust when we want to show off. It's got to be used on an everyday basis in the home.

Can that be fixed so that people move from acquisition to use?

There's no magic fix – no-one knows how we make that next step stick, but there's plenty of research going on. We're on a tight time frame – I predict that if we don't get this right, we may have no Māori language by 2050. So far, we've been following the examples set by other cultures, and often their native languages are in decline – why are we following failing models? We need to find what will work for Māori. It's up to every individual to be responsible for the language.

Is this something all New Zealanders can do?

Definitely. We need all New Zealanders to see Māori as a common second language that can then feed into more language acquisition. It opens



Percentage of Māori speakers in the Māori population by age group, 2001 and 2006
Statistics New Zealand

those neural pathways to learning, and adding on more languages opens up the world. At the same time, it enables people to learn more about the culture – otherwise cultural wealth will be held by only a few and it will die out with them.

You're Tūhoe, and your people have a reputation for being pretty staunch – both in language and in attitude towards the outside world. What are you doing differently?

Tūhoe has a reputation of being a bastion of Māori language, but we're also experiencing a state of decline, and it's going to get worse. I make a point of speaking Māori at home to my kids, and when the older people call my place wanting jobs done, they speak to me in Māori. The reason we're seen as hard line is because our people have experienced atrocities that no other group of people in New Zealand had to endure. We don't forget, and we only want what is rightfully ours.

What are the key components to keeping the Māori language alive and thriving?

It involves the family – it has to. Language is the foundation of culture, and we need to ensure our foundations remain secure by encouraging intergenerational use of the language and asking for higher standards in our tertiary institutions. Universities shouldn't be doing introductory courses – they need to be stretching our scholars by focusing on a higher level. There are plenty of great people out there who are dedicated to the cause and have been working for many years without a lot of money, even though language is a multi-million-dollar industry. ■

Now living in Ruatahuna in the heart of Te Urewera, **Dr Rangi Mataamua** was, until recently, a researcher at Te Pūtahi-a-Toi in the School of Māori Studies, and he continues to supervise Māori doctoral students across a number of universities, with the expectation being that the doctoral theses will be authored in te reo. Currently he is supervising around 20 students. Dr Mataamua chairs the Mataatua Marae Committee, and runs a consultancy and research business. He is an alumnus of Victoria and Massey universities.

ObeseCity

... everyday neighbourhood environments can provide opportunities to live a healthy lifestyle.

How does place have an effect on waist?

It is inconceivable that environmental changes have not contributed to obesity levels when you consider what is happening now in the developing world. In two decades, in countries such as China and Brazil, we have seen increases in obesity that took closer to 100 years in the industrialised world. The consumption of energy-dense foods and an increasing reliance of motorised transport are key drivers. Depending on where you live, access to healthy food and places to be physically active varies. Our book, *Geographies of Obesity*, pulls together what is known about those aspects of our environment that contribute to weight gain. It looks at the policies and practices that have created them and may, in turn, solve them.

What is your particular area of interest?

Our research investigates relationships between neighbourhoods and health, in particular relating to physical activity. We are studying the different aspects of neighbourhoods, such as service and amenity access, land-use mix and street connectivity, and public and open spaces and how they impact on physical activity. Although we come from a public health disciplinary base, because our research involves measuring and describing the city, it crosses over into urban planning – or at least has implications for urban planning.

Is obesity a symptom of town planning?

Sprawling suburbs are more car-centred. You have the breadwinner zipping into work along the motorway and children being dropped off at school rather than walking. Suburbs with a purely residential function – few shops, parks, community services and usually poor public transport connections – promote physical inactivity because people have to drive to get anywhere. The lack of interconnecting streets, lollipop streets rather than grid systems and tortuous curvilinear roads you have to take to get to your destination all hinder physical activity. Traditionally in New Zealand, industrial, retail and residential land use has been separated. This doesn't allow people to live, work and play in close proximity and, when they can't do this, they are less active.

What is the effect on children?

Distances between home and school stretch out in car-centred cities. It's further to walk to places. Also parents have responded to perceptions of a less safe street environment by chauffeuring kids more and monitoring their every move. This inadvertently reduces physical activity that occurs through walking or cycling from A to B and regular outdoor play. The same level of physical activity is not accumulated as readily through formal sports-type activities. Declining levels of physical activity and increasing levels of sedentary behaviour are contributing factors towards increasing obesity rates. Also, as more and more children are whisked off the street by concerned parents, walking and cycling become less and less safe for the children who are still walking on the street – the so-called 'social trap'.

But aren't cul-de-sacs traditionally seen as safer for children to play? Is there a solution?

There is another approach, which has been taken in the Talbot Park development in Glen Innes, Auckland, where tenants include many families with children. At Talbot Park, there is natural surveillance from the houses, which are built with windows overlooking areas where children play. This helps people to feel more comfortable because it encourages a neighbourhood collectively keeping an eye out. It's an interesting area. It's well located for shops and public transport and nearby streets have been deliberately modified to create obstacles in them to slow the traffic down. There are spaces in the centres of streets for playing hop-scotch. It will be interesting to track whether this encourages play and activity.

So a child growing up here is less likely to get fat?

It is hard to say as there are so many factors that impact on the foods they consume and their opportunities for exercise. But everyday neighbourhood environments can provide opportunities to live a healthy lifestyle.

Are there any other 'pro-play' areas?

We don't know yet. But when you map the urban design features linked to physical activity in adults, you get neighbourhoods that we anticipate will be better than others – beachside centres, such as those along Auckland's North Shore, where the infrastructure has been built up around the beach, and places such as Te Atatu Peninsula, with a village hub and access to lots of resources

Childhood obesity is a growing problem in New Zealand. One in five Kiwis aged two to 14 is overweight. One in 12 is obese. Should we be changing the way our cities and suburbs are laid out? **Associate Professor Karen Witten**, of Massey University's SHORE and Whariki Research Centre, is studying the relationship between where we live and what it means for our health. She talks to **Kathryn Farrow.**

conducive to a healthier lifestyle. By contrast, in large and sprawling suburbs such as Massey, a car becomes essential to meet everyday needs.

You also did a study known as Kids in the City; what did you find?

This was a small pilot study but it alerted us to the plight of children living in high-rise apartments in the Auckland CBD. Between 2001 and 2006 there was a 12 per cent increase per annum in the number of children under 15 living in the central city. This figure is high. City properties that were built for students, young couples and empty nesters are being occupied by young families because of the lack of affordable housing. Spaces for kids to play and socialise in the dwellings and immediate neighbourhood environments, especially outdoor spaces, are dismal.

You've just received funding from the Health Research Council for a new research project – what will you be doing?

We are about to commence a three-year study of children's mobility and physical activity in six higher-deprivation neighbourhoods in Auckland. We will be recruiting 120 eight- to 11-year-olds and their parents/caregivers to assess their physical activity in relation to the neighbourhood infrastructure and streetscape. The areas vary in their urban design characteristics and public transport access, but all are either higher density or targeted for intensification in the future. New Lynn, Talbot Park, Western CBD and Ranui are likely study sites and possibly Otara and a second site in Manukau.

What do you aim to achieve?

As Auckland intensifies, we'd like it to become a more child-friendly city, with neighbourhoods that parents and children experience as safe for walking and cycling and that include opportunities for children's outdoor play and exploration. We hope the study will provide an evidence base on how to move towards a more child-friendly public realm in the city. Children's needs have been largely relegated to skateparks and playgrounds from a planning perspective, whereas all public spaces can be designed to be inclusive of children. We want to bring children's voices into the way cities are designed.

revolutionary movements

Bryan Gibson talks to two very athletic academics, **Associate Professor Steve Stannard** and **Dr David Rowlands**

Associate Professor Steve Stannard at work and, at page head, at play

It's six in the morning, and Steve Stannard rolls out of his warm bed and slips on his cycling shoes, ready to hit the road. Like many cyclists, he knows nothing can substitute for time on the bike, and he puts in hundreds of kilometres each week, in any weather; the tougher the terrain the better. This is personal time: time to work on his fitness; time to think.

"Most of my research ideas come from personal experience," says Stannard. "Often it's your own experiences and observations in the sport that drive your research agenda. You hope that what you find out is useful to other people."

Stannard, who heads Massey's new School of Sport and Exercise Science, is an exercise physiologist with a background in the science of nutrition. And he is a serious cyclist: between his undergraduate degree in agriculture and his postgraduate studies in exercise physiology, he raced competitively in Europe for several years.

These days his expertise ranges across sport science, human nutrition and physiology – the disciplines that claim know what works and what doesn't when it comes to exercise performance.

But how valid are their claims? The more Stannard rides, the more he questions.

Take the matter of whether it is best to train before or after breakfast. Stannard knew what the nutritionists thought from his time studying in Australia.

"I did my master's degree in human nutrition at the University of Sydney, and was supervised by Jennie Brand-Miller, who's well known for her research into the blood sugar response to carbohydrate meals," Stannard says. "I'd talk to her about carbohydrates and her belief that to perform one needed to consume loads of carbs before and during training and racing. That was the received wisdom at the time."

Stannard's experience was to the contrary. "When I was racing, we often used to train before breakfast, sometimes more than 100 kilometres on an empty stomach," he says. "We thought that by increasing the best metabolic stress it would 'teach' our muscles to burn fat."

He knew that he and the nutritionists couldn't both be right. "I realised that I could try to follow the prescriptions that the nutritionists outlined, but it just didn't work. In fact often the more carbs you ate, the worse you felt!"

Continued on page 14

Standing ovation

To stand or to sit: that is the question biomechanist Dr Philip Fink asked himself late one night while watching the Tour de France. He had noticed that some riders got out of their saddles for the climb up the Pyrenees, while others stayed seated.

Now, he hopes to find out the secrets to the art of climbing. He will use a pair of new, state-of-the-art, $40,000 cycle cranks paired with a high-specification bike donated by New Zealand bicycle manufacturer Avanti to test the forces applied to the pedals during a climb.

"These cranks are able to collect data that will tell us exactly what force is exerted on the pedals," Dr Fink says. "We'll link this data to a video image that will give us a precise impression of just how the rider is achieving power."

Current Tour de France champion, Spain's Alberto Contador, is famous for standing out of his seat as he powers up the hills. But Fink says other riders stay seated when climbing, with almost equal success. "Not a lot is known about the bio-mechanics involved, so we're looking to pinpoint where the power comes from – whether it be the hip, knee or ankle – at any given time. We will be able calculate whether it is technique, or strength in different muscle groups, that allows a rider to excel."

He will also measure such things as how the height of the saddle affects power and performance.

Riders will be monitored on a treadmill coated with a special ceramic paint that is also used by the United States' National Aeronautics and Space Administration on its space shuttles. "The treadmill is important because it allows the rider to do all of the things he or she usually would on the road," Fink says. "We want to get as close as we can to normal riding conditions, while still maintaining the type of control we need to collect the information. A stationary bike wouldn't be able to do this." ■

The state-of-the-art cranks used to gather force data

Above, Dr Philip Fink at work

At Massey, Stannard and his colleagues decided to put it to the test. They followed two groups of novice cyclists as they trained for a four-week period. The groups cycled for up to 75 minutes daily at a moderate intensity. One group ate a high-carbohydrate breakfast before training; the other trained before breakfast.

Before the training regime began, blood samples and muscle biopsies were taken from the legs of each rider. After the four weeks were over, more blood samples and biopsies were taken.

The results showed that those riders who trained before breakfast were ultimately able to store higher levels of muscle glycogen than those who ate breakfast just before training, and their peak power and ability to use oxygen (known as VO_2max) also showed greater levels of improvement.

Dr David Rowlands showing his mettle

For Stannard, this makes intuitive sense. "While performance is about being first across the line, training is all about putting the body under stress, and that doesn't necessarily mean going faster," Stannard says. "So by starting out with less carbohydrate fuel on a training ride, you will reach the point where you really begin to stress the body sooner. This means you will spend longer under stress and, providing you can recover, ultimately the training will be more beneficial.

"In an endurance event, such as road race cycling, the person who can start the race with the highest level of glycogen in their muscles, yet have the greatest ability to burn fat, has a huge advantage."

But in terms of burning fat there is a caveat. Stannard's initial trial had been with men and the fat–burning ability of their muscles improved when they trained on an empty stomach. However, when he conducted another trial, this time with women, the result was reversed. The women tended to improve their muscles' fat-burning capacity when they trained after breakfast.

Why the difference? Stannard suspects it has to do with differences in body fat distribution and sex hormones and the subtle difference these make to the way the muscles use their fuel.

In Wellington, Stannard's colleague Dr David Rowlands has also found differences in the way men and women respond to diet and exercise. The current national road cycling champion in the 35-39 age category, Rowlands was interested in the role protein played in the recovery of cyclists. He carried out a study on male cyclists, working them hard on the bike then giving them either a carbohydrate or a carbohydrate-and-protein meal afterwards, before their next workout.

He found cyclists who ate the protein meal performed 4 percent better in the later workout than those who did not. But in a following study, he found women did not seem to realise the same performance advantage.

"From the limited available information, it appears that because the protein turnover rate – rate of utilisation by the body – is lower in women than in men, trained women use less in metabolic reactions, and therefore need only about two-thirds the amount of dietary protein for an equivalent amount of exercise adjusted to fat-free mass and relative exercise intensity," Rowlands says.

He thinks women still benefit from protein in their diet to help them recover from training and adapt physiologically. "It's just they might have a different level from men; however, the question needs further study."

And if you are about to enter a race? Whether you are male or female, sensible eating will help. "There is a large amount of evidence supporting carbohydrate ingestion before and during prolonged exercise to increase endurance performance. In essence, this means that eating some carbohydrate before competing will help you go faster for longer during a race," says Stannard.

Stannard's finding that training before breakfast confers athletic advantages for men made the news worldwide. The reasons? One was that it contradicted the proclamations on the cereal boxes. How could the breakfast of champions be no breakfast at all – or, at the least, breakfast deferred?

In fact, the food aisles of the supermarket are filled with products making spurious health claims. Stannard says he and his colleagues at the school are in a constant battle to make the truths known about sport, science and nutrition. "In our area, everyone has an opinion, and it's hard to be heard above that," he says. "Whether it's the cereal companies or bottled water companies, everyone's got things to hawk, haven't they? At Massey I'm determined that we continue producing well qualified graduates who have a healthy dose of cynicism so they can sort fact from fiction to keep the public informed."

A rendering of the proposed velodrome on the Manawatu campus alongside, at right, the Sport and Rugby Institute

His other battle is to make sure that alongside the applied research – making athletes faster, stronger, fitter – there is also the room and the money for fundamental science. The piece of work of which he is most proud is a good example. "My most important piece of research was on starvation. My team was the first to show that if a physically fit person is starved, there's a shift of body fat from their 'spare tyre' to within the muscle cell, to ensure there's fuel there for the muscle to contract if it has to. This is a major physiological finding. There has to be funding found for work like this; it's not going to come from a food company!"

Stannard is the first to admit that taking part in one of his studies isn't for the faint-hearted. "It isn't a lot of fun. We work you to exhaustion and then take blood samples and muscle biopsies, and then we do it all again a few days later."

We work you to exhaustion and then take blood samples and muscle biopsies, and then we do it all again a few days later.

But he has never had difficulty recruiting participants. Locally, competitive cycling is thriving, and there is a strong club scene.

"There are plenty of wide-open and relatively quiet roads for people to train on, whether they're elite athletes or Sunday riders," he says.

What he would like to see more of is Monday-to-Friday riders. Want to get fit? Don't just join a gym, he says, bike to work.

"For most people the best way is to incorporate exercise into a daily routine. Travelling to work is the most common way to do this, so if you can ride your bike to work you can get your exercise in, you can cover a reasonable distance, and it hasn't taken time out of your day."

The region's cyclists, especially the younger ones, who want to take their skills to the next level may soon have a world-class facility in which to do it. Massey University is part of a group bidding to host New Zealand's Cycling Centre of Excellence.

Stannard says the centre would provide a living laboratory for ongoing research. "Our sports science group is already one of the leading cycling science laboratories in the Southern Hemisphere," he says. "A centre like this would provide the perfect focal point for our ongoing research and for nurturing cycling talent."

Which region will host the centre is expected to be made known early next year. Stannard has his fingers crossed. He thinks the strong cycling community, quiet roads and the presence of his own School of Sport and Exercise Science give Manawatu a strong case.

Until then, look for him in the early morning, out on the open road, the kilometres spinning by. He is hungry for his breakfast, and puzzling over some question that really should be looked at more closely. ■

Stanard's finding that training before breakfast confers athletic advantages for men made the news worldwide. The reasons? One was that it contradicted the proclamations on the cereal boxes.

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

the new black

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

In the first of two features, Malcolm Wood talks to MAF-Associate Professor in Soil Science and Biochar **Marta Camps.**

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

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

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

Marta Camps, who took up her position as MAF-Associate Professor in Soil Science and Biochar in January 2009, knows about building soils. In recent years she has been based in Bilbao in the Basque Country and worked in collaboration with the University of Santiago de Compostela. This is la España húmeda, 'wet Spain', its lushly green landscape similar to that of Ireland. But it is not without blemish. Bilbao's industrial prosperity lies in part in the region's history of iron mining.

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

The difference lies in a thin layer of what is known in the trade as a technosol: a soil created in large part from materials made or extracted from the earth by humans; components such as the sand, slag and iron oxides from foundries; the fly ash derived from biomass combustion; the shells from the seafood fisheries; and sewage sludge.

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

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

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

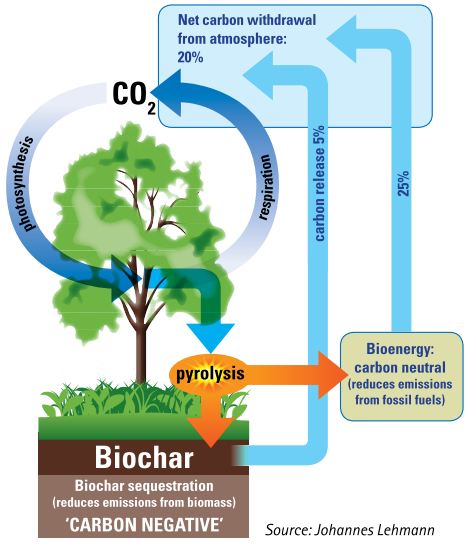
"We started reading Johannes Lehmann."

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

It was the early 1990s: global warming and the likelihood of its anthropogenic origins were causing increasing unease. Perhaps, Lehmann and others thought, one way of addressing a climate-altering rise in atmospheric CO_2, as well as realising a number of other substantial benefits, might be to learn to sequester it in the soil.

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

Here is a relatively simple, small-scale technology that goes beyond simply reducing emissions. This process uncouples the terrestrial carbon cycle as it removes carbon from it in a



Source: Johannes Lehmann

Amazonian terra-preta – an 'anthrosol' – a fertile, carbon-rich soil created by a human intervention: the use of char-and-burn over millennia. Photo courtesy of Professor Felipe Macias, University of Santiago de Compostela

form that can remain stable in soils for hundreds to thousands of years.

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

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

Lehmann and others thought one way of cutting back the climate-altering rise in atmospheric CO_2, and of realising other benefits, might be to sequester it in the soil as biochar.

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

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

"Australians are quite happy to spread biochar across Australia. It's dry and their soils are highly weathered and low in organic matter, hence biochar can make a difference."

In New Zealand's young and well watered soils, there is a risk that the added value of biochar to soil fertility might be modest. It is even possible that the unthinking addition of biochar could initially boost microbial activity to the extent that it leads to some decomposition of native organic matter.

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

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

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

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

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

Biochar in our backyard?

The Amazon basin has terra-preta, the Netherlands has the so-called plaggen soils, and it turns out that New Zealand too has a tradition of carbon-enriched man-made soils. Soil maps of Waikato show river terraces, with sunward facing aspects, covered in a charcoal-gravel mix, and Camps has excavated soil profiles that show a black topsoil – a rich mix of gravel, ash, charcoal and organic matter – blending down to heavier, less productive soils beneath.

The gravel, which improved drainage, allowing earlier plantings, was taken from borrow pits still visible as grassy dimples in today's landscape of paddocks and shelter belts.

According to Massey's Nick Roskruge, whose doctoral thesis examined traditional agricultural practices, the charcoal and ash derive from tightly packed bundles of wood and vegetation that would have been slow-burned to a charcoal-like consistency before being mixed into the soil, year on year building into the thick layers of carbon-enriched soils seen today.

Camps is fascinated by these soils. By dating their charcoal content she should be able to make statements about how long biochar persists, and by looking further afield – to Nelson and Kaikoura, where such soils are also found – she will be able to separate out the influence of climate.

The signs of Māori kumara cultivation: borrow pits and biochar-enriched soil profiles. Photos courtesy of Emeritus Professor John McCraw, University of Waikato

The New Zealand Biochar Research Centre is funded by the Ministry of Agriculture and Forestry, at whose instigation the centre was founded. Among the numerous agencies collaborating with the centre and making its work possible are GNS Science, Landcare Research, Plant and Food Research, AgResearch and the New Zealand Agricultural Greenhouse Gas Research Centre.

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

produced at a lower temperature – and it will also contain more ash, which, being alkaline, is useful in neutralising acid soils.

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

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

What good can biochar do? Activated biochar – charcoal treated to enhance surface charge – is, it turns out, good at accumulating cations (positive ions) on its surfaces, a process called adsorption.

A postgraduate student is working on activating biochar to better hold ammonium. This could lead to biochar soil amendments that prevent ammonium entering the water table, or alternatively, when preloaded with ammonium – perhaps filtered from wastewater – can be used as slow-release fertilisers.

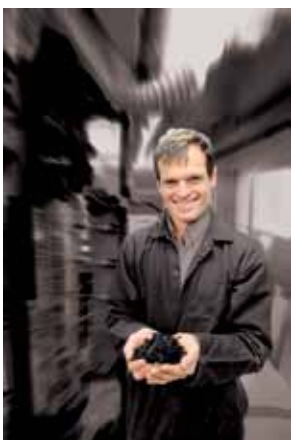
However, natural weathering when the biochar is added to the soil has much the same effect, naturally tending to increase the surface charge of the charcoal particles. As this happens, the biochar's 'cation exchange capacity' climbs, raising the soil's fertility and its ability to hold nutrients.

Professor Camps is intrigued by the processes that occur as biochar amendments weather and react with soils over time. One of the research projects she would like to pursue is the analysis and dating of carbon-enriched soils from historic Māori agricultural sites, using the results to elucidate the interactions between the particular biochar, the particular soil, and the local climatic record.

And the promise of all this? Professor Camps brings up an image of a number of plant-nursery sized containers of grass. They represent the sandy soil of profiles of nearby coastal Foxton. Two are particularly striking, a 'before' and 'after'. One shows the soil enriched with urea; the other enriched with urea and biochar. The grass definitely grows more lushly on the biochar side of the fence.

In spring 2011 she will begin field trials using biochar sourced from a purpose-built pyrolyser. ■

Around 40 percent of groundwater monitoring sites in New Zealand have levels of nitrate that are elevated above natural background levels, and one in 20 has levels hazardous to human health.

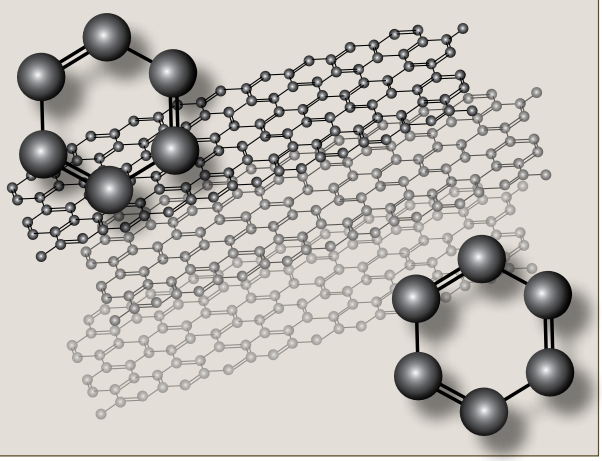


In the next issue of *definingnz* we bring you an interview with Professor Jim Jones, who has taken up the ancient profession of charcoal maker.

One ring to bind them

Why is charcoal so stable? In charcoal the carbon atoms are often found linked together in the form of lattices of hexagonal rings. These rings are often depicted as carbon atoms linked by alternating single (one electron shared) and double (two electrons shared) bonds. In fact, the bonds fall somewhere between, with the electrons circulating freely around the ring, a phenomenon, called 'aromaticity'. In charcoal these rings fuse – or 'condense' – together to form two-dimensional, honeycomb-like hexagonal latticeworks. This 'aromatic condensation' makes the charcoal extraordinarily stable.

In the ideal, biochar needs to be both stable and have enough surface charge to carry – or pick up – a freight of nutrients and interact with soil particles.



Under the SURFACE

Fascinated by the world's hidden places, ***Associate Professor Wayne Barrar*** *has photographed underground homes, mines, industrial parks, film archives and university campuses. He speaks to* ***Sarah Young*** *and* ***Malcolm Wood.***

Bed, spare room (underground house), Coober Pedy, Australia 2003

Drill line, new underground dwelling, Coober Pedy, Australia 2003

If you live in Coober Pedy, adding a spare bedroom means taking up not hammer and nails but jackhammer, rock drill and dynamite. The bonus: the chance of veins of precious opal.

In this parched mine-riddled landscape, the sensible place to live is underground. And people do; suburban frontages emerge unnervingly from rock faces.

This is where Associate Professor Wayne Barrar first discovered the underworld as a subject for photography. Power is expensive in Coober Pedy. Barrar's memories are of taking a series of time exposures by the light of 40-watt bulbs while being trailed by the house owner frugally turning off the lights in his wake. His photos show unrendered, rough-hewn rock spaces mixed with the trappings of everyday domesticity. Something about it entranced him.

That was seven years ago. Coober Pedy became the first in his series of explorations of humankind's use of underground space. Soon after, whenever his teaching and marking schedule allowed, Barrar sallied forth, with tripod and medium-format camera, to obscure subterranean locations in America, France, Australia and New Zealand.

The explorations became a project; the project, an exhibition; and now there is a book: *An Expanding Subterra.*

What did he and his camera witness? Wonderful things. The outline of a lemon-squeezer-hatted digger incised into the chalky wall of a French tunnel. A vast complex of man-made caverns 600 metres below the surface of an American desert gradually being filled with the debris of decades of nuclear weapon development. Hundreds of tarpaulin-shrouded cars. Hydroelectric plants from the 1960s that seem frozen in time. A crystal-clear underground lake inhabited by a solitary bass.

Barrar cannot be accused of taking conventionally pretty photographs. Nor does he shoot the stuff of Magnum-agency documentary photo essays.

His enduring interest is in the complex relationship between culture and nature: how humankind alters and shapes the surface of the Earth. Before he turned to photographing underground spaces, his subject matter included Whanganui riverbank retention and the phosphate-mined landscape of Nauru.

His almost clinical use of photography may owe something to his early days. As a boy he bought a camera he could use to take photographs down a microscope, developing the black-and-white photographs in the family bathroom, and his undergraduate degree was a BSc in zoology, back in the 1970s.

Photography then hardly existed as a fine arts option in university study, but there was an independent photography scene. Barrar became an active member of PhotoForum, an organisation promoting independent photography, and he took to reading the influential British journal,

Underground company frontage (ATP), Space Center, Kansas City, Missouri, USA 2004

Creative Camera, whenever it turned up in the public library.

Then, in 1975, came the landmark exhibition in the US, New Topographics: Photographs of a Man-Altered Landscape, which marked a turning point for international landscape photography.

Barrar terms it one of the two most influential photographic exhibitions of the 20th century. These were photographs that dispensed with such notions as beauty, emotion and opinion, displaying, instead, according to the catalogue introduction, "rigorous purity, deadpan humour, and a casual disregard for the importance of the images".

It changed the way he thought about photographic practice.

Something else unusual: the photographers were linked to higher education as students or academics.

Ten years later, Barrar too was linked to higher education, completing first a Postgraduate Diploma in Photography, then a Masters in Design while working as a newly appointed staff member at the School of Design in Wellington, later to become part of Massey University.

Earlier in his career, Barrar's interests in the human uses of landscape, the changes that result, and finally the attempts made at landscape restoration and rehabilitation led him to photograph open-cast mine sites in New Zealand, Australia and the US.

But most of the world's mining happens underground, out of plain sight. Barrar was interested in these spaces and what happened to them when they were depleted.

Hence the visit to Coober Pedy: a wonderful example of what can happen to that depleted space. Here the tradition of mines-as-dwellings stretches back to soldiers returning from World War I. On the Western front they had lived in trenches and dugouts, taking shelter from shell fire. In Coober Pedy, where summer temperatures can range from 35 to 47 degrees Celsius, the shelter their new homes gave was from the heat: the near-constant underground temperature of 20 degrees Celsius makes for comfortable living, says Barrar.

After Coober Pedy, Barrar began actively looking for mines that were "reused or retrofitted, instead of being capped off, as most mines are".

In Missouri and its neighbouring states he found what he was looking for, reused underground space that extends to more than 400 hectares. This is where the iconic image Barrar has used for his cover comes from: an industrial park called Subtropolis, "a nice science-fictiony name, and it has that feel when you get there".

More than 50 companies work in Subtropolis, deep within a hillside, in what Barrar terms "commodified space" – space that can contain all manner of things, from light industry to recreational facilities (Barrar has photos of a paintball battlefield), to, very commonly, storage.

More than 50 companies work in Subtropolis, deep within a hillside, in what Barrar terms "commodified space".

Continued page 26

Clockwise from top: Associate Professor Wayne Barrar and exhibition print; Kiosk, Carlsbad Caverns, USA 2006; Raw unfinished cavity, salt mine, Hutchinson, USA 2004

Notes from the UNDERGROUND

Before you take your underground photographs, there is first the small matter of gaining permission. Barrar may have gained access to a restricted nuclear waste repository, but he was not always so successful.

"The response was either very good or none at all – not much in between. Most people when they did allow me access were very helpful, and would provide people and transport to get around the spaces."

One site had put together an official welcome sign for its distinguished guest. But not everywhere let him in. That modern-day bogeyman, terrorism, was one reason given for denying access.

"This included a very large hydro station in Australia, which given that I'm a university based-researcher in New Zealand seemed a little odd…"

In working mines his kit, as well as camera and tripod, would include emergency air supply, helmet, headlamp and batteries, overalls, and protective footwear.

Generally, there would be low-intensity lighting in place. At times his photos – tripod-mounted exposures of up to 30 minutes duration – would be lit by fluorescent lights, halogen bulbs, ordinary bulbs, the headlights of the golf cart in which he was travelling, or miners' headlamps. Partly by choice, partly from necessity – electronic devices being prohibited in coal mines because of the risk of gas, for example – Barrar has generally not used flash. The images taken in France's Arras tunnels are the exception.

Barrar prefers his photographs people-free. "If people are in there, the eye tends to go straight to them, and you start thinking about them, about their work… you tend to be a bit more analytical about the space itself when you're looking at empty space."

But Barrar's underground environments are in use when his shutter is open, and people do crop up, appearing as ghostly blurs or sometimes the neon-tube-like trails traced by their headlamps.

"When you view a big exhibition print it looks really strange – like big, hard, bent metal tubes of light – and all they actually are is little headlamps. You get the same effect with the headlights of moving vehicles down there too."

Back in Wellington, Barrar's photographs were scanned to produce digital files that he and a skilled phototechnician then colour-corrected and prepared for printing. "Without this time consuming but crucial work the prints would come out in all sorts of weird [artificial light] colours – strange blues, oranges and yellows and unfortunately not particularly appealing."

Often a photograph would take half a day to perfect. "Being shot on large negatives, some were really tricky – sometimes it took me several concentrated hours just to remove spots or remove dust marks from the high-resolution scans."

The digital files used to generate the 1.5-metre-wide prints for Barrar's Dunedin exhibition ranged from 400 to 1000 megabytes in size.

"We found when we started working on exterior landscapes again [with natural light], it seemed really easy in comparison to the artificial underground!" »»

Height survey, Huntly underground coal mine, New Zealand 2005

Transuranic waste remote handling insertion machine (underground salt walls), Waste Isolation Pilot Project, New Mexico, USA 2006

The Cold War is over, but its toxic physical legacy is near-eternal. Take plutonium-239: store it for 24,000 years and half of the original amount of plutonium will remain highly hazardous. And in transforming uranium into plutonium for bombs, the US produced huge quantities of waste contaminated with transuranic (higher in atomic number than uranium) elements like this.

Where, then, do you safely store transuranic wastes for a period longer than recorded human history itself? Deep beneath New Mexico's Chihuahuan Desert in a purpose-built cavern complex carved into a 3000-metre-thick salt bed is one attempt at answering this question: the Waste Isolation Pilot Project (WIPP).

For Barrar, it was essential that he see it. But before he could descend the 655 metres down into the Earth (the equivalent of two stacked Auckland Sky Towers) there was a marathon of documentation, security clearances, days of travel, and above-ground lectures. Even so, he points out, he was allowed in.

"It might seem a little strange I suppose, when there is all this waste there from the military and no public access, but the Federal Government has a policy of letting in a certain number of people to help educate the public about what it is doing…and even though I was from New Zealand, what I was doing was still deemed to be useful."

WIPP holds lower-level waste – gloves, tools and equipment that have handled radioactive materials, contaminated clothing and rags, radioactive debris and soil – collected from throughout the US on special rail shipments. More than 5000 loads have already been processed since disposal started in 1999, and it will continue to take waste until 2070.

Huge trucks deliver the waste down a long, winding road into the underground, where it is stored in steel drums lined up in one cave-like room after another. Barrar was driven through the complex in an oversize electric buggy resembling something you would see on a golf course.

He remembers it as a very formal, sanitised – and short – visit: he was underground for about an hour. "Your visit is very structured – there's not much chance to deviate from what they want to show you." A request to view the rooms where the drums were stored drew a short, sharp "Not today sir".

But he did see and photograph the passing of a convoy of trucks carrying drums of the waste. "Everyone had to get out and literally stand there and wait for it to go past. It was a weird feeling watching as it was being delivered into and through the underground – it's almost like some kind of strange ritual in a strange space."

He also saw where higher-level radioactive waste is inserted into the pure salt walls. "They simply drill a big hole into the wall, insert the drums, and then a stainless steel cap is put over it. Another hole is drilled next to it and so on. It's certainly sealed in." Over a span of time, the same thing will happen naturally to the stacked barrels.

"When they cut the spaces out [of the salt layers], the roof immediately starts to droop. Over the years, it'll sag right down and close over the drums. And when the whole interior space is filled, they'll seal it off, and the sagging salt roof will sag down around the drums and seal them in further.

"Eventually the drums will no doubt break and crush but by then the contents will be encapsulated in thousands of feet of solid dry salt. [The government's view] is that it's better to be storing it in one place properly rather than all over the country in old untested facilities from the 1960s. So however you feel about the waste, you've got to feel reasonably positive about WIPP because at least it's making this stuff sometimes referred to as 'heritage waste' safer and everyone knows where it is. And it's definitely way, way down."

Carrière Wellington/Arras tunnels (lemon-squeezer-hat graffiti), France 2009

In 1914 the small French town of Arras had the misfortune to find itself on the wrong side of the front line in a stalemated war. Stymied above ground, the Allies looked elsewhere. In November 1916 the men of the New Zealand Tunnelling Company began work. In their civilian lives they had mined for coal or gold (their commander complained that his life was not made any easier by the fact that he had 17 trade union secretaries answering to him); now, sometimes working 18-hour shifts, they burrowed into the chalk. Others had been there before them. The ground beneath Arras is riddled with tunnels, cellars, sewers and chalk quarries dating back to medieval times, with which the Allied tunnels would link.

New Zealand Tunnellers Monument (2007), Arras, France 2009

Eventually the network would extend to 20 kilometres, be capable of holding 24,000 men, and feature running water, electric lights, kitchens, a light rail system and a hospital. The miners gave the tunnels the geography of home – in the north were quarries called Auckland and Wellington; in the South, Nelson, Blenheim, Christchurch and Dunedin.

"So when you visit it now," Barrar notes, "all the signage and wall markings relate to New Zealand. Carved into the wall are the names of miners and soldiers, so there are a lot of familiar New Zealand (often Māori) names. There's even some wonderful graffiti of a man wearing a lemon-squeezer hat so there's that sense of the ANZAC tradition or feeling too."

Eventually, in the course of one extraordinary morning in April 1917, thousands of troops stormed out from the tunnels, moving forward under the cover of an artillery barrage to take the German front lines.

Rediscovered in 1996, the tunnels now host the 'Carriere Wellington' museum, which opened in 2008.

Barrar found his nationality held him in good stead. One local told him: "the reason we liked New Zealanders so much is because they came over here and they actually worked, rather than just sort of… occupying".

"People were extremely friendly because I came from Wellington," says Barrar. "Just a little while before they'd had [Wellington Mayor] Kerry Prendergast visit and they were also getting ready for a visit from the Mayor of Waihi. There's a lot of interest in the tunnels, their links to New Zealand, and of course to the battle sites and military cemeteries near Arras and Lille." ■

I am interested in other secured spaces . I am looking at issues to do with New Zealand's biosecurity. That includes archiving, quarantine, biological control spaces... that kind of thing.

WEB VIDEO **Under the Surface**: a conversation with Wayne Barrar
http://mediasite.massey.ac.nz

Bowfishers returning with the catch at Lake Waahi, Koi Carp Classic 2007

Continued from page 21

The stable temperature and humidity makes former mines good candidates for storing film and computer media.

Subtropolis has been quarried out for limestone, and Barrar found that a number of the 'commodified spaces' that he visited still sustained active mining operations at their peripheries. Salt mines, for example, would spring into action as the North American winter drew near, so that salt could be stockpiled to de-ice roads.

Now his interest took another shift. He had seen mines that had been reused – what would mines that had existed for so long that they were almost permanent structures be like? He headed to vast Mount Isa mine in Queensland to find out.

"These mines are so large that they have crib rooms, workshops, garages and recreational areas. It's like a vertically structured town. I was interested in recording the ways people adapted to such spaces – particularly the vernacular architecture that emerged."

He remembers in one facility descending by elevator 150 metres into the Earth, to be greeted, when the doors opened, with a classic office interior and someone offering him a glass of water.

At Mount Isa mine he would commute through the workings by Toyota Land Cruiser, at one point being driven through an archway where a sign announced that they were now a mile underground.

Here the walls were warm to the touch. But, again, this lead, zinc and silver mine, like the salt and limestone mines, felt like a secure environment.

Coalmines, on the other hand (Barrar visited the Huntly coal mine), are another matter. "Coalmines are quite unstable – they crack and spit bits of coal at you. They feel like they're quite fragile places and in fact they are – miners constantly test for methane gases and things like that. You don't get the same feeling that you are in a permanent dwelling like you do in the other 'hard rock' mines."

Other underground environments Barrar photographed for Subterra include caves (the restroom in Carlsbad cavern is featured), a nuclear waste repository (see page 24), an underground university campus, hydro stations in New Zealand and Tasmania, and the tunnels excavated by New Zealand troops under the French town of Arras during World War I (see page 25).

It has been an extraordinary odyssey, and you sense that, now the project is done – the exhibition mounted, the book published – Barrar is pleased to have emerged into the sunlight.

And now? "I am interested in other 'secured spaces'. I am looking at issues to do with New Zealand's biosecurity. That includes archiving, quarantine, biological control spaces... that kind of thing.

"It also returns me to the landscape, where I am looking at the effects and consequences of invasive species."

Recently Barrar exhibited some of these works at Wellington City Gallery. One is a multiframe photo of dead koi carp being tossed into 'Storman Norman', a tractor-mounted mincer. Their bodies are a vibrant orange, as is the mass of minced up fishing berley that flows into wheelbarrows.

Another work shows koi unceremoniously mounded on a lake foreshore.

A destructive pest in New Zealand's waterways, koi carp commands high prices as an ornamental species in places like Japan. The difference in value of this fish in different regions (and landscapes) is part of what motivates Barrar's interest in this ecological study.

It is an arresting image, matter of fact, yet ambiguous. Even, in some ways, beautiful. ■

AN EXPANDING SUBTERRA
Wayne Barrar photographer with essays by David Pike & Aaron Kreisler
Dunedin Public Art Gallery
Hardcover $55

Native affairs

The Warbrick brothers from the 1888 New Zealand Natives rugby team, played by Mitchell Nikora-Baker (Alf), Pere Durie (William), Calvin Tuteao (Joseph), Francis Kora (Fred) and Meihana Durie (Arthur). *Image courtesy of Legacy Films Ltd*

Brothers playing brothers could be a subtitle for the short film *Warbrick*, which celebrates New Zealand Māori rugby's beginnings.

It tells the story of unsung rugby hero Joseph Warbrick and his four equally sporting siblings who were members of the 1888 New Zealand Natives rugby team, which played 107 matches on its tour through New Zealand, Australia and the British Isles.

The 12-minute film was written and directed by Massey graduates Meihana and Pere Durie, who also appear before the camera.

"Initially, we didn't have any desire to act in our own film," Meihana says.

"There were a small number of actors who were called away at the 12th hour for commercials and feature film shoots and we realised we'd run out of options. In the end, however, stepping into these roles seemed the right thing to do. We also knew we needed 15 players to make up the team. It was good to have the opportunity to be in the film and be one of the Warbrick brothers."

Warbrick won the Aotearoa Short Film Audience Award at the 2009 Wairoa Māori Film Festival, was honoured with the Teueikan prize at the Montreal First People's Film Festival in Canada in June of this year, and has been accepted for screening at the Cinema des Antipodes St Tropez Film Festival in October and the Toulouse Short Film Festival in November.

Members of the All Blacks viewed *Warbrick* at a special screening in Wellington. "Not a lot of people know about the Natives' tour. I did, but I didn't know they played over a period of 18 months and more than 100 games," said captain Richie McCaw. "The haka we do now, I didn't know they did it back then."

The brothers came upon Warbrick in Greg Ryan's 1993 book *Forerunners to the All Blacks*. "Pere found it in a second-hand book shop and started reading it, then I read it and we started doing more research into the team at the New Zealand Rugby Museum in Palmerston North," Meihana says.

Pre-production research by the brothers confirmed that captain Joe Warbrick was central to the story of the Natives' rugby tour.

"It was the first tour of its kind and preceded the All Blacks by several years," Meihana says. "The film's purpose was to unlock the mysteries behind some of the well known All Black traditions of haka and the silver fern."

Calvin Tuteao (who played Dr Victor Kahu in TV's *Shortland Street*) plays the lead, and the brothers sought support from the Warbrick whanau for their idea.

"We wanted to give New Zealanders an opportunity to see a story that is part of our nation's history."

Warbrick and his brothers also figure elsewhere in New Zealand's history, being part of the rescue efforts in the aftermath of the Mt Tarawera eruption of June 1886, which destroyed the famed Pink and White Terraces. Joseph died in 1903 after venturing too close to the Waimangu geyser, which erupted unexpectedly.

Meihana Durie has a Bachelor of Education and is completing a PhD in Māori studies while lecturing at Te Wananga o Raukawa in Otaki. Pere, from Tauranga, has a Bachelor of Arts in media studies and communications and teaches at Tauranga Boys' College. Their parents are Deputy Vice-Chancellor Professor Sir Mason Durie and recently retired Professor Arohia Durie. ■

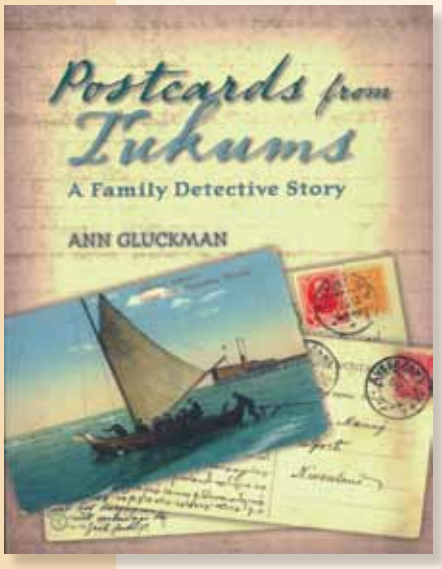
Postcards from Tukums: A Family Detective Story
Ann Gluckman, David Ling Publishing
Paperback, RRP: $45
Reviewed by Jane Tolerton

All New Zealanders are immigrants or the descendants of immigrants.

While Māori often know their genealogy, many Pākehā New Zealanders would be hard pressed to name their great grandparents. Try all eight of them.

And it is often hard to find out why ancestors came to New Zealand. Clues to the back story are elusive.

As Ann Gluckman writes in her book *Postcards from Tukums: A Family Detective Story*, "It seems not uncommon that first-generation immigrants do not reveal much of their previous history to their children. Parents break from their past in order to give their children a new life. A generation or more on, the stories from an often-tragic past become confused, and that past limited to a few incidents. Now I believe such an effort to protect leaves the descendants lacking a history, and in this troubled world, much of the past is virtually irretrievable, even in the age of the internet."



Ann says it was understood that she should not ask questions about the past. "It was never the right time to talk to [my mother] Augusta about the past. It was always later." She remembers that if she asked her grandmother, Yetta, about the past, she would cry.

Later, luckily, in spite of this silence, Ann found three ways of retrieving the past: a bundle of postcards, an oral history of her mother done in 1987 by Shirley Ross for a Jewish oral history archive, and a clutch of letters that were found in a cardboard box carefully hidden in the eaves of the Remuera house in which the family had lived for three generations.

Postcards from Tukums tells the story of Ann Gluckman's grandparents, Adolph and Yetta Manoy, and her parents, Augusta Manoy and Samuel Klippel. The family were from Latvia, then part of the Russian Empire, although they spoke German.

Arriving in Wellington in 1904, Adolph Manoy settled in Stratford where he opened a drapery shop. It took him six years to save enough money to bring Yetta and their three daughters over. They were shocked. As Augusta said in her oral history, "After the beauty of the Baltic, it was like standing in a desert… because in those days the only beauty you could see in Stratford was Mt Egmont… all you could see was burnt-out trees where we were and it was very depressing."

The postcards that came from back home are reproduced in this book, along with their translated (from German, Russian, Hebrew and Yiddish) messages. Augusta's letters home were kept by her parents and sisters, and inform Ann's narrative.

Augusta went to medical school in Dunedin in 1917. She worked at Southland Hospital then went to study in Vienna. In Sydney, on the way, she met the man she would marry – Samuel Klippel. They wrote devoted letters, which are quoted from in the book. They married in Stratford in 1926 and lived in Australia and England – where Ann was born – before settling in Auckland.

Augusta's spirit shines out of the book. Her husband-to-be tells her she is "the ideal of Jewish womanhood, the

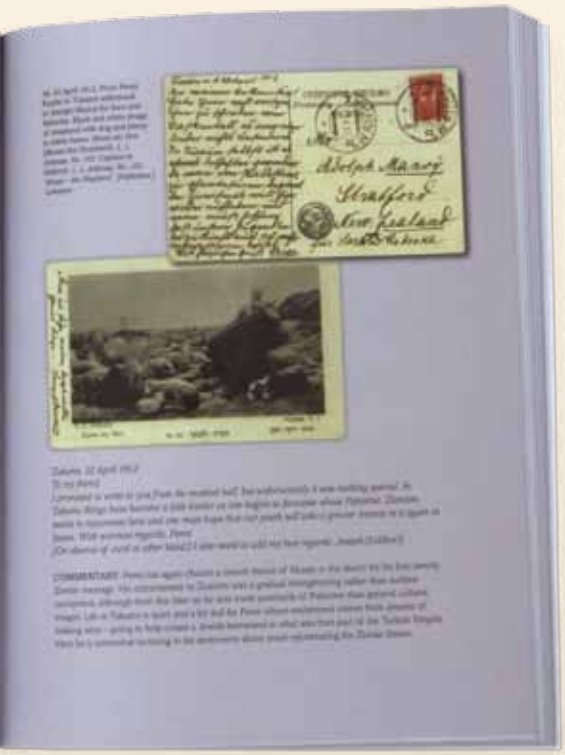
Ann Gluckman

Ann Gluckman, now 83, was the first woman to be appointed principal of a New Zealand state co-ed school – Nga Tapuwae College in Mangere, now part of the Southern Cross campus, in 1975.

She was born in London, in a house owned by Virginia Woolf's husband Leonard. She wanted to be a marine biologist and started a Bachelor of Science degree. "My mother said I should be a teacher of English and Latin and I rebelled against her by studying science instead."

She married Laurie Gluckman in 1926. When he was diagnosed with tuberculosis, five months before she completed her degree in geology, botany and zoology, she had to take time out from university. "There were no extramural studies then. I didn't get back to university until I had four children, at the age of 32."

The geography timetable was the one that meshed best with family life, and she graduated with a BSc in 1962



courageous girl with the great heart". Her daughter writes, "She was the undoubted head of the house: my father was the provider; Augusta the decision maker."

In 2004 Ann's son Philip handed her the box of letters – which she realised Augusta would have been too short to have put under the eaves herself. The man who translated the old German of some of the postcards from friends and family in Tukums gave her the idea of putting them together into a family history

This is a book full of regret – "I was profoundly upset by the letters and the tape: why hadn't she talked to us of the past?". And of celebration: "I have found my roots". ■

and an MSc in 1964. Her thesis was on The Climates of Auckland.

Shortly afterwards she found herself teaching at her old school, Epsom Girls' Grammar.

Ann was foundation Jewish co-President of the Auckland Council for Christians and Jews, and was on the first Middlemore Hospital Ethical Committee.

She has a Diploma in Educational Administration and a BA in religious studies, both from Massey University. She served on the Massey University Council from 1987 to 1990, elected by the Court of Convocation. In 1990 she was awarded the OBE for services to education and the community.

Her eldest son, Professor Sir Peter Gluckman, is the Prime Minister's Chief Science Advisor. John has climbed the highest mountain and run a marathon in every continent, and Philip is a general practitioner in Auckland. Her youngest son, David, was killed in a car accident at 21.

Cinéfile

Graeme Slater
Media studies lecturer

Can you name a film that changed the way you view the world?

On the Waterfront was the first film that I formally studied during my undergraduate degree. Prior to that I enjoyed film but never really analysed or looked at it in any depth. This was the film that opened my eyes to a different world, one with which I have become more and more engaged. I still enjoy the movie today.

If you were to recommend three films to friends and relatives, what would they be?

This is a bit more tricky – because not everyone sees films through the same eyes – but I would probably guide people to *Casablanca*, because it is such a brilliantly made film. I think everyone needs to see it. Then I'd choose the *Shawshank Redemption*, because even though it is populist I think the narrative is brilliantly woven. Finally, I would recommend a Western, probably *High Noon*, because Westerns are so good at telling simple stories and doing so simply.

What is your favourite line of film dialogue?

It is not a line but a word: "Rosebud" from *Citizen Kane*. "Rosebud" speaks loudly to people who are into film and says nothing to people who aren't.

Who is your favourite actor and why?

Morgan Freeman. I have enjoyed most of what he has done and find him a convincing actor in almost every role he plays.

What is the most recent film you have seen?

The Girl Who Played with Fire is the most recent film I have seen. I found the first of this trilogy, *The Girl With the Dragon Tattoo*, engrossing, complex and a little disturbing, and *The Girl Who Played with Fire*, the follow-up, even more so. I was surprised at my own reaction to what is a subtitled film. Now I am waiting apprehensively for the third in the series. I hope the English-language version that is being discussed does not destroy a brilliant narrative, and I am debating whether I should read the books now or later.

Casket presented to Prime Minister William Ferguson Massey on being accorded the Freedom of the City of London, 6 November 1916

This splendidly elaborate casket, bringing together what would be an odd combination today of nationalism and imperialism, was presented to Prime Minister William Ferguson Massey on being accorded the Freedom of the City of London in 1916, at the midpoint of the war to end all wars.

When Britain declared war against Germany, Massey's response on New Zealand's behalf was swift and unequivocal. "All we have and all we are," he cabled the imperial authorities, "are at the service of the King." But expectations in some quarters that it would all be over by Christmas were soon dashed. The Gallipoli campaign ended ignominiously in December 1915, at the cost of 7473 casualties, and, when Massey accepted the Freedom of the City of London, men were still dying in the final days of the battle of the Somme. It would be another two years before the armistice of 1918.

During the ceremony, the Lord Mayor paid tribute to the gallantry of both the New Zealanders and the Irish, and Massey – who was Irish-born – responded in kind. "As a resident of the Dominion, it is not for me to boast of what has been done, but I glory in what has been accomplished, and the brotherhood which has been established between the different parts of the Empire."

In the northern spring of 1917, Massey took part in a meeting of the Imperial War Cabinet. He returned to New Zealand in June after a 10-month absence.

The tradition of presenting elaborate caskets containing illuminated scrolls goes back to medieval times or earlier. This one was made by the Crown Jewellers Garrard and Co and features a number of distinctly New Zealand symbols: the koru motif around the edging, probably based on designs published in A Hamilton's *The Art Workmanship of the Maori Race in New Zealand* (1896-1901); the superbly realised figure of the New Zealand soldier in full battle kit, probably modelled from life; the Māori warrior, less realistic but typical of such representations of the time; and, of course, the New Zealand coat of arms. The side panels feature London scenes photographically printed onto porcelain, while reigning over all stands the British lion. The casket contains 26 ounces of 18-carat gold and 100 ounces of silver gilt.

In an act of great generosity, the casket was presented to Massey University by the Massey family in 1977 as part of a collection of gifts given to William Massey during his time as Prime Minister .

Incidentally, the Freedom of the City was accompanied by another of-its-time gesture. The New Zealand soldiers who made up the guard of honour were presented with their own souvenirs – boxes of cigarettes bearing the City's arms.

Bronwyn Labrum

Dr Bronwyn Labrum is Director of Research in the School of Visual and Material Culture

Cherished illusions

In the first of a series of articles, Associate Professor Wyatt Page looks at why you shouldn't always believe your eyes.

Have you ever heard voices in the sound of running water, or felt the ground sway for a while after getting off a boat? Have you seen a mime artist walk into an invisible wall? These are examples of sensory illusions or distortions of our senses. Knowingly or unknowingly, our brains often make assumptions about the world based on incomplete or noisy sensory information, and this can lead to a mismatch between reality and what we perceive. Investigating why sensory illusions occur can give insight into how the brain organises, processes and interprets sensory stimulation. In principle, all our senses can be fooled into creating an illusion. Relatively simple senses like olfaction (smell) typically have to work in conjunction with another sense to generate an illusion, whereas more sophisticated senses such as audition (hearing) or vision can experience illusions directly.

Visual illusions (often called optical illusions) are by far the most widely researched and understood of the sensory illusions. There are three fundamental stages in sensory processing: sensation (referring to immediate experiences generated as stimuli fall on our sensory system); perception (involving the interpretation of those sensations, giving them meaning and organisation); and cognition (involving the acquisition, storage and retrieval, and use of information).

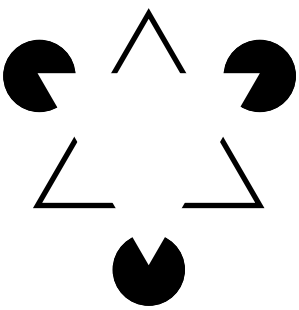


Figure 1

For the Kanizsa triangle, figure 1, ask yourself: What do you see? What part is sensation? What part perception? Is there cognition involved?

For the human visual system, these three processes form a hierarchy of tasks that build one on top of each other and allow our brains to construct worlds inside our heads based on visual samples from the surrounding environment. Visual illusions can broadly be broken into two classes, those that are perceived immediately (within a single glimpse) and those that take longer to see. The more quickly the illusion is perceived the more it is the result of early visual processing. Visual illusions that take some time to be perceived will generally involve higher-order processing by the brain.

The human eye is quite remarkable; it contains both monochrome (intensity only) and colour photoreceptors. There are around 100 million of the very sensitive monochrome (rods) sensors in the retina, but these only get used for night vision. This means that most of the time modern humans are only using the 6-7 million colour (cones) receptors for vision. In an age of low-cost digital cameras with 10-megapixel or more resolution it doesn't sound like much. However, unlike a digital camera, the distribution of the photo-receptors in the eye is non-uniform. The most densely packed region is called the fovea and contains around 120,000 cones (and no rods) and occupies only about five degrees of our visual field. The density of receptors drops off in an approximately log-polar distribution. By the time one gets to the periphery of our vision, there are very few receptors. Hence the resolution of our vision varies dramatically across the field of view.

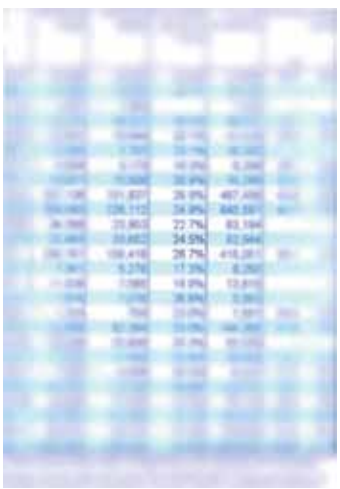
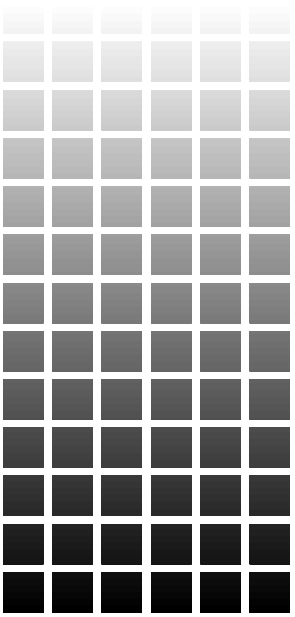
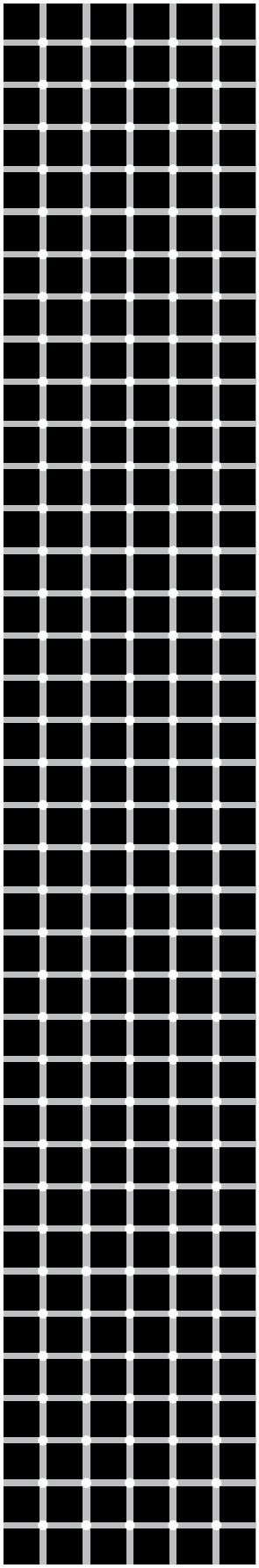


Figure 2

So if you were looking at the figures in a spreadsheet, the retina would see something like figure 2, where only a few of the figures in the centre are sharp and of high resolution. To compensate for this lack of global resolution, the eye continuously moves the high-resolution spot to where it is required, fixating in defined patterns call saccades. The eye has a thin layer of interconnected neurons built into it that preprocess and code the information from the retina before sending it to the visual cortex via the optic nerve.

Wyatt Page is the Associate Professor of Acoustics in Human Health at the Massey Wellington campus. He has more than 17 years experience in academia, mainly in engineering and technology programmes. Before taking up his current appointment, he spent six years designing, developing and delivering a major in multimedia systems engineering in the Bachelor of Engineering programme. His research interests cover everything from surround sound for immersive environments to environmental noise and its impact on human health.





It has been known for a long time that a simple line sketch of an object is generally sufficient for the visual recognition of the object. To produce a line sketch from an image, the intensity changes associated with object/background boundaries need to be identified. In computer vision this is commonly called edge detection. The neural processing built into the eye combines photoreceptor signals in a number of ways that respond to and even enhance intensity changes. For example, over 30-degree orientations it computes first- and second-order differences of intensity. This means that when there is an intensity change, your vision measures its strength and orientation.

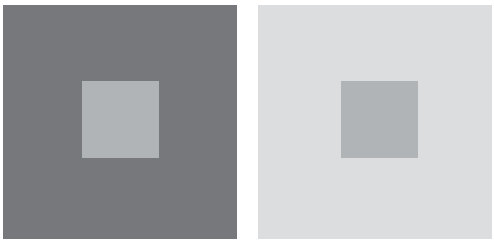


Figure 3

Psycho-physics, the scientific study of the relation between physical stimuli and sensation, was all the rage in the mid-1800s when much of the early work on human vision was done. Figure 3 shows an illusion of simultaneous contrast. Both of the small grey squares have the same intensity but the background intensities are different. The small square looks lighter on the dark background and darker on the light background. This is because our vision responds to differences in intensity and not absolute intensity. The first law of psycho-physics was derived from this illusion, which demonstrates that the photoreceptors have a logarithmic response to light intensity. If you recall from high school, logarithmic quantities have some desirable properties. Adding two logarithmic quantities is equivalent to multiplying the original values whereas subtraction is equivalent to division of the original values. The subtractive property is very useful when computing ratios of intensity at boundaries. To enhance intensity changes at boundaries, the neural processing in the eye suppresses nearby intensity changes (called lateral inhibition).

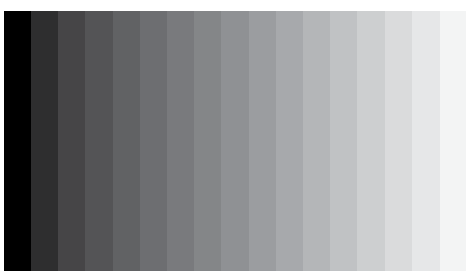


Figure 4

Figure 4 shows the Mach-band illusion resulting from this process. The vertical bars in the figure are of solid intensity and progress from black to white. When there is a transition from a darker to a lighter bar, there appears to be an extra-bright rim at the transition, whereas when there is a transition from a lighter bar to a darker one, there appears to be an extra-dark rim at the transition. Combining these two properties results in the 'Halo and Smoke' illusion of figure 5.

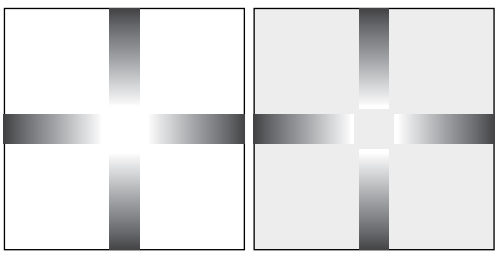


Figure 5

The left-hand image is on a white background and the centre of it seems to disappear in a halo, whereas the right-hand image is on a light grey background and there seems to be a smoke ring in the middle.

Figure 6 shows the Herman grid illusion of 1870. This illusion is the result of the previous two effects combined with the fact that the eye has varying spatial resolution and that it is continuously moving. If you focus on the middle of the image and fix your gaze, there should appear to be small light grey circles at the intersections of the grid, except for the intersection directly at the middle of your gaze. If you allow your eye to

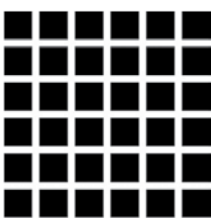


Figure 6

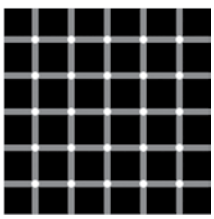


Figure 7

roam about the image the illusionary grey circles move about. An even more striking version of this illusion was created by E Lingelbach in 1994. In this illusion, shown in figure 7, the background is grey and small white circles have been placed at the intersection of the grid. If you hold your gaze very steady in the middle of the grid, all but the white circles in the centre of your vision will disappear. As soon as you relax your gaze and allow your eyes to move to another location in the grid, some of the white circles appear to turn black. If you continue to scan the image, the white-black flipping occurs all over the place and if you are not careful you'll get a headache.

As strange as these illusions are, you are unlikely to encounter them in everyday life as they

rely on supra or extreme intensity differences. I mentioned earlier about the importance of finding boundaries in images in order to find the edges of objects for later identification. The early vision processing built into the eye only provides information called edgels to the visual cortex. You can think of these as being tiny fragments of what will become edges. One of the first layers of the visual cortex is responsible for connecting the edgels in an attempt to complete the edges of objects. Joining the edgels may sound straight forward, but this is only true if you know what it is you are drawing in the first place – and at this stage of visual processing you don't. If there is a nearby edge that crosses over the one that is being traced by connecting the edgels, there is opportunity for misinterpretation and what is called bias in intersection.

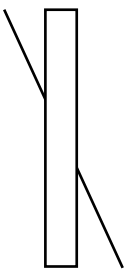


Figure 8a

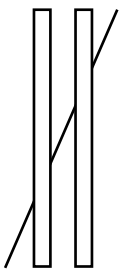


Figure 8b

The simplest example of this illusion is from Poggendorf in 1860. Figure 8a shows a rectangle with a straight line on an angle, passing through it. Part of the line is obscured by the rectangle and the two sections of the line appear to be disjoint. If you place a ruler along the line segments you will find they do line up perfectly. If there are two disruptions as in figure 8b, the line appears to be broken into three disjoint sections. The more acute the angle, the greater the illusion, and at right angles there is no illusion at all because there is no ambiguity at the intersection.

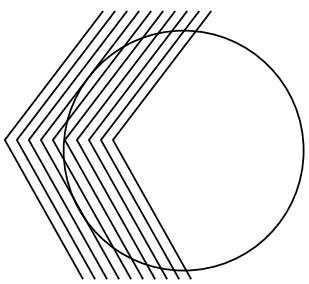


Figure 9

If the edgels trace a more complex shape, such as a circle, they can be thought of as small arcs that must join together. If, however, there are lines nearby that cross over the circle, the arcs will be biased towards the lines, and the more acute the angle of intersection, the greater the bias. Figure 9 shows the Luckish pattern illusion of 1865: a circle that appears distorted where the lines cross over.

In the Ehrenstein illusion of figure 10, the shape in the middle is a perfect diamond (get your ruler out and check).

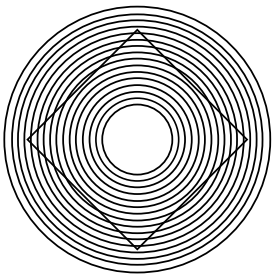


Figure 10

Probably the most striking illusion due to bias in intersection is the 'Cafe Wall' illusion discovered by Emeritus Professor Richard Gregory in the early 1970s while having a coffee outside his favourite cafe. All the lines in figure

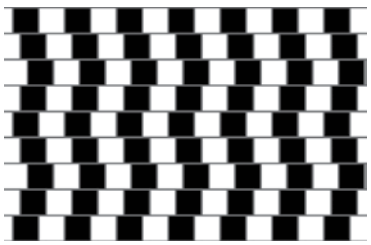


Figure 11

11 are straight, honestly! The illusionary waves in the lines are caused by edgel-linking over a wide range of scales.

I'll finish this first instalment of sensory illusions with a visual proof. The coloured blocks that make up the top triangle of figure 12 have been shuffled around into a slightly different configuration to create the lower triangle. But where did the extra square come from in the bottom of the triangle? ■

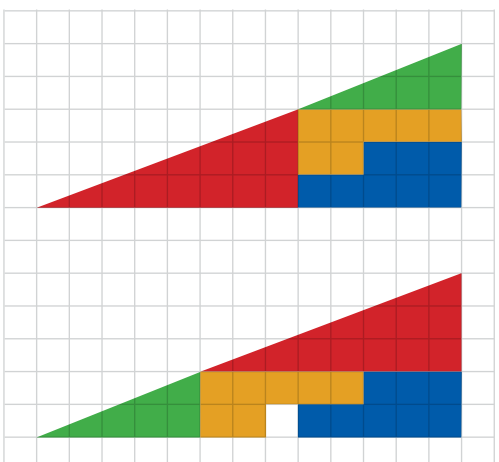


Figure 12

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ki Pūrehuroa

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Our lives are shaped by the discoveries we make

Forever discovering