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122

Michael Walker – science and the sea

Lynley Hargreaves

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Front cover photos Top. Cleaning the catch, Waitemata Harbour. Bottom, No need for this bird to ask directions. © New Zealand Herald

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A personal vocation for science

Michael Walker has always had a strong desire to achieve. But achieve what? “The only thing I could see was that I was never going to be an All Black or a Black Cap,” he says. “Once I realized that, I never really wanted to be anything except a scientist.”

It might have been partly the teaching of Mr Hoddle, Michael’s science teacher at intermediate school. “What hit me with him was the way he presented ideas that made me change the way I thought about the world,” he says. They looked at things like how air can be poured, because it is a fluid, and the fact that you can compress air but not water. “It certainly got my attention.”

But his science marks at high school didn’t help Michael reach his goal. “I was absolutely terrible at science and maths at school. I was much better at languages, but I didn’t really enjoy them.”

A family gathering to celebrate Michael’s christening, Auckland
Front: Isaac Walker, Wairata Walker, Andrea Walker, Francis Dodson,
Back: Ranginui Walker, Michael, Deirdre Walker, Molly Dodson.

Back at the pa: with Ratana and friend Bett Wansborough at Waiaua Marae near Opotiki.

“I lost the plot a bit in third form,” he says. He was in a high streamed class, and the way maths was taught didn’t work for him. “I flogged my guts out and never got anywhere.” In his final year of high school at Mt Albert Grammar his maths marks were less than his age.

Languages kept Michael’s overall marks respectable, and he enjoyed reading science fiction, but he says sport was what got him through school. He represented the school in both rugby and cricket.

Colin Walker

From the sea – a drive for success

Michael Walker started life in the township of Oakura, in the beautiful Whangaruru Harbour about 45 minutes drive from Whangarei. His iwi is Whakatohea, which is based around Opotiki in the Bay of Plenty.

Career opportunities drove the Walker family to Auckland when Michael was still a toddler. Michael's parents set high standards of honesty and hard work, and they demanded high standards of their children. When Michael was young, his father worked four jobs: as a teacher at the local primary school, teaching English at Queen Victoria School for Maori girls, teaching Maori at night school, and going to university part time.

End of the day conversation – anything from the catch of the day to politics.

But the Walkers returned to the sea, first to Oakura, to the eastern Bay of Plenty where his father grew up, and later to Whananaki (north of Tutukaka), for their holidays. Michael's younger brother and sister both became medical doctors, but Michael's drive to succeed became entwined with the sea. His master's thesis was on the population biology of kina, or sea urchins, and Michael has since worked with tuna and stingrays.

At university, Michael continued to get mediocre results in the biology papers he was taking until his third year when, at enrolment for classes, the Head of the Zoology Department actually knew him by first name. "That absolutely blew me away."

Michael's marks picked up after that, because the smaller classes helped him get a personal connection with the lecturers. He particularly appreciated the teaching of Bob Lewis, who was a hard-working teacher who cared for his students well.

After a masters degree at Auckland, Michael got a scholarship from the East West Center to the University of Hawaii. That was a big cultural shock. “It’s not just that they drive on the opposite side of the street … There are all sorts of crazy differences. Switches go up instead of down. I couldn’t fill out forms because the forms were set up differently. I couldn’t follow instructions because of the different way they used English … I found all kinds of almost trivial opportunities for misunderstanding. But once he’d got his head around life in the United States, Michael still had to figure out what he actually wanted to study. “I reached the point of getting up one morning and saying, ‘If I don’t have a research topic by the end of the day, I’m going home.’ I’d tried ecology, I’d tried biochemical studies – nothing set me alight, or would have got me out of bed in the morning.”

Magnetic donuts and tuna hoops

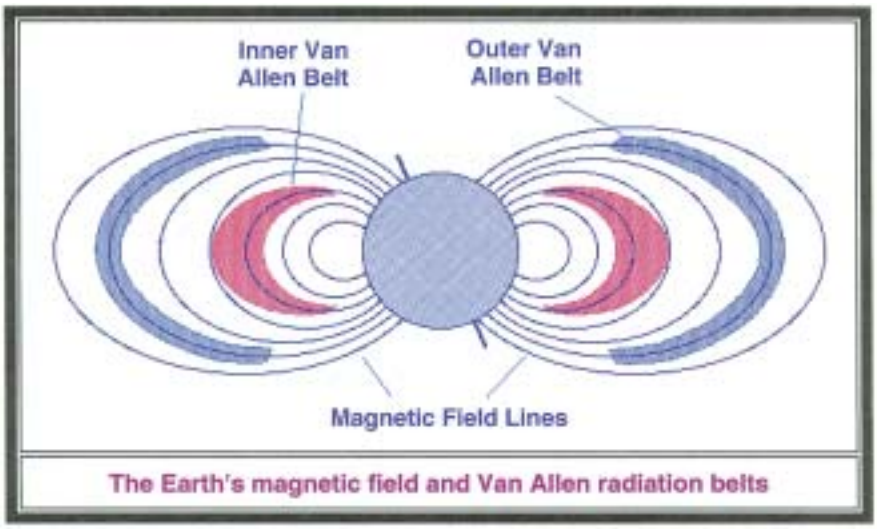
It had long been a mystery how so many animals could be so good at navigating their way around the world. Homing pigeons find their way back over hundreds of kilometres of unknown terrain and European swallows migrate all the way to Africa and back, sometimes returning to the same building.

Michael reviewed everything he’d ever done. He noticed that how tuna navigate around the oceans was another animal navigation enigma. He remembered a class he had enjoyed with Bob Lewis on animal orientation. After growing up and holidaying near the sea, he wanted to do something around that too. Finally, he noticed that the National Marine Fisheries Service laboratory had tanks with tuna available for use. “So I put all that together and said ‘OK, that’s a topic that inspires me.’”

Andrew Dizon, the director of the lab thought that would be pioneering work and came back to Michael with an even more far out idea. Joseph Kirschvink, a geophysicist, had mentioned his work on the idea that animals can have a magnetic

Michael wearing a lei po’o (head lei).
With him is Lilikala Kame’eleihiwa, a friend from student days who now teaches at the University of Hawai’i. Her neck lei is made of maile, a fragrant leaf used in leis as a symbol of leadership.

Michael and friends from all over the Pacific, East-West Center.



With permission of the Department of Physics and Astronomy, University of Tennessee.

Golden plover*

Gannet. Photo Colin Walker

Lesser knots*

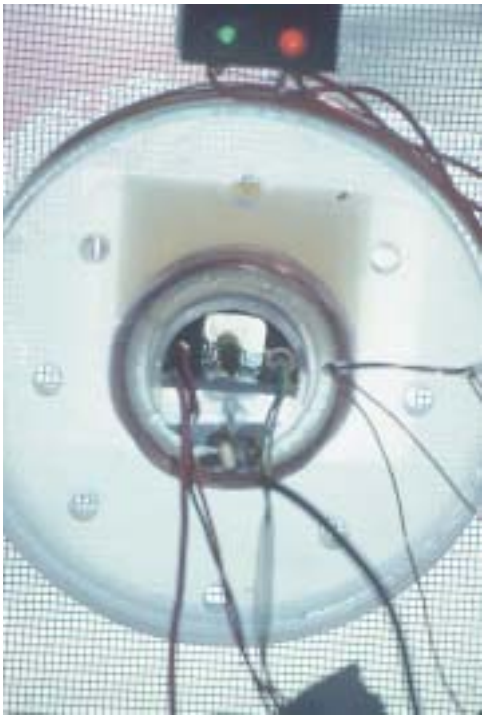
Curlew Sandpiper*

*Photos David Cornick, Welllington

sense of direction, like a compass in their heads. Michael could try to discover if this was how tuna found their way around. “My first reaction was, ‘Well, that field has got a terrible rep’. It was lunatic fringe science.”

It had been suggested since late in the 19th century that certain animals might be capable of detecting the magnetic poles. The entire earth has a magnetic field, which you can imagine to be like a bar magnet stuffed inside an orange. (Earth’s field is thought to be caused by the convection of molten iron in the earth’s core, which causes electrical currents and therefore a magnetic field.) But it was only in the 1970s that research results had finally demonstrated that some birds, at least, probably use the earth’s magnetic field to navigate their way. The evidence, however, was far from conclusive, and nobody had come up with a mechanism that could explain it.

Andrew told Michael that Kirschvink had found magnetite in honeybees. “I said, ‘Really? Oh well, end of story – I’m in.’” Also known to early seafarers as the lodestone, magnetite had been known to have magnetic properties for thousands of years. Bits of the black rock can be used to make a simple compass. Finding the substance in bees meant that there was now a way that they could feasibly have a magnetic sense of direction. “Suddenly a conceptual breakthrough was made.”



Michael then had another lucky break. Because the tuna and their tanks were so big, he had to use an unusual method of testing whether they could sense magnetic fields. Usually people tried to get animals to do things in response to magnetic field direction, like seeing if they could tell which way was north. Michael couldn’t get a big enough coil for his tanks so he was forced to work with magnetic field intensity. He used a coil to produce a magnetic field that, when on, would be like a donut-shaped lump in the ‘magnetic floor’ if the fish could detect it. It worked! Michael could train the tuna so they swam through a hoop only when the magnetic field was on.

A honeybee has used the magnetic field produced by a coil to find a well that contains a sugar solution. A second coil (not shown) was producing no field and provided only water. The lights above the coil indicate the presence of the field (red) and the bee (green).

Tuna going through magnetic hoop in laboratory tank – National Marine Fisheries Service, Kewalo Laboratory, Honolulu, Hawai'i.

During this time, there were plenty of other distractions, because the lab was on the beach in Honolulu. Michael and his friends used to go surfing there at lunchtime. He also met his wife-to-be, Ratana, who had arrived on a similar scholarship from Thailand, to study sociology. She got as far into the surf as boogie boarding, Michael says.

Return to Aotearoa

Michael's PhD was a very successful one. But despite his burgeoning career he found it difficult to get back to where he really wanted to be – New Zealand. He bounced around between postdoctoral appointments in Honolulu and Southern California for about five years, wearing his excuses for extending his United States working visa thin. By this time he and Ratana were married, and they moved to New Zealand soon after she finished her PhD.

Despite having a difficult transition to life in New Zealand, Ratana found work before Michael did – as a demographer and planner at the Auckland City Council. He found work after about three months, as a clerical assistant at the DSIR. After about nine months at DSIR, Michael got a postdoctoral position at the university.

Since then he has continued to work on the magnetic sense in animals. He and his students have now worked with trout, homing pigeons, and honeybees, which he says are "wonderful little animals". He's also had one student who trained stingrays to respond to magnetic fields. Because rays can detect electric fields if you put them in a conducting medium – like salt water – they should

Female tuna in laboratory tank – National Marine Fisheries Service, Kewalo Laboratory, Honolulu, Hawai'i.

Michael and Ratana on their wedding night.

also be able to detect how the electric currents change when they move in the magnetic field. Michael's team tested the hypothesis that the rays were detecting magnetic fields indirectly through these changes in the electric field. "We now think they've got a magnetoreceptor system based on magnetite just like the other vertebrates we've studied," he says.

Some scientists have suggested that humans may have an innate sense of magnetic direction too – although most experiments have found no evidence for this. In one experiment in the 1970s students were driven around blindfolded, then asked to point in the direction from where they had started. This experiment – though others could not repeat the result – found that students did best at this task before the blindfold was taken off. Michael counts himself among those who would likely fail in this experiment. "I would really like to have a magnetic sense because it would help in my research. Unfortunately, I have to rely on my instruments to tell me whether or not the coils I use to produce magnetic fields are working."

Now Michael's work covers the very small – like figuring out which cells detect magnetic fields and finding the nerve that transmits this information to the brain – to the enormous, such as how animals use this magnetic sense in their long-distance migrations.

And what of that pesky maths? Michael's research is high level stuff and demands maths. Although he still struggles with the maths required for his work, he finds "the logical mindset is very valuable'.

Making the cultural link

When Michael first arrived to work at the University of Auckland, he was disappointed to see how few Maori and Pacific Island students continued on to second and third year courses. "I recognised that I actually had something to offer that a standard postdoc didn't – and that was to help with the issue of retention of Maori and Pacific Island students, which was abysmal. What we found was that 60% of the students were just disappearing." In 1991, only a year after Michael started working at the University, he helped set up the Tuakana (elder sibling) Programme for those students. The system made contact with first year students and got second and third year Maori and Pacific Island students to work with them as tuakana (peer tutors and mentors). "All that you're really doing is providing them with a friendly face, helping them learn the system."

Colin Walker

Talking on the phone at the end of a hard day converting a geology laboratory into a clean laboratory for studying magnetite in animals.

Preparing a marlin head for study in the clean laboratory (rugby jersey by Mount Albert Grammar).

"It's very simple, but the key element is that it helps them with that massive cultural shock. They come primarily from the periphery of Auckland society, from the south, the west, a small area in the North Shore, or out in the country. They're from a school that's got small classes in Years 12 and 13 with a high proportion of brown faces. And then they arrive here to classes of up to 1000 in which they are a very small minority. It's a huge shock, on top of the shock of coming from school to university anyway."

Within three years of starting the peer tutoring system, the total enrolments in the department for Maori and Pacific Island students had doubled, and pass rates for those students jumped from about 30% to 60%. Now pass rates are approaching the normal rate of 70 – 80%. This has been hugely gratifying for Michael. "I've ended up teaching them, I've seen them getting jobs – they have a very high employment rate because they're a relatively rare commodity. The first intake that we had, I remember one of them was offered a job before he finished and had to take his final exams at Victoria University in Wellington."

The Tuakana Programme has now been extended into a number of schools. First year Maori and Pacific Island students who are achieving in their science studies at university work with students at Oranga Primary together with Tangaroa and Tamaki Colleges in South Auckland. " The university students assist the students with their studies. But their most important roles are in helping the schools to raise the aspirations of the school students by showing that Maori and Pacific Island students succeed at university and have bright futures ahead of them."

Michael has recently been part of a successful bid for money from the Government to start a Centre of Research Excellence (CORE) focused on Maori development. Nga Pae o te Maramatanga, the National Institute of Research Excellence for Maori Development and Advancement, is aimed at research in areas like Environment and Health, Education and New Frontiers of Knowledge.

Using "non-magnetic" dissection techniques on a marlin head.

Not sushi but Michael with a small sample dissected from a marlin head for closer study.

New Zealand Science and Technology Silver Medal 2000 presented to Michael Mathew Walker 'for his conspicuous scientific contribution to the better understanding of the phenomenon of biomagnetism and how migrating animals use the Earth's magnetic field'. Presented 7 May 2001 at The University of Auckland.

It will also be offering scholarships to encourage Maori students to take that extra step into higher education. "Maori students in the education system tend to think of themselves as not capable of going beyond where they currently are. They come through to the end of their bachelors degree and they don't think of themselves as potential graduate students."

Michael and Leilani at a family wedding, Auckland 2003.

Being part of the CORE has also given Michael more of a chance to speak Maori. When he was a kid, speaking Maori was discouraged in society generally. "I picked up a bit as a young person, but could still only speak it as a second language."

Michael also helped government science organisations understand their responsibilities under the Treaty of Waitangi, such as consultation with Maori. This stemmed from his position on the founding board of Landcare Research back in 1992. "The important issue was that they hold collections of native plants and animals. The land is a fundamental part of their business. They were going to have to come to terms with how to talk to Maori as stakeholders," says Michael. He suggested that they create a management position for someone with expertise in the Treaty of Waitangi. Most of the other government science organisations have since implemented this too.

Michael and son, Punahamoa sharing and enjoying a book together.

The kid from Oakura now enjoys high prestige in the world of science – Michael has been elected a Fellow of the Royal Society and was part of New Zealand's Science and Innovation Advisory Council. But he is much less focused on success than he used to be. "I was driven by a desire to achieve, for a long time, without really knowing what I wanted to achieve. I'm much less driven now, doing stuff that I enjoy."

The morning catch at Whananaki.

Cleaning the catch with young friends.

Michael and Ratana's children, Leilani and Punahamoa who are 14 and 11, are pretty typical kiwi kids, he says. "They're interested in just about everything: they like sport, she's a great reader and, ironically from my point of view, he loves maths". Michael and Punahamoa both love fishing, and the whole family recently had a great time on their first skiing holiday. But their first choice for holidays is still to head back up to Whananaki and the sea.

A family game of touch rugby on the beach at low tide at Whananaki.

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