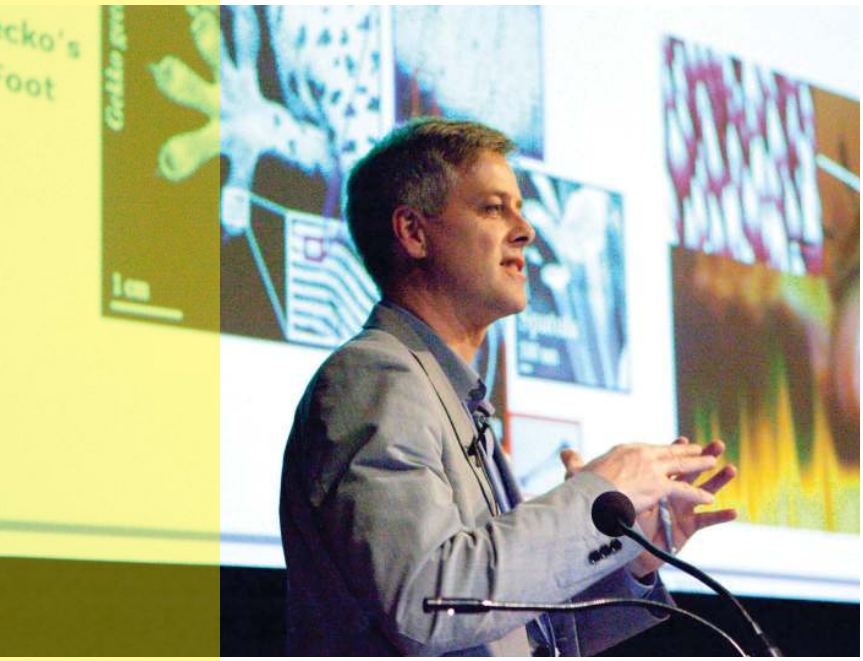
Science - it's all about passion

If you talk to a scientist about their work, you might be surprised how often you hear the word passion. Scientists are often passionate about the work they do. Some scientists are driven by a fascination to learn about how the world works. Others delight in discovery. For applied scientists, like engineers, seeing a simple idea grow into a product that makes an impact on people's lives can be the most satisfying part of the job.

That's what drives Richard Blaikie, a professor in the Electrical and Computer Engineering Department at the University of Canterbury. As a professor he divides his time between research and teaching and – his least favourite – administration. He also works as director of the MacDiarmid Institute for Advanced Materials and Nanotechnology, which is named after Alan MacDiarmid, who won the Nobel Prize in Chemistry in 2000.



A fascination with the world

At school in Dunedin, Richard was fascinated by the world and wanted to find out how it worked. He took lots of science subjects and also enjoyed technical drawing, working with size and scale and dimensions to represent 3D objects on a flat piece of paper.

This technical ability ran in the family. Richard's father, grandfather and uncle were all surveyors, measuring the landscape to create maps of the world around them. He remembers working with his father to pull apart an old brass theodolite, a surveying instrument used to measure angles. Maths, and how it could be used in the real world, was a common topic of conversation in Richard's home.

Richard started university with an engineering intermediate year at the University of Otago. Engineering intermediate provides students with a broad introduction to the sorts of skills and knowledge that are useful for an engineering degree – a combination of theoretical and applied science and maths, along with other practical skills. Richard liked the workshop course provided by the local polytech and still has the toolbox he made when learning about welding and metalwork. But it was the physics courses that really sparked his interest, and that's what he ended up studying, completing an honours degree in physics in 1988.

Then what?

"I really didn't have any strong career thoughts," says Richard. "Only in my last year did I start asking people about what kind of job you can get in New Zealand with a physics degree."

The response was not very encouraging. Richard hoped he could get a job with a company like IBM, a major technology company with a very strong focus on applied research. That was the appeal for Richard. "I wanted to do research for a reason, and not just for academic interest."

In Rutherford's footsteps

When scholarship information came along, Richard applied for everything. He ended up with a Rutherford Memorial Scholarship – which looks for students with "a passion for science and

technology" – to do a PhD at Cambridge University in the UK. Sir Ernest Rutherford, who won the 1908 Nobel Prize in Chemistry for his work on radioactivity, had won a scholarship to study at Cambridge in the 1890s. He later became head of Cambridge University's Cavendish Laboratory

It was a big change for Richard, going from a small post-graduate group in Dunedin to a different country, culture and learning style. He found himself in a microelectronics group, which had strong links between physics and engineering, and plenty of industry connections.

> ***"People don't just take a science degree to get a career in science. They go and do all kinds of things. You go to university to train your mind."***
> ***– Richard Blaikie***

When the Japanese technology company Hitachi established a research laboratory at the Cavendish, Richard was shoulder-tapped to work with them on a project looking at what electrons were doing on the nano-scale.

Messy student rooms gave way to an air-conditioned corporate laboratory. Richard took trips to Japan and worked on Hitachi stands at shows and conferences. Hitachi's own in-house research budget was about the same as the entire research budget of New Zealand at the time. While 90% of that budget was for developing new products, there was also money for basic research. The collaboration with Hitachi gave Richard direct links to the world of international industrial research and development (R&D).

Richard's fellow students went on to work in widely differing fields, some as scientists and others heading for management or commerce. One member of his group was studying quantum physics while waiting to get an Actors' Equity card (Ben Miller later turned up on screen in films like Johnny English and television series such as Primeval).

A dumb career move?

It was a busy time, but after five years in the UK, Richard wanted to come home. He admits the decision might not have been the smartest one.

"It was really dumb career planning," he says. "New Zealand didn't have a micro-electronics industry."

Richard wrote to all the heads of physics departments in New Zealand and ended up with a research contract in fibre optics. It was an area he had no experience in, but he saw it as another opportunity for discovery.

"I had to learn all this wonderful new stuff," he says. And the position gave him a foot in the door at the University of Canterbury. When a lecturing position came up, he applied, and has been part of the Electrical and Computer Engineering Department ever since.

That presented new challenges. Now Richard had to teach. It wasn't something he had thought about doing, but he has found it very useful and now wouldn't give it up.

"By having to teach and having people asking me questions, I found gaps in my knowledge or misinterpretations I had made. Teaching helps you refresh your knowledge. The balance between teaching and research is a nice two-way mix."

International connections

International travel is still very much a part of Richard's life. Although technology like email and video calls allow researchers in New Zealand to interact with colleagues around the world, nothing beats personal contacts. Sometimes the best ideas come over a cup of coffee or a chance meeting in a lobby.
"It's amazing the ideas that generate around casual conversation."

That can be where many important connections are made. Richard thinks it is really important that young scientists get a chance to make those connections. It can mean opportunities like the ones he has had, or life-long mentoring and collaborations.

It's all about ideas

Richard often comes back from his trips with a renewed passion for his work and more ideas than he can deal with. But Richard knows that many, many ideas have to be looked at to find one that really works. Most new ideas will go nowhere, he says, "but if it doesn't make money, that doesn't mean it's not a good investment. Ideas add to the foundation of knowledge."

As a student and as a professor, Richard has dealt in ideas all

his life. He knows people are naturally curious about the world. As a father of three young children, he sees the wonder and passion that ideas can spark. For many youngsters it starts with stars or dinosaurs; Richard has seen his own students become passionate about light and electrons and biosensors and nano-whiskers. And he has seen others move on to become teachers, lawyers and bankers, which he considers as much a success as those students who have stayed in science.

"The best thing to do is to follow your passion, be it in accountancy, engineering, literature or science."

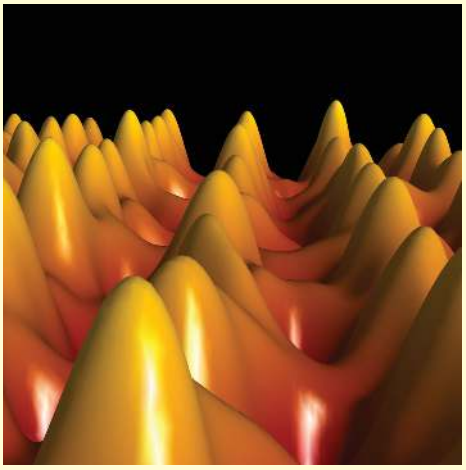
Richard and his team have been working on finding another way to create these nanoscale components. The work involves computer modelling, electromagnetic equations, simulations and hands-on experiments with silver lenses and electron microscopes. They can now print the lines needed for electronics components as small as 44 nm, or one-seventh the wavelength of ultraviolet light. This provides another approach and a new set of tools for nano-engineers making the tiny components that underpin much of our technology.

New uses for science

Richard's work usually focuses on semiconductors and electronics technology. But Richard and his team at the MacDiarmid Institute have recently used these same techniques to produce nanoscale inscriptions on a special one-off All Black jersey. One single thread woven into the Silver Fern logo had the names of 10,000 keen rugby supporters inscribed on it. The stamped thread made its debut at a Bledisloe Cup match between New Zealand and Australia. "We've got this technology now that we didn't have before, so we'll be looking for other applications," says Richard.

Richard and Ritchie McCaw show the nanoscale inscriptions of rugby supporters woven into the All Black jersey.

Powers of 10



Back in 1968, when Richard was four, and six years before the word "nanotechnology" was ever used, the short film Powers of Ten gave us an idea of how to look at the very, very big and the very, very small. The viewpoint starts with a picnic, zooms out to the size of the observable universe and then back in to the sub-atomic particles inside a carbon atom's proton. It steps through these by powers of 10, each step being 10 times more (or less) than the previous step.

The nano-world is a world of the very small. A nanometre is only 3-5 atoms wide, or 40,000 times smaller than the width of a hair. A strand of DNA measures just 2 nm across. There are a billion nanometres to a metre, making it 10-9 of a metre. It might be hard to imagine this scale, but the size of a nanometre to a metre is the same as the width of a marble compared to the width of the Earth.

At the nanoscale, materials can have different physical or chemical properties than they do at human scale. Copper becomes transparent like glass; gold dissolves. Research like Richard's looks at how these basic properties change and how they can be used in new and exciting ways.

(If you'd like to see the Power of 10 movie, it's available online here: http://www.powersof10.com/)