2003 New Zealand Science and Technology Postdoctoral Fellowship

Investigation of drying and re-hydration of powdered dairy products with magnetic resonance imaging

Getting home with a 'FRST Fellowship'

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They say that home is where the heart is. In my case, that was certainly true. My FRST Science and Technology Postdoctoral Fellowship got me home and got me a job. You can't ask for more than that.

I qualified from the University of Auckland in 1998 with an honours degree in Chemical and Material Engineering and undertook my PhD at University of Auckland. My thesis topic was 'Fundamentals of spray crystallisation of food solutions'. Basically, it involved observing the freezing of droplets suspended on a thermocouple with high-resolution video. The work that I was doing interested a visiting lecturer from Cambridge (UK), Dr Ian Wilson, who offered me the opportunity to undertake postdoctoral work at Cambridge University. He thought it would be interesting to see if magnetic resonance imaging (MRI) could be used in place of video to observe the freezing of droplets. Funding for the project was obtained from the United Kingdom Engineering and Physical Sciences Research Council (EPSRC) over an 18-month period.

So, with newly wedded wife in tow, I headed to England. One of the most interesting things about my stay at Cambridge was the efficiency of knowledge transfer within the Chemical Engineering Magnetic Resonance Research Centre. At Cambridge, I worked with Drs Mick Mantle and Andy Sederman, both of whom were undertaking postdoctoral research at the same facility. Part of their job was to teach someone like me, who had absolutely no MRI experience, how to use the MRI instruments. Because of their background in MRI-specific research, they were able to identify which MRI methods I needed to use for my experiments and, as necessary, create new methods. Their day-to-day administration and knowledge of the MRI instruments was far superior to that of a technician. While they had their own research projects, a significant proportion of their time was specifically allocated to the day-to-day administration of the instruments and researchers within the research group (postdoctoral researcher and postgraduate student alike).

What is also a little unusual is that Drs Mantle and Sederman were the first postdoctoral research fellows that I had ever met. During the whole of my time as a PhD student at Auckland University I had not worked with one postdoctoral fellow – it seemed that most PhD graduates at Auckland either got work or headed off overseas to study. In my experience they did not undertake research on a postdoctoral basis in New Zealand (certainly not at Auckland University as far as I was aware). In my view, the advantage of having postdoctoral fellows assisting other postdoctoral fellows and PhD students on a hands-on basis was instrumental in me being able to complete the amount of work that I was able to over my 18-month period in Cambridge.

The MRI unit at Cambridge was impressive – state-of-the-art, modern, well organised and well funded. Prof Lin Gladden is the founder and current director (and a very nice lady). It services 10 postdoctoral researchers and 21 PhD students. There were five MRI systems, worth approximately in excess of $10 million (NZ). Most of the capital equipment funding had been sourced externally from either private funding or research grants. I believe very little was funded internally from Cambridge University itself.

I would have stayed in MRI heaven, but for the fact that my wife and I had just had our first child in England and we were keen to come back to New Zealand. So, when Prof Paul Callaghan from Victoria University of Wellington (and Director of the MacDiarmid Institute) came to visit, I naturally asked him if he knew of any jobs going, back in New Zealand. My engineering background was not suitable for the work that the MacDiarmid institute was undertaking, but Prof Callaghan advised me that there was an old MRI instrument in mothballs at Massey University. He suggested that if I could get some money together, I might be able to re-commission the machine and undertake my own research projects. He thought that the most likely source of income would be from a FRST Science and Technology Postdoctoral Fellowship.

Trading down from a state-of-the-art institution to an old mothballed MRI instrument was like swapping a BMW for an ancient Ford Cortina, but the lure of 'getting home' was strong. So, I started knocking on doors, trying to drum up support for a funding application. The project had to be a collaborative

[1] On 1 Dec 2008 HortResearch merged with Crop and Food Research to create the New Zealand Institute for Plant and Food Research Ltd.

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affair: HortResearch[1] owned the magnet, but it was located at Massey University in Palmerston North; I needed a mentor and the work that I was proposing to do (the investigation of drying and re-hydraftion of powdered dairy products with magnetic resonance imaging) was within Prof Don Cheng's (University of Auckland) area of expertise. Prof Cheng also happened to be a principal of the Riddet Institute[2] at Massey University. With Prof Callaghan's support, we were able to get all parties working together – HortResearch agreed to transfer the MRI Instrument to Massey University, the Riddet Centre (Prof Paul Moughan and Prof Harginder Singh) agreed to house me at Palmerston North; Auckland University agreed to be the host institution for the project (Massey University later took on this role) and Fonterra[3] contributed money and support to the application.

My FRST application was successful and my wife and I flew home. The fun was only just beginning! The MRI instrument was 12 years old, and I could not be certain if it could be successfully re-commissioned. There were problems with its physical location; it had to be re-housed, and that involved getting a new lab space modified. Superconductive magnets are delicate instruments and don't like being moved. I couldn't be sure if moving it would result in a major fault occurring. New seals were required for the instrument, and, because of its age, the seals had to be made to order – this resulted in more delays. Specialised engineers (who are rare as hen's teeth) were required from New Zealand and Australia and their unavailability resulted in even more delays. Finally, after 20 months, the instrument was energised...and....(sigh of relief) it worked!

Unfortunately, because of all the delays caused by the re-commissioning of the Instrument, I was only able to accomplish some of my stated project objectives. Fortunately for me, FRST didn't ask for their money back.

Notwithstanding that I didn't complete my research goals, real benefits have resulted from the re-commissioning of the MRI instrument. It is the only horizontal wide bore MRI instrument of its type within the lower half of the North Island and increasingly, various research groups are integrating its use into their research programmes. Following a donation of a magic angle spinning solid state probe by Industrial Research Limited (Wellington), the instrument now has dual capability for both imaging and solid state nuclear magnetic resonance spectroscopy (NMR). This new capability widens its application over a number of research areas, such as food, material sciences and soil sciences, and has sparked a considerable amount of interest amongst a wide range of research groups in the lower North Island.

In my view, one of the best things about having a FRST Postdoctoral Fellowship at Massey University was that I was able to construct my own research field. This factor and my contacts with many diverse research groups (through their use of the instrument), greatly assisted me in securing a permanent position as a lecturer at Massey University. At present, I have a 60/40% time split between lecturing on behalf of the Institute of Food, Nutrition and Human Health and doing research for the Riddet Institute. This enables me to maintain my research output for various projects and also lecture for the University. I certainly believe that FRST has enabled me to get back to New Zealand and create a research field of my own much more quickly than might otherwise have been possible if I had stayed in Cambridge waiting for a position to become available.

FRST Science and Technology Fellowships are to be credited for creating opportunities for young PhD scientists. I do believe, however, that there is room to add more flexibility to the programme. At the moment it is very focused on individuals and their particular research projects. In my opinion, a further proportion of the fellowship could be allocated to non-specific research output by way of contribution to a research group/institution which could incorporate PhD and student supervision as part of its research programme. This would have a dual benefit of 'grooming' postdoctorates for academic responsibility by giving them an opportunity to supervise PhD students as well as creating a more efficient knowledge transfer (as I experienced in Cambridge).

FRST's policy could also be broadened to include fellowships of a shorter or longer duration than the current three-year fellowships, and the rule limiting applications to only one application per applicant could be relaxed. The British EPSRC system allows projects to be funded from one year to up to 5 years, and there is no limit to the number of applications that can be made. In fact, each funded project is reviewed and given a grading which is used in assessing an applicant's future applications. This means that successful projects have the opportunity to continue and may grow into new on-going research fields within an institution. Also, there is external and internal funding available for 'research officers' which is a position which fits between an academic and a researcher. Research officers have a dual role; conducting research for their own projects, but also passing on research knowledge and skills to PhD students and postdoctoral researchers (as in my case on technical matters involved in MRI instrument methods). The advantage of this system is that there can be an intermediate layer of knowledge created around a long-term research project which enables time efficient transfer of skills to others. For example, if I was to currently host a PhD student for a specific project, I would have to spend time upskilling that student on the technical skills required to operate an MRI instrument. Arguably, the level of skill required for MRI use is outside the skill level of a technician, and really warrants more academic input. In my experience, most academics don't have the time to devote to skill transfer to the extent required for effective PhD supervision.

These positions appear to be available mainly to Tertiary Education Commission-funded Centres of Excellence as a result of those Centres having long-term funding. In my view, there should be further scope for smaller funded research programmes to have funding for these positions and FRST may be the best solution for providing funding for that purpose.

I would like to acknowledge the Foundation for Research Science and Technology and all the people who I have worked with and for, but especially Prof Paul Callaghan, Prof Paul Moughan and Prof Harjinder Singh for supporting me throughout my academic adventure. Without their support I would not have a career back here in New Zealand.

[2] The Riddet Institute was established in 2003 at Massey University, Palmerston North. It was accorded Centre of Research Excellence status in 2007 by the New Zealand Government. Significant government and industry funding brings together leading researchers from around the country to expand scientific knowledge of foods and digestive processes. Partners in the national centre are Massey University, University of Auckland, University of Otago, AgResearch, and Plant & Food Research.

[3] Fonterra Co-operative Group Limited is New Zealand's largest multinational dairy company.