# Mathematical minds

**Robert McIntosh***

*Gazette: Where did you grow up?*

*McIntosh:* My father, Gaius McIntosh, was the first lecturer in Philosophy at the University of New England (UNE), Armidale, northern NSW, moving there in 1947 (then an offshoot of Sydney University). My mother, Edna McIntosh, was also a great believer in education, and she and Dad raised seven children, all of us gaining degrees from UNE. The seven of us are Alan (who became head of Mathematics at ANU), Colin (who became head of Mathematics at Monash), Graeme (a head mathematics teacher), Malcolm, Dorothy, Cathy and myself (the youngest). It was said that my dad took up Philosophy because he found mathematics too easy! At an early age we played games my father devised that involved mathematics.

*Gazette: Did you enjoy maths at school?*

*McIntosh:* When I was in grade two primary at Armidale Public School I remember enjoying a mathematics book that had lists of square numbers, log tables, formulas et cetera. I remember learning many square numbers off by heart, and one that caught my imagination was 13 456. My teacher, Mrs Bozzer, asked the class to use four mathematical operations to end up with 10. She was expecting answers like $4\times2-1+3=10$. I gave the answer $\sqrt{13\,456}-10^2-4^2+\sqrt{100}=10$, or something like that, and Mrs Bozzer had to check with the head-mistress if I was correct. My brother Graeme recently told me that this response was still being talked about at a NSW Department of Education conference as recently as a few years ago (around 35 years later!). A book I enjoyed when I was 13 was *Cheaper by the Dozen* (a 1948 book written by Frank Gilbreth Jr and Ernestine Gilbreth Carey) where the father taught his children to answer questions like $43\times37$ quickly (to impress the headmaster) by using the trick that $43\times37=(40+3)\times(40-3)=40^2-3^2$, which is easy to calculate. At the Armidale High School, I was very fortunate to have Pop Farrell and John Galvin as my mathematics teachers, as they were both supportive and able to create an enjoyable environment. Pop Farrell would say that 80% is a 'pass mark', as a score above 80% shows that you have understanding of the material.

*Gazette: What did you want to do when you started university? What made you go on to do a PhD in maths?*

*McIntosh:* University was an environment that I really enjoyed, mostly due to its freedom and the need for the student to be self-disciplined if they are to succeed. I question the pressure that society places on our Year 12 high-school students (some of it driven by a school's financial needs) when people excel at different

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times in their lives and it is perhaps the higher level of education that we should be emphasising. My enjoyment and success in mathematics increased significantly at UNE (gaining first class honours) with supportive lecturers like Mike Campfell, Norm Dancer, Joe Hempel, a terrific tutor Simon Smith, and fellow students Ian Roberts and Mirka Miller who had a great love of maths. UNE was such a good environment for learning mathematics.

My love of mathematics was driven by its ability to help us understand our physical world and subjects like cosmology enthralled me. Wes Taylor was my encouraging Honours supervisor in General Relativity. That love of learning about physical systems encouraged me to undertake a PhD at ANU. It was an environment with many top international mathematicians, and took me to Stanford University in California, where I met my wife, Wendy.

My career in industry may have been better served if I had undertaken a subject such as electrical engineering but I feel that mathematics is a very enriching subject. A mathematical background often provides me with the confidence and skills to tackle problems that others may not.

*Gazette: What made you decide to work in industry? Where have you worked?*

*McIntosh:* After coming from a family heavily involved in the academic environment, the world of industry was novel and interested me. I was at BHP Research for 10 years (becoming a Senior Research Scientist) and Telstra Research Laboratories for seven years, until both were closed. I am now with Telstra's Chief Technology Office and am currently one of a fortunate few to be doing research (in radiation safety). This is an area that involves a broad range of skills in physics, statistics, biology, and electrical engineering as well as maths. We are part of the collaborative effort at the Australian Centre for Radiofrequency Bioeffects Research. Most of the mathematical work is performed using computational packages (that solve Maxwell's electromagnetic equations) and I often long for the time when computers weren't around. Recently I coded up a finite-difference solver for thermal analysis which can calculate the induced heat in a human body due to radiofrequency (RF) radiation.

My most inspiring boss was a man called Dr Peter Ellis (when I was at BHP). Peter was the stereotypical absent-minded professor type and there were many stories about Peter (including stories told by himself) about his absent-minded ways. He would often come in to work and tell us about ideas that he had at 4 a.m. and the team would then go about trying to implement his ideas. Those days were very exciting and we would design many devices to control the flow of liquid metal. We used powerful six Tesla permanent magnets to break the flow of molten steel being cast, electrical coils that would levitate liquid Zincalume as steel strip was being coated, and highly efficient non-contact pumps (designed with permanent magnets) that would pump the highly corrosive Zincalume. Maths in its many forms was used in the design process. Checking and matching theory with physical testing is always key to good understanding and design.

Another area that I worked where maths was important at BHP was in signal processing for airborne electromagnetic exploration. Noise reduction methods were sought to provide better quality maps of the geological structures.

*Gazette: What is the best career advice you have ever received?*

*McIntosh:* Probably lots but none that I can specifically remember! I guess if I was to give advice it would be to work in areas that you are passionate about.

*Gazette: What achievement are you most proud of?*

*McIntosh:* I am very fortunate at the moment to be able to supervise university students (as an industry supervisor) and that is a great pleasure. One PhD student, Teddy Kurniawan, looked at analytical methods to solve for the electromagnetic field in the near field of an RF source. On a personal note, I have twice won an award for best presentation at a conference — the B.H. Neumann student award (Bernard was such a nice man) at the Australian Mathematical Society conference at UWA in 1986; and the best paper award at the Australasian Radiation Protection Society Conference in Sydney in 2006. The key for speaking in public is to prepare thoroughly and to give much thought to the material. My youngest daughter, Whitney, recently won a BHP award for mathematics and the four mathematicians that made the presentations at the awards ceremony gave poor talks. If mathematics is to be promoted then we must take every opportunity to connect with the audience and our youth need to see why mathematics is relevant, including how it can be used to give insight to our physical world.

Rob McIntosh obtained his PhD in Mathematics at the Australian National University in 1989 in the area of PDEs. He has been a member of the Electromagnetic Energy Safety Research team at Telstra since 1999, developing and applying a numerical modelling environment for the study of radiofrequency dosimetry and human body absorption. Rob is also a member of the Australian Centre for Radiofrequency Bioeffects Research and an Adjunct Professor at Swinburne University of Technology. Between 1989 and 1999, he worked at the BHP Research Laboratories on the development of electromagnetic levitation, pumping, and braking devices for liquid metal, and new techniques in noise reduction in electromagnetic geophysics. Rob is a member of the Australian Mathematical Society. (Photo by Leah McIntosh.)