



# Obituaries

## **Jonathan M. Borwein**

**FAAAS, FBAS, FAustMS, FAA, FAMS, FRSNSW**

**20 May 1951 to 2 August 2016**



*An innovative and prolific mathematician of international renown*

Jonathan Michael Borwein's sudden and unexpected passing on 2 August 2016 sent shockwaves of sorrow throughout the mathematical world. Jon was a true polymath whose mathematics and infectious enthusiasm for it changed the way innumerable people think and feel about mathematics.

### **Life and career**

Jonathan was born on 20 May 1951 in St Andrews, Scotland, where his father David (a mathematician) was on staff at the University. In 1930 the Borwein family, including six-year-old David, had emigrated from Lithuania to South Africa, where in 1944 David graduated with degrees in Electrical Engineering and Mathematics from the University of Witwatersrand. It was there that he also met and subsequently married Jon's mother; Bessie Borwein (née Flax), a noted anatomist and biomedical scientist. In 1948 David and Bessie moved to the United Kingdom where in 1950 he was awarded a PhD from the University of London and secured a lectureship at St Andrews. 1963 saw the Borwein family, including Jon and his two siblings, Peter and Sarah, moving to Canada, where David Borwein became Head of Mathematics at the University of Western Ontario (now Western University). It was there in 1970 where Jonathan met his partner for life, Judith Borwein (née Roots). In 1971 Jonathan completed a B.A. (Honours Mathematics). From 1971 to 1974 Jon was an Ontario Rhodes Scholar at Jesus College, Oxford, graduating with an M.Sc. in 1972 (Thesis: Monotone Operators and Non-Linear

Functional Analysis) and a D.Phil. in 1974 (Thesis: Optimization with Respect to Partial Orderings). And, here we recognise the seeds of two of his life long interests.

Jon's first Academic appointment was as a Post Doctoral Fellow at Dalhousie University. He remained at Dalhousie as an Associate Professor and then Full Professor until 1991. Taking leave 1980–1981, he spent two years as an Associate Professor at Carnegie-Mellon University. From 1991–1993 he was Professor in the Department of Combinatorics and Optimization at the University of Waterloo. The period 1993 to 2004 saw him occupying various positions; the Shrum Professorship and a Canada Research Chair, at Simon Fraser University where he was founding Director of the Centre for Experimental and Constructive Mathematics. In 2004 Jon returned to Dalhousie to take up a Canada Research Chair in Collaborative Technology. His final move was to the University of Newcastle (UoN) in 2008, where he was appointed as Laureate Professor of Mathematics in the School of Mathematical and Physical Sciences.

### **Australian connection**

Jon enjoyed a long association with Australian mathematics and mathematicians. While on a sabbatical in North America, John R. Giles (UoN) visited Dalhousie University in 1977 where he had a never to be forgotten encounter with the recently appointed Jonathan Borwein. Five years later Brailey Sims (then at the University of New England) spent two weeks visiting with Jon at Dalhousie. A visit which resulted in a life-long friendship and their first paper together. These were the first of many visits by an armada of Australian mathematicians.

Besides those mentioned already, included among Jon's Australian colleagues and collaborators were:

The late Simon Fitzpatrick (University of Western Australia) whose contributions to convex analysis and the theory of maximal monotone operators Jon greatly admired. Jon was the principal speaker at a memorial conference for Simon held at the University of Western Australia in 2005.

The late Alex Rubinov (University of Ballarat — now Federation University) who spearheaded optimization in Australia.

The late Alf Van der Porten (Macquarie University) who was a frequent visitor to Jon in Canada. Jon organised an International Number Theory Conference in memory of Alf hosted by CARMA in 2012.

Starting with a three-month visit to UoN in 1988, Jon (often accompanied by Judi and his daughters) became a frequent visitor to Australia; visiting again in 1994, 1995, 1998, 1999, 2000, 2001, 2003, 2005, and 2007. As a result, Jon was well known throughout Australia for his participation in a variety of workshops and conferences; and, he became a much sought after colloquia speaker.

In 2008 Jon and Judi together with two of his daughters, Naomi and Tova, and grandson Jakob moved to Australia to take up his Laureate Professorship at UoN.

Immediately after his arrival Jon embarked on a campaign to enhance mathematics at Newcastle. He proceeded to attract a number of high profile mathematicians and outstanding early career researchers to the faculty; Wadim Zudilin and Michael Coons among them, and to spearhead Newcastle's engagement with the local, national and international scientific communities. These efforts, combined with his own prodigious output, soon resulted in UoN being recognised as one of Australia's mathematical 'hotspots'.

Shortly after his arrival, he founded and directed (2010 to 2016) the ongoing University of Newcastle Priority Research Centre for Computer-Assisted Research Mathematics and its Applications (CARMA). Under Jon's stewardship CARMA promoted, among other things, research and research training through supporting a regular stream of visiting scholars, seminars and colloquia, and hosting an average of seven conferences and workshops each year.

During the eight years of his Newcastle tenure Jon contributed greatly to the well being of the mathematical sciences in Australia. In 2010 and 2012 he was a panel member for the *Excellence in Research for Australia* review. He sat on the Council of the Australian Mathematical Society (2009–2016). He served on the Executive of Australia and New Zealand Industrial and Applied Mathematics (ANZIAM) and chaired the Scientific Advisory Board of the Australian Mathematical Sciences Institute (AMSI) (2010–2016). From 2010 to 2016 Jon co-edited with George Willis the *Journal of the Australian Mathematical Society*. He was elected a Fellow of the Australian Academy of Sciences in 2010 and a Fellow of the Royal Society of NSW in 2015.

### Accomplishments

Jon's mathematical interests embrace a staggeringly diverse range of topics: pure and applied analysis (especially convex, and more generally nonlinear, analysis), optimization, special functions and analytic number theory, numerical and computational mathematics, and high performance computing, all bound together by the unifying methodology of *experimental mathematics* for which Jon was a powerful pioneer. Practicing mathematics as one would an experimental and inductive science with the computer as the principal laboratory tool of investigation became a way of life for Jon. And, much like Leeuwenhoek's microscope it guided him to numerous unexpected insights and discoveries. Jon's special function work surrounding  $\pi$ , initially undertaken together with his brother Peter and Simon Plouffe, has spanned more than three decades and earned him the nickname of 'Dr Pi'.

Over his career Jon has been an author of over 15 books, and contributed almost double that number of book chapters. Starting in 1976 with a paper entitled 'tangent cones and convexity' (in the *Canadian Mathematical Bulletin*) he has over 380 refereed papers, most in leading journals, and in excess of 100 contributions to conference proceedings. Much of his work has had, and continues to have, a major impact, with his publications attracting some 6,000 citations. Jon was generous with his ideas, enjoying sharing them almost as much as having them. This coupled

with his enthusiasm made him a natural collaborator and, as a quick glance on MathSciNet reveals, he has worked with over 150 co-authors. This, combined with the breadth of his mathematics, ensured that his investigations often crossed boundaries and made him an almost accidental catalyst for interdisciplinary research, so prized in the modern university.

An energetic promoter of all things mathematical, Jon was an inspiring teacher, supervisor and colleague. His talks while bursting with information were also always an enthralling performance. He committed himself to the advancement of the mathematics profession through various leadership roles, and his editorial and committee work. He was President of the Canadian Mathematical Society (2000–2002), a member of the Board of Governors of the Mathematical Association of America (2004–2007), and has served on numerous granting bodies and advisory boards from international organisations, like NATO, to regional ones.

He directed or supported some 40-odd post doctoral fellows and associates and has been the principal supervisor for nearly 30 PhD students.

### The person

The multitasking Jon could have been many things. His early inclination was toward studying history, but luckily for us he eventually settled on being a mathematician. Nonetheless, he retained a passion and deep seated curiosity for history (both human and natural), the arts, the organic world around him, and much, much more.

Extensively read, it was rare to stumble upon a literary work that Jon had not also delved into. When the occasion was right he would recite lengthy tracts of poetry (and the occasional bawdy limerick). He compiled an extensive file of quotations, which may be found at <https://carma.newcastle.edu.au/quotations/allquotes.php>. Quotations that he liberally peppered throughout his talks and writings.

An inveterate communicator, Jon, in collaboration with among others his friend and long-standing colleague David Bailey, was an avid blogger contributing to over 300 blogs on a wide range of topics (see <https://carma.newcastle.edu.au/jon/index-blogs.shtml>).

Excursions into the countryside often including long walks (but rarely without an accompanying laptop or iPad — in earlier times, notebook) provided a weekly source of relaxation for Jon and family. These frequently also included one or more of the numerous mathematical visitors who gravitated to him. For many years his other source of ‘relaxation’ and daily exercise was to swim laps of an Olympic-sized pool for 45 minutes or more during his lunch ‘break’, often emerging from the water with a problem solved.

As so many can attest, an evening spent with the Borweins was always a memorable occasion filled with probing discussions of current scientific and world events, often illuminated with astute political analyses (Jon was an engaged and active ‘small l’ liberal), lightened by musings on the latest happenings in the world of sport (especially cricket and tennis — Jon’s favourites), all accompanied by an eclectic

selection of music and the shared enjoyment of good food, wine and whiskey (he was after all born in Scotland). How Jon found time to stay abreast of so much while at the same time doing so much remains a great mystery.

He sparkled with a wry sense of humour. He was proud of his Jewish heritage, though perhaps the closest he came to a religion was as a Pastafarian and ordained minister in the Church of the Flying Spaghetti Monster—of which he often boasted.

Jon was extraordinary and engaging; a unique individual who is, and will continue to be, sorely missed by all lucky enough to have known him. He is survived by his parents: David and Bessie, his siblings: Peter and Sarah, wife: Judith (Judi), three exceptional daughters: Rachel, Naomi and Tova, and five grandchildren whom he adored: Jakob, Noah, Sky, Zoe and Taj. Jon could not have been who he was without Judi's love and support, and Jon often told that his greatest achievement was saving her (with CPR, learnt from watching TV) after she suffered a massive heart attack in 2006.

Jonathan M. Borwein may well be irreplaceable, but his legacy is a huge one and one which leaves much for us to build upon.

A wealth of further information on Jon, including many of his papers and talks, may be found on his personal web pages at <https://carma.newcastle.edu.au/jon/>. Also worth a visit are:

<http://jonborwein.org/>

<http://experimentalmath.info/blog/2016/08/jonathan-borwein-dies-at-65/>  
and

<https://carma.newcastle.edu.au/meetings/jbcc/>.

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