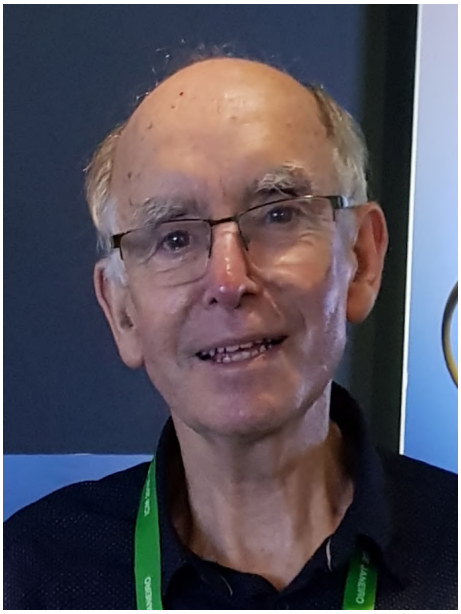
PROFILE

Kevin Broughan



Emeritus Professor Kevin Broughan has been at the University of Waikato since 1971. Although he retired in July 2011, he has continued with his academic work.

Kevin was born in Wellington and attended St Bernard's College, being Dux in 1960 and 1961 and being Awarded a National NZ scholarship. He entered the Marist Brothers teaching order, and remained in this for nine years, teaching for some of this time at St Paul's College in Auckland, and leaving the order in 1970. He completed a first class Honours degree in Mathematics at the University of Auckland, spent most of 1968 as a Junior Lecturer at the University of Auckland, and then headed to New York, taking up a Faculty Fellowship in mathematics at Columbia University. After two years he returned to New Zealand, taking up a lectureship at the then quite new University of Waikato in Hamilton.

In 1973, Kevin was elected by NZ mathematicians assembled at the Mathematics Colloquium to serve on a working party with Donald Joyce of Massey University and David Vere-Jones of Victoria University, to establish a New Zealand Mathematical Society. Kevin wrote its first draft constitution and served on its Council for over 10 years, for a period as its Secretary, and later being elected Fellow and a Life Member.

His research in the seventies was mainly in the topology of metrizable spaces. He developed a classification for range-dependent topologies and along the way proved that every metrizable space could be decomposed into at most a continuum of closed dense subsets. He completed the Columbia University PhD in 1975, having returned to NY with his wife Jackie during study leave to write his thesis. This was supervised by Edgar Lorch, a functional analyst, who had a deep knowledge of metrizable spaces. The thesis was published by Springer-Verlag.

In the latter part of the 20th century, the University of Waikato was a small university, greatly in need of development. During a study leave at Cambridge UK in 1980 with his family, which now included two young children, Jude and Beck, he was quite taken with the emerging field of symbolic computation and the related field of computer algebra. Returning to NZ, he established a working party which had as its aim to create what was to become the School of Computing and Mathematical Sciences at the University of Waikato. The academic basis was that mathematics and computing had roots and applications throughout the whole of the university and society and not just in the physical and natural sciences. The School has now been in existence for over three decades.

For his own academic work, Kevin established a Mathematical Software Project in the 1980's and 1990's. It was to develop a fully interactive symbolic computation system which included Risch integration, finite element analysis, interfaces to the NAG Library of numeric subroutines and Numerical Recipes. Although it provided thesis work and publications for students and received grants including from the NZ Development Finance Corporation and NAG Ltd, it was difficult to sustain. He believed this was, in part, because mathematicians were slow to recognize computers were much more than mere "number crunchers". During this period Kevin had a close connection with Richard Fateman of the University of California at Berkeley, with several visits exchanged. The project and its relationship with Berkeley was to provide a foundation, because of its software needs, for the University of Waikato to become New Zealand's gateway to the Internet through the work of John Houlker.

During the 1990's, Kevin undertook, with Alfred Sneyd, a contract to model the scheduling of power from the eight hydro stations on the Waikato River. The goal was to determine the water flow down the river to generate a specified pattern of power output from the 50 generators for a two day period in advance. This was a fascinating challenge with the model having over four thousand variables and constraints. Being a mixed integer and real number optimisation problem, it was certainly NP hard. The solution Alfred and Kevin developed was to iterate from a large database of good solutions to a range of common schedule types to a close approximation to the required schedule.

The late 1990's were spent, first with Alfred as co-chairperson, and then as chairperson of the Department of Mathematics, working to restore the student numbers of the Department. This was achieved, with a doubling of the student enrolment over the 6 year period. Part of this endeavour was to join with a small group of other members of the University to establish engineering degrees. Howell Round from Physics and Kevin wrote the original submission, but others made very significant contributions to what has grown to become a very strong part of the University's teaching and research components.

While chairperson of department, Kevin started work in number theory, an accessible field with many unsolved problems. He had three excellent collaborators, Ross Barnett, an expert in the computation and properties of special functions, Florian Luca, a genius-level number theorist with over 600 publications, and Dorian Goldfeld, a Columbia University mathematician. With the latter, following several visits to Columbia University, Kevin wrote a suite of mathematical functions to go with Goldfeld's book on automorphic forms and L-functions. With Luca he worked on a range of arithmetical problems in number theory. With Barnett and Frances Kuo he evolved the theory of holomorphic flows, with applications to the zeta and related functions. Fundamental to this, Kevin showed that limit cycles do not exist, even for meromorphic flows, enabling good classifications to be made of the basins of zeros.

Following retirement in 2011, Kevin started work of a different nature. This was the production of expository books which would enable a student, starting out on their research, to gain sufficiently deep knowledge of an unsolved problem to have a hope of making progress towards a solution. Three volumes of "Equivalents of the Riemann Hypothesis" (over 2000 pages in all published by Cambridge in 2017 and 2023) and a single volume "Bounded Gaps Between Primes" (also published by Cambridge in 2021) were written in just over a dozen years. Although the final volume of Equivalents laid foundations for a proof that the Riemann Hypothesis was decidable, this proof was not completed until after the book was published and, at the time of writing, is being refereed.

Stephen Joe