

Curriculum Vita: Peter Jephson Cameron

I am a (half-time) Professor of Mathematics and Statistics at the University of St Andrews, and a Professor Emeritus in Mathematics at Queen Mary, University of London.

This CV gives an outline of my career. A detailed publication list is appended to it, but I have not provided detailed lists of talks given, conferences attended, etc. Further information is available from my Web page, <https://cameroncounts.github.io/web/>



1. Education

I was born in Toowoomba, an inland city in southern Queensland, Australia, on 23 January 1947, and grew up on a dairy farm in the village of Biddeston, outside Toowoomba. After receiving my early education by correspondence (not uncommon then for children in the bush), when we moved house in 1954 I attended Biddeston State School (I rode a horse to school, as did several other children) until 1959, when I went to Toowoomba Grammar School as a boarder. While there I discovered I had a talent for distance running, and was captain of the athletics team and Darling Downs champion in the mile.

In the Senior Public Examination (matriculation) in 1963, I was 5th in the State, and top in Mathematics and Science, for which I received a medal from BHP and an Open Scholarship to the University of Queensland.

I attended the University from 1964 to 1967 taking the four-year honours degree in Mathematics. I was a member of the University athletics club, winning the Australian Universities cross-country in 1966, and spent a year as club secretary. I graduated with First Class Honours in Mathematics and a University Medal in 1968. That year, I also won a Rhodes Scholarship to Oxford.

At Oxford, where I was a student at Balliol College, I took my DPhil in 1971, under the supervision of Peter Neumann; my thesis was on “Structure of suborbits in some primitive permutation groups”. These permutation groups also happen to be automorphism groups of graphs and designs, and the work pitched me into combinatorics as well as algebra. My external examiner was Donald Higman, who was a pioneer of the use of combinatorial techniques in the study of permutation groups (and co-discoverer of the Higman–Sims group which featured prominently in my thesis).

One of my discoveries was that graph-theoretic methods could be used to give much simpler proofs of some old theorems of W. A. Manning on permutation groups; at Peter Neumann's suggestion, this was the subject of my first publication, in volume one of the *Bulletin of the London Mathematical Society* in 1969.

2. Employment

In 1971 I was awarded a Junior Research Fellowship at Merton College, Oxford. During the three-year fellowship, I spent a semester at the University of Michigan, at Donald Higman's invitation. At the end of the semester, I travelled across the USA by Greyhound, meeting on the way mathematicians including Ed Assmus, Bill Kantor, Marshall Hall Jr., and Herb Ryser.

At the end of my fellowship in 1974, I took a job as a lecturer at Bedford College, London, where I shared an office with Warren Dicks. Before being offered this job, I had agreed to stand in for Dan Hughes at Westfield College while he was on leave; Bedford allowed me to fulfil this commitment. As well as undergraduate teaching, I gave a course of lectures on connections between graphs and designs. At about the same time, Jack van Lint also lectured at Westfield on codes and designs, and Dan Hughes encouraged us to publish our lectures in the relatively new London Mathematical Society Lecture Note series.

In 1975, a tutorial fellowship was advertised at Merton College; encouraged by friends there, I applied, and was successful. Though reluctant to leave Bedford College, I spent eleven very good years at Merton. Among other things, I was Principal of the Postmasters (Merton-speak for Dean) for several years, and was also chair of the Mathematics and Philosophy Committee which administered the joint degree in Mathematics and Philosophy.

At Oxford I supervised 13 DPhil students, including Eric Lander (currently President and Director of the Harvard/MIT Broad Institute for Genome Research) and Dugald Macpherson (a professor at Leeds and leading model theorist).

In late 1985, a chance visit by Dan Hughes (then at Queen Mary College) led to the offer of a position there, which I accepted, moving in September 1986. I was appointed as a Reader but became Professor of Mathematics the following year. I retired from Queen Mary in 2012, and am currently Professor Emeritus in Mathematics there.

In March 2013, I was appointed Professor of Mathematics and Statistics at the University of St Andrews, on a half-time basis: I taught a MSc course on Advanced Combinatorics, and was head of the Algebra and Combinatorics group. Currently I am employed 25%, and recently designed and presented a new module on Set Theory and Mathematical Logic.

In London I briefly revived my running career and ran the London marathon twice, with a best time of 2 hours 46 minutes 59 seconds in 1987.

3. Teaching

While at Queen Mary, I gave lecture courses on a variety of topics in algebra, analysis, logic, combinatorics, coding theory, computational group theory, probability, operational research, and cryptography.

Several of these courses I designed myself. These include *Complexity and Optimization in OR* (jointly with Thomas Wolf), *Cryptography*, and *Introduction to Algebra*. Later I designed and taught another new course entitled *Mathematical Structures*, which all mathematics and joint honours students take in the first semester. The course is an attempt to equip the students with the right mindset for successful study of mathematics, and the problem-solving skills which will serve them well in their degree and in subsequent employment. The course has been very successful; one graduate told me that it was the only one of his undergraduate modules which had been useful to him in his subsequent career.

At Queen Mary, I was awarded a Drapers Prize for Teaching and Learning at the 2007 graduation: the graduating students showed their pleasure by a Mexican wave (the first time those present had seen such a thing at a graduation ceremony).

At St Andrews, I was awarded a prize for teaching innovation in 2015. The award cited the way my lectures were closely tied to ongoing research, and the flexibility gained by having multiple syllabuses for the module.

I was also awarded the Pedro Nunes teaching award at the Universidade Aberta (Open University) in Portugal in 2015.

I have given postgraduate or MMath/MSci courses on *Permutation Groups*, *Projective and Polar Spaces*, *Group Theory*, *Codes and Ciphers*, *Classical Groups*, and *Counting* (aka *Enumerative and Asymptotic Combinatorics*), and *Advanced Combinatorics*, and an LTCC advanced course on *Enumerative Combinatorics*. I have also given short courses in Eindhoven, Rome, Budapest, Prague, Tehran, Barcelona, Shanghai and Hangzhou, as well as two LTCC Intensive Courses on *Synchronization* and on *Laplacian Eigenvalues and Optimality* (the latter with R. A. Bailey). In 2014 I taught a pre-doctoral course on *Group Theory* at the Open University of Portugal.

My habit now is that, for every course I teach, I produce and polish to the best of my ability a set of lecture notes. These are available on my web page and now includes eight sets of undergraduate notes and six sets of graduate notes, as well as a three-part set of St Andrews lectures on advanced combinatorics. These are freely available on the web, at <https://cameroncounts.wordpress.com/lecture-notes/>

13 students have obtained DPhils at Oxford, 26 PhDs at Queen Mary, and two PhD at St Andrews, under my supervision. I also regularly supervise summer research projects, some of which lead to publishable results.

4. Examining

As well as examining my own lecture courses, I have been on the examination board in Oxford (where six examiners covered all subjects), as well as external examiner at the universities of Exeter, Warwick, UW Aberystwyth, Imperial College London, and Oxford.

I do not have a complete list of PhD students examined; the total number is in the region of 50, including most recently Justine Falque (Paris-Saclay), Natalie Behague (Queen Mary University of London), Maya Thompson (Royal Holloway University of London), Matt McDevitt, Chris Russell and Mun See Chang (St Andrews).

5. Research

As noted earlier, most of my research lies in either Algebra or Combinatorics, with excursions into Logic and other areas (including Measurement Theory in mathematical psychology). However, I do not see anything real in these divisions. If I had to describe my research briefly, I would say “Symmetry and Structure”. These two themes run through much mathematics, sometimes orthogonally, sometimes reinforcing each other. One of my favourite theorems is the theorem of Engeler, Ryll-Nardzewski and Svenonius in model theory. This asserts that, for a countable structure M in a first-order language, the following properties are equivalent:

- axiomatisability (M is determined up to isomorphism by its first-order theory and the fact that it is countable);
- symmetry (the automorphism group of M has only finitely many orbits on n -tuples for every natural number n).

Of course, the second part of this equivalence means that a sequence of natural numbers is associated with any such structure, linking enumerative combinatorics and formal power series to group theory and model theory. I coined the term *oligomorphic* for groups with the stated property, and much of my work has involved these groups and structures. Recently these groups and structures have become increasingly important in the field of constraint satisfaction, in computer science, as well as Ramsey theory and topological dynamics.

I have always thought that the purpose of a group is to act on something; much of my research involves using deep properties of groups in order to understand better the structures (finite or infinite) they act on, which may be designs or graphs (in my early work), or more general first-order structures, metric spaces, etc.

My most influential paper was an investigation of the impact that the Classification of Finite Simple Groups (believed then to be imminent) would have on the theory of finite permutation groups. This work, especially the results on orders

of primitive groups, have been applied in many areas, from graph isomorphism to profinite groups. The recent breakthrough by László Babai on the graph isomorphism problem rests on this paper.

The work of which I am most proud involves finding unexpected connections between apparently different things. One of my most cited papers (with J.-M. Goethals, J. J. Seidel and E. E. Shult) used the classification of root systems from the theory of Lie algebras to get substantially improved results on graph spectra (a useable classification of graphs with least eigenvalue -2).

Beginning in 2021 I have been involved in a big collaboration with mathematicians mostly in India but also Russia, China and Vietnam, on graphs defined on groups. Another research project, with João Araújo (Lisbon) and others, involves using properties of permutation groups (especially those using the classification of finite simple groups) to study transformation semigroups.

I have over 350 academic publications, with over 200 coauthors. A complete publication list is attached. My Erdős number is 1, and my H-index is 61 (according to Google Scholar, which counts 16990 citations of my work).

I was awarded the London Mathematical Society's Junior Whitehead Prize in 1979 (the inaugural year for this prize), and their Senior Whitehead Prize in 2017, one of only three people thus far to be awarded both (especially pleasing as Henry Whitehead is my mathematical great-grandfather). I won The Institute of Combinatorics and its Applications' Euler Medal for Lifetime Achievement in 2003.

In 2014, I spent two months at the University of Auckland as a Hood Fellow. I primarily worked with Dr Dimitri Leemans on regular polytopes, but interacted with several other mathematicians and visitors there. Following two one-month visits to Portugal (to different research groups) in 2015, in 2016 I made an extended research visit to the University of Western Australia. In each of the years 2017–2019 I visited China, to work with research groups in Shanghai and Hangzhou and to give a course at a conference and summer school in Yichang (Three Gorges).

Since my appointment in St Andrews I have been involved in three research projects with several members of the School of Mathematics and Statistics.

In 2020 I was a long-term participant at a programme on *Groups, Representations and Applications* at the Isaac Newton Institute in Cambridge, which unfortunately was cut short by the COVID-19 pandemic. I am involved in two major research projects with participants in the programme, and two others with coauthors in Florence, Lisbon and Denver, along with many smaller projects ongoing.

6. Seminars and special lectures

I have given talks at seminars and conferences, at universities and govern-

ment or industrial research organizations in the U.K., Eire, Belgium, the Netherlands, France, Germany, Italy, Greece, Hungary, the Czech Republic, Slovenia, Serbia, Russia, Tunisia, U.S.A., Canada, Jamaica, Iran, India, China, Japan, Australia and New Zealand. These include: section speaker, International Congress of Mathematicians, Kyoto 1990; section speaker, European Congress of Mathematics, Barcelona 2000; plenary speaker, Australian Mathematical Society meeting, Brisbane 2000; plenary speaker, Canadian Mathematical Society meeting, Halifax, 2004; plenary speaker, New Zealand Mathematics Colloquium, Dunedin, 2004; plenary speaker, Portuguese Mathematical Society summer meeting, Caparica, 2014; and speaker at EMS regional meetings in Prague 2004 and Barcelona 2005.

I was London Mathematical Society Popular Lecturer in summer 2001: this involved three talks (in Strathclyde, Leeds and London), and a video was produced from the third talk.

I gave the 2007 Kathleen Ollerenshaw Lecture at the University of Manchester; the 2009 Copson Lecture at the University of St Andrews; and the 2010 Coulter McDowell lecture at Royal Holloway, University of London; and the 2018 Venn Lecture at the University of Hull in May 2018. In 2024 I will give lectures dedicated to Simon Norton and to Richard and Louise Guy.

I was the London Mathematical Society's 2008 Forder Lecturer: this involved a month-long lecture tour of New Zealand giving 13 lectures in six different centres, including a popular lecture to 150 people in Auckland, and an interview on the Kim Hill show on Radio New Zealand; the podcast of the interview is at <http://www.radionz.co.nz/national/programmes/saturday/audio/1500732/peter-cameron-sudoku-and-mathematics>

In 2013 I delivered the London Mathematical Society's Gresham Lecture; the title was "Mathematics: The Next Generation", and I discussed the development and delivery of the Mathematical Structures module at Queen Mary. The video of this talk is available on YouTube at <https://www.youtube.com/watch?v=i2f4KHAAGy8> The video had been watched more than 800,000 times by the end of June 2018.

7. Conference organisation and talks

I was joint organiser of a 6-month programme on "Combinatorics and Statistical Mechanics" at the Isaac Newton Institute, Cambridge, in January–June 2006. I was also joint organiser of the 16th BCC at Queen Mary, 1997, and of a LMS/EPSRC short course on "Design in Combinatorics and Statistics" at Queen Mary in 2002.

I was one of the organisers of a Durham Symposium on "Graph Theory and Interactions" in 2013; in 2015 I organised another, on "Permutation Groups and

Transformation Semigroups”. I am on the scientific committee for a six-month programme at the Newton Institute on “Groups, representations, and applications” in January–June 2020.

I organised a special session on Combinatorics, and was a principal speaker, at the 1996 British Mathematical Colloquium. I also co-organised a special session on Combinatorics and Finite Geometry at the first ever joint Belgian/London Mathematical Societies meeting in 1999. I also assisted in the organisation of the 2014 BMC at Queen Mary, though because of my retirement and move to Scotland was unable to contribute as much as I had hoped.

Recent short meetings organised include “Combinatorics and Statistical Mechanics”, London, 2005; “Algebra and Design of Experiments”, London, 2007; “A celebration of Karl Gruenberg”, London, 2008, and “Donald Preece Memorial Day”, London, 2015.

A conference for my 60th birthday took place in Ambleside in August 2007; speakers include Persi Diaconis, Eric Lander, Cheryl Praeger and Alan Sokal. A conference for my retirement was held at Queen Mary in July 2013; speakers included László Babai, Peter Neumann, and Anatoly Vershik. In July 2017 a conference for my 70th birthday was held at the University of Lisbon, with speakers including Jaroslav Nešetřil, Gregory Cherlin, Boris Zilber, John Meakin, and Dugald Macpherson.

In the first half of 2020 I was a Simons Fellow at the Isaac Newton Institute, for a scheduled six-month meeting on *Groups, Representations and Applications: New Perspectives*, which was cut short by the COVID-19 pandemic; it was continued in the summer of 2022.

8. Administration, service

From 1994 until 2022 I was chair of the British Combinatorial Committee, the Scottish-registered charity which supports combinatorial mathematics in the United Kingdom. Its most important role is organising the biennial British Combinatorial Conference, a large international conference which I helped organise at Queen Mary in 1997 (on that occasion it attracted 319 delegates). I was re-elected to this position at the conference Business Meeting every two years until I stood down in 2022. I was also responsible for the Committee’s web page at <https://britishcombinatorial.wordpress.com/>

I was on the SERC mathematics committee from 1989 to 1992 (this committee no longer exists!) I was on the EPSRC Mathematics College from 1995 to 2005.

In 1996 and 2001 I was on the Pure Mathematics Panel for the UK Research Assessment Exercises. I also helped produce the Queen Mary submission in 2008.

In 2003 and 2011 there were International Reviews of UK mathematics, commissioned by EPSRC. I was responsible for presentations to the panel on both

occasions, on Combinatorics in 2003 and Algebra in 2011. I also participated in the EPSRC “Balancing Capability” review in 2016.

I am honorary Editor-in-Chief of the *Australasian Journal of Combinatorics*, a journal which (I am happy to say) moved to Diamond open access (free to both authors and readers) in 2014. The journal can be found at <http://ajc.maths.uq.edu.au/>

I have been the editorial boards of a number of other journals, but have given up most of these since retirement. In 1990 I became editor of the *Queen Mary Maths Notes*, a very successful series which has been effectively killed off by web publication.

I served on the Website Committee and the Prizes Committee of the LMS.

9. Media appearances

I appeared on a BBC *Horizon* programme “To Infinity and Beyond”, which was watched by about one and a half million people, and was listed among the best *Horizon* programmes on the iPlayer. I also discussed infinity on a BBC World Service radio programme, at the “How the Light Gets In” festival at Hay-on-Wye, organised by the Institute of Arts and Ideas, and at the first meeting in a series entitled “Mass Interaction” in London, where I discussed infinity with John Barrow.

In May 2016 I gave another IAI course at Hay-on-Wye, this time on cryptography.

I have also been briefly on television discussing cryptography and also interest rates, and was quoted on the front page of the *Daily Telegraph* discussing palindromic dates. My interview on Radio NZ was mentioned above.

I run a blog under the name “Cameron Counts” at <https://cameroncounts.wordpress.com/>, which is listed on the LMS catalogue of mathematical blogs.

10. Publications

I have authored or co-authored thirteen books: three undergraduate texts (on algebra, combinatorics, and set theory and logic), three graduate texts (on permutation groups, on graphs codes and designs, and on enumerative combinatorics), three research monographs and four edited conference proceedings; and more than 350 papers. Some of these have been translated into languages including Russian, Kazakh, and Farsi. A list is attached. On 21 March 2020, a paper with my 200th coauthor was accepted for publication.