

Sir Vaughan F. R. Jones (1952–2020)

David Evans (Cardiff University, UK) and Sorin Popa (University of California at Los Angeles, USA)



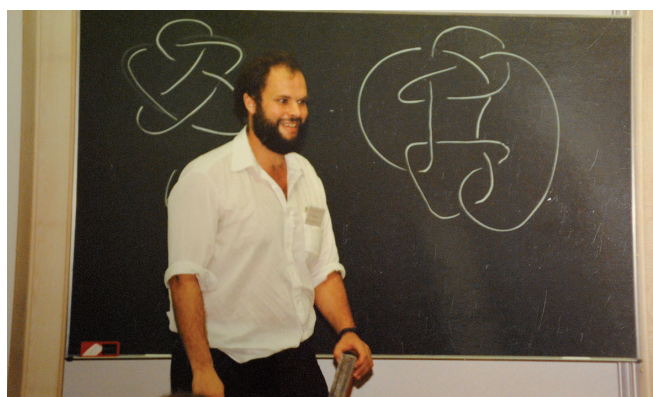
Sir Vaughan Jones died aged 67 on 6 September 2020, following complications after a severe ear infection. An inspired and inspiring mathematician of exceptional originality and breadth, his enduring work brought together several disparate areas of mathematics, from analysis of operator algebras to low dimensional topology, statistical mechanics and quantum field theory, with major impact and unexpected, stunning applications, even outside of mathematics, as in the study of DNA strands and protein folding in biology. A crucial idea leading to these striking connections was his groundbreaking discovery in the early 1980s that the symmetries of a factor (an irreducible weak* closed algebra of operators on Hilbert space), as encoded by its *subfactors*, are *quantized* and generate quantized groups, a completely new type of structure, endowed with a dimension function given by a trace and an index that can be non-integral.

Vaughan Jones was born on 31 December 1952 in Gisborne, New Zealand. He was educated at Auckland Grammar School and the University of Auckland, where he earned a bachelor of science and a master of science with first class honours. He then received a Swiss government scholarship and completed his PhD at the University of Geneva in 1979 under the supervision of André Haefliger and Alain Connes, with his thesis awarded the Vacheron Constantin Prize. He was a Hedrick assistant professor at UCLA in 1980–1981, an associate professor at the University of Pennsylvania 1981–1985 and was then appointed full professor at UC Berkeley in 1985. From 2011 on, he held the Stevenson Distinguished Chair at Vanderbilt University, while also being professor emeritus at UC Berkeley.

Already in his thesis work, Vaughan Jones was interested in the classification of finite groups of automorphisms (“classical symmetries”) of a class of von Neu-

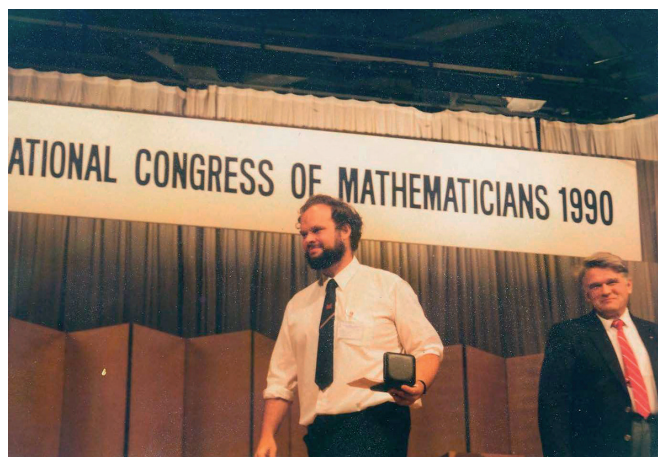
mann algebras called II_1 factors, following up on Connes’ classification of single automorphisms. He developed a novel, algebraic approach, where the action of the group was encoded in the isomorphism class of a subfactor. Soon after, this led him to consider abstract subfactors together with a natural notion of relative dimension that he called *index*, and to study the values it can take. By late 1982, he had made a series of amazing discoveries. On the one hand, the index of a subfactor can only take values in the discrete set $\{4 \cos^2(\pi/n) \mid n \geq 3\}$ or in the continuous halfline $[4, \infty)$. On the other hand, all these values can actually occur as indices of subfactors, and, indeed, as indices of subfactors of the most important II_1 factor, the so-called *hyperfinite* II_1 factor (the non-commutative, quantized version of the unit interval). The proof involved the construction of an increasing sequence of factors (a *tower*), obtained by “adding” iteratively projections (i.e., idempotents) satisfying a set of axioms which together with the trace provide the restrictions. Shortly after, Jones realised that his sequences of projections give rise to a one-parameter family of representations of the braid groups, and that appropriate re-normalizations of the trace give rise to a polynomial invariant for knots and links – the *Jones polynomial*.

This immediately led to a series of spectacular applications in knot theory, solving several of the Tait conjectures from the 19th century. More importantly, it completely reinvigorated low dimensional topology, igniting totally unexpected developments with an exciting interplay of areas, including physics, and a multitude of new invariants for links and 3-dimensional manifolds, altogether leading to a new brand of topology, *Quantum Topology*.



This revolutionary work also had a huge, far-reaching impact on the theory of II_1 factors and operator algebras, posing exciting new questions about the classification of subfactors and of the quantized groups they generate. Many outstanding results by a large number of people have followed. Jones was much involved in this development, notably finding the best way to characterise

the group-like object arising from the tower of factors (the *standard invariant*) as a two-dimensional diagrammatic structure of tangles called *planar algebra* (1999), and then classifying them up to index 5, in a remarkable programme developed with some of his former students (2005–14). This, together with a quest to produce conformal field theory from subfactors, led Jones to a study of the Thompson groups and again to unexpected spin-offs for the theory of knots and links (2015–2020). In a parallel development which started in 1983, the connection was made with calculations by Temperley and Lieb in solvable statistical mechanics, triggering yet another series of connections with physics, statistical mechanics and conformal quantum field theory, where a similar dichotomy of discrete and continuous parts of the central charge occur.



Vaughan Jones was awarded the Fields Medal in Kyoto in 1990, and was elected Fellow of the Royal Society in the same year, became Honorary Fellow of the Royal Society of New Zealand in 1991, member of the American Academy of Arts and Sciences in 1993 and of the US National Academy of Sciences in 1999, and foreign member of national learned academies in Australia, Denmark, Norway and Wales. He received the Onsager Medal in 2000 from the Norwegian University of Science and Technology (NTNU). In 2002 he was made a Distinguished Companion of the NZ Order of Merit (DCNZM), later re-designated Knight Companion KNZM. The Jones medal of the Royal Society of New Zealand is named in his honour.

He had a strong commitment of service to the community. In 1994 he was the principal founder and director of the New Zealand Mathematical Research Institute, leading summer schools and workshops each January. He was vice president of the American Mathematical Society 2004–2006, and vice president of the International Mathematical Union 2014–2018.

Vaughan had a very distinctive and personal style of research in mathematics. His warmth, generosity, sincerity, humour and humility led him to thrive on social interaction, and for the mathematical community to significantly benefit from his openness in sharing ideas through every stage of development, from initial speculations and conjectures about the way forward to the discussion and

explanation of the final results. His presence both at formal and informal events and his regular interaction with mathematicians, especially graduate students, including his own, of which he had more than 30, enriched all those who came into contact with him.

Vaughan regularly mixed his passion for skiing and kite-surfing with hosting informal scientific meetings at Lake Tahoe, Maui and his family retreat in Bodega Bay. His love for rugby was legendary, as was the fact that he wore an All Blacks jersey for his plenary at the ICM in Kyoto following the award of his Fields medal. His other major passion was music, especially choral singing and orchestral playing, shared intimately with his family and friends. Vaughan is survived by his wife Martha (Wendy), children Bethany, Ian and Alice and grandchildren. He will be dearly missed by his family and the many friends all over the world.

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David Evans [EvansDE@cardiff.ac.uk] is an Honorary Distinguished Professor at Cardiff University, Wales, UK; formerly Professor at Cardiff 1998–2019 and Swansea 1987–1998, Lecturer and Reader at Warwick 1980–87 and Research Professor at RIMS Kyoto 1990–91. His research interests are in Operator Algebras, K-theory and applications in Statistical Mechanics and Conformal Quantum Field Theory.



Sorin Popa [popa@math.ucla.edu] is a professor and Takesaki Chair in mathematics at UCLA. He was a professor at the University of Geneva in 1996–1998 and a frequent visitor of the Institute de Mathématiques de Jussieu in Paris, including a Chair Blaise Pascal 2009–2010 and Chair FSMP 2016–2017. He is an analyst working in operator algebras, group theory and ergodic theory, especially on rigidity aspects pertaining to these areas.