Roy Chisholm, who has died aged 88, was a highly regarded mathematical physicist who is remembered with much affection and respect by those who had the good fortune to work and collaborate with him. In many ways the term 'polymath' could have been invented to describe Roy. His classical education certainly influenced his approach to his work and also his willingness to embrace other disciplines and outlooks so he was able to entertain a broader view than perhaps someone whose scholarship was narrower and more focused. This broad perspective extended to people as well, and, as a result, those who count him as having an influence on their career and approach are many and various. He had the ability to combine the best aspects of the past and the present: he could be 'old-school' while simultaneously being open-minded and tolerant – modern and young at heart - while at the same time having the best attributes of what might be regarded as something of the past - good 'old-fashioned' manners and breadth of knowledge.

Roy was born on 5 November 1926 in Barnet, Hertfordshire. His secondary schooling was during the war years 1939-45 at Highgate School, where he was Head of School. From there he went to Christ's College, Cambridge University to study mathematics. He was a Wrangler in part 2 and achieved a distinction in part 3 of the mathematics tripos, 'the oldest and most famous maths exam in the world'. However, his prowess was not just in mathematics: he represented Christ's College in four sports: tennis, football, hockey and badminton.

In 1948 he became a research student at Cambridge, researching into quantum field theory of elementary particles and developing what was 'new' at the time, Feynman graphs, in particular breaking new ground with his derivation of the 'symmetric integration' formula. Household names in that branch of mathematical physics were either his fellow students or academics in the group; for example, Professor Paul Dirac was a senior academic there. It was this time which was to shape much of his professional career and his personal life too. It was then he met his future wife Monty Eriksen who was studying at Homerton College and also others whose academic paths would cross again with his later in life. It was also where his interest in higher-dimensional theories began.

Roy's early career took him around all of the countries of Great Britain and beyond. Immediately after obtaining his Doctor of Philosophy from Cambridge he moved to become a Nuffield Research Fellow at Glasgow University and from there to University College, Cardiff, where he had his first lectureship in Applied Mathematics. Although Roy was the only particle theorist at Cardiff, he kept in touch with new developments through his contacts at Harwell and the Rutherford Laboratory. It was during one visit there that his mind was opened up to the opportunities afforded to visiting academics and with that he started to think about how to take advantage of overseas travel to broaden his experience, the first of which was his successful application for a year's secondment to CERN during 1962-63.

The list of institutions which welcomed Roy as a visiting academic over the years is too long to include all, but to give a flavour of how prestigious they are, they included Texas A&M, Los Alamos, Stanford, Adelaide, plus regular short trips to CERN. The opportunities to travel and meet a wide range of people had a profound influence on his outlook, on his life and on his family's lives as well. The invitations to visit overseas continued throughout his career and are a tribute to the affection and esteem with which he and Monty are regarded, and to the number and range of contacts and enduring friendships that they made.

While at Glasgow and Cardiff his work using Feynman graphs continued, investigating field theories of various different interactions and their equivalencies. At Glasgow he also found time to work and publish on the fundamentals of statistical mechanics, and in Cardiff he was commissioned, with Rosa Morris, to produce a seminal text book on mathematical methods for scientists and engineers. However, it was at the Rutherford Laboratory that was influential on the focus of his work since there he was introduced into numerical computation and in 1962 to Padé approximants, a topic which dominated his research for the next sixteen years.

At CERN in the early sixties, Roy's interest in aspects started in his doctoral thesis was rekindled and he is credited for developing the full set of algorithms for scalar products of the Dirac gamma algebra, to which his name is attached – the Chisholm-Caianiello-Fubini Identities. This led to a paper a few years later on the linked Pauli algebra – and in many ways was the forerunner of work that was to dominate his research for the latter part of this career.

Roy returned from CERN in 1963 to his first chair (in Natural Philosophy) at Trinity College, Dublin, a post which he had deferred a year earlier to visit CERN. He was to remain at Trinity for only two years, then he spent a year in the US prior to returning to England in 1966 to take up the founding Chair of Applied Mathematics at the new University of Kent; a position in which he remained until he retired in 1994. Roy built up the core of the applied mathematics staff at Kent whose specialisms were numerical analysis and numerical computations applied to physics, including of course Padé approximants. Roy and his colleagues applied Padé approximants to accelerate sequences of numerical approximations to single integrals and then more generally to numerical integration. The culmination of the group's Padé work in this area was a successful Summer School and Colloquium in 1972, supported by the then Science Research Council, NATO and the Institute of Physics. This brought together mathematicians and physicists and led to a resurgence of interest in the topic, including Roy's, and prompted his breaking new ground with the development of multivariate Padé approximants with which the name of the applied group at Kent became associated throughout the seventies and beyond.

It was the mid-1970s which saw Roy's research take a new direction, although picking up on several aspects which had been part of his research interests years earlier: higher dimensional theories and the Dirac and Pauli algebras. The Dirac and Pauli algebras are examples of Clifford algebras in spaces of particular dimensions, and it was these algebras on which Roy's and my 'spin gauge theories' were based. Spin gauge theories are Lagrangian field theories unifying the interactions of the fundamental particles based on Clifford algebras of higher dimensions, with the interactions generated by gauge symmetry transformations in the higher dimensional space. It was a truly satisfying piece of work, like fitting bits of a jigsaw together with the algebras driving the production of an internally consistent theory which pieced the bits together. The most notable achievement was the prediction of the mass of the top quark which was very close to the experimental measurement.

The time spent working on spin gauge theories coincided with a growing awareness that a significant number of small research groups from around the world were also working on the applications of Clifford algebras. Roy's positive experience of the Padé conference in 1972 led him to set about bringing together these different groups by organising, with Professor Alan Common, an international conference at the University of Kent with funding from NATO and the Science and

Engineering Research Council. It was a revelation and generated a great sense of bonhomie. It triggered a series of conferences which continue to this day bringing together different aspects of research using Clifford algebras which are very much in the spirit of Roy's approach to mathematics research: open-minded and embracing. Roy is highly regarded and respected internationally as one of the founding fathers of mathematical applications of Clifford algebras.

For Roy, the work on Clifford algebras opened new and unexpected avenues of work. The Clifford algebras are named after their inventor, William Kingdon Clifford, a Victorian mathematician, who with his wife, Lucy, was at the centre of scientific and literary culture in London at the time. With Monty, Roy found himself moving into new aspects of research: history and philosophy inspired by the lives of William and Lucy. Latterly Roy is probably remembered equally as much for this work with Monty as his mathematics. His retirement in 1994 is definitely a misnomer as it coincided with much of this work taking off and to a string of invitations enabling him to extend those travel opportunities around the world that he had sparked off decades earlier while at the Rutherford Laboratory. Exotic destinations to add to the previous list included Mexico, Japan, China and Australia. Nevertheless, Roy did manage to make time to continue with the mathematical legacy of Clifford, defining Clifford manifolds.

Roy never retired in the true sense of the word and in the last few years of his life he continued to dwell on matters relating to spin gauge theories. However, what really inspired him during this time was the discovery that he was accomplished at creative writing both in the form of stories and also poetry. His novel 'Changing Stations' was published in 2014. It is a rattling good yarn with a university campus setting and those of us with a knowledge of Kent surely try to spot familiar places and faces set into the fictional tale. However, for those of us close to Roy what is truly characteristic is the play on words and puns of the characters' names, based on underground stations in London and other world cities.

It should be remembered that Roy founded the mathematics department at the University of Kent and was its head for various periods of time. He was therefore extremely influential in forming and shaping the nature of applied mathematics at Kent, which lives on today. Taking on a senior position at Kent in the early days as a university meant that he was also involved in committee work. His interest in sports led him to establish the Sport and Recreation Committee which he chaired for 13 years and in that capacity was responsible for the setting up the new Sports Centre, so not only did he develop applied mathematics at Kent but also the sports facilities are his legacy. In those various roles, Roy could be said to have been a university leader and manager, but he never would have described himself in that way – he was first and foremost an academic with an overwhelming interest in his own subject and in soaking up knowledge. He has never been an establishment figure, which is said as a compliment, and he has never been afraid to challenge or to court controversy. He would stand up for what he considered was right and would fight for and defend what he believed in, for example, adequate resources for his departments.

Roy died on 10th August 2015 after a short time in hospital. Although his health was deteriorating for a while in recent years, he remained active with an enquiring mind – just like the Roy we all think of so fondly. He is survived by his wonderful wife and companion, Monty, by his beloved children, Carol, David and Alison, and his granddaughters, of whom he was immensely proud. I, and many others, feel privileged to have been able to have him as part of our professional lives. He defended

to the last those with whom he collaborated and in whose work he believed; we thank him for his steadfast loyalty.

Professor Ruth Farwell CBE DL recently retired as Vice Chancellor of Buckinghamshire New University. She was an undergraduate student in mathematics in the early days of the University of Kent, and Roy Chisholm was the supervisor of her PhD. It was the PhD research on which they worked closely together that was the start of a long collaboration between the two of them, lasting several decades during which they developed and further refined 'spin gauge theories'. More details of Roy's career and his work can found in his memories on http://www.roychisholm.com/