degeneration left P. R. legally blind throughout his adult life, he considered this just a minor obstacle to the pursuit of his goals. He was a man of broad interests: Everything in nature interested him, and he threw himself into each project with tremendous energy and enthusiasm. He wanted everyone to share in the wonders of this world and was well known locally for his down-to-earth talks to civic clubs and organizations. He had a great love of music and, in younger days when his eyesight was better, sketching and woodcarving.

P. R. will be remembered for his love of science, his unassuming ways, the love he gave to his wife and son, his kind and gentle nature, and his happy disposition.

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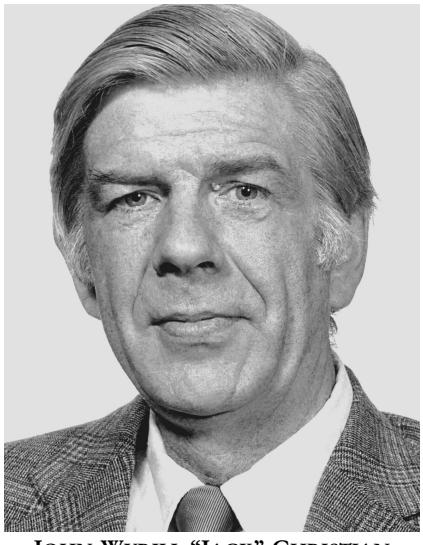
John Wyrill 'Jack' Christian

John Wyrill "Jack" Christian collapsed and died suddenly on 27 February 2001 while doing what he loved best: working in his office at the department of materials, Oxford University, in England. Although he had been suffering from Parkinson's disease for more than 20 years, he was active both socially and academically—the evening before he died, he and his wife had gone to the cinema.

Jack was born on 9 April 1926 in Scarborough on the east coast of Yorkshire, England. At age 17, he went to Oxford University's Queen's College to study physics. He completed the accelerated wartime course with honors two years later. Although a physics graduate, Jack joined William Hume-Rothery's science of metals group in the university's Inorganic Chemistry Laboratory for his doctorate. He worked on the chromium–manganese and cobalt–manganese phase diagrams and was awarded his DPhil in 1949.

Jack found the determination of phase diagrams rather dull, so when "H. R." invited him to stay with the group, he started to look at problems in what was then called metal physics, which fascinated him. In 1951, he published his first important paper, in the *Proceedings of the Royal Society*, on phase transformations, explaining the solid-state transition in cobalt in terms of dislocation theory. International recognition soon followed, and Jack became a leading authority on martensite, an alloy of iron and carbon. A review paper (*Institute of Metals Monograph and Report Series*) with Bruce Bilby in 1956 on martensitic transformations is particularly noteworthy.



JOHN WYRILL "JACK" CHRISTIAN

Jack (known as "Chris" to his students) believed in describing research projects in broad terms, so students were obliged to work out their own inclinations. He was also kind to his students. On one occasion, in the days of mechanical typewriters and rigid submission dates, Jack, on hearing that one of his students was having difficulty finding a typist to do the thesis, offered his services with the words, "I'm two fingered, fast, not very accurate, but I don't charge."

His first research student was the late Z. S. "Bas" Basinski, whose project was on the martensitic-type phase transitions that occurred in manganese–copper and indium–thallium alloys. The transformed structures are heavily twinned and the application of stress gives rise to a reversible deformation, which is now known as the shape memory effect.

It was with Basinski, then in Ottawa, Canada, in 1956, that Jack started his work on the deformation of metals and alloys; their 1960 paper, published in the *Australian Journal of Physics*, on the deformation of iron at low temperatures was the first to show that pure iron had a large Peierls–Nabarro force and that thermal activation was the key process for dislocation glide. On returning to Oxford in 1956, Jack initiated the building of crystal-growing facilities and special mechanical testing machines. His research on the deformation of single crystals of iron and other body-centered cubic (BCC) alloys (especially pure niobium) established that a large Peierls–Nabarro force exists in all crystals with the BCC structure. It also became clear that there was an asymmetry of slip for glide on {211} planes (shear in the twinning sense being easier than the reverse) and at temperatures below ambient, there was a complete breakdown of Schmid's law with the occurrence of anomalous slip. He also established that the screw dislocation was important in the deformation of these materials.

A great reader of the scientific literature, Jack was able to draw together seemingly unrelated theories and show that they were different facets of a common model. The earliest, and probably the best known, example concerns martensite; in 1955, he was able to prove (see *Journal of the Institute of Metals*) the equivalence of the two general phenomenological theories of the crystallography. Later, in 1976, he performed similar research on the structure of interfaces, and in the field of deformation married the rival Peierls–Nabarro and dislocation dissociation models.

Jack was a modest and self-effacing man with a brilliant intellect. In scientific discussion, he listened carefully and courteously to what others had to say, be they visiting world authorities or undergraduates. However, he subjected their comments to a rigorous analysis, never failing to point out any weaknesses in the argument. He also was a lucid, inspiring teacher. One student claims that Jack never answered a question directly in eight years of undergraduate, postgraduate, and postdoctoral supervision. Instead came the dreaded words, "Well, what do you think?" The ensuing discussion not only solved the problem but developed intellectual powers far more than any direct answer could have done.

Jack corresponded and collaborated with many scientists worldwide. He used his sabbaticals to take up visiting professorships across North America; he enjoyed visiting and lectured in India, China, Japan, Australia, and South America. He also was editor or assistant editor of several international scientific journals. Jack was elected a fellow of the Royal Society in 1975.

Jack, with Hume-Rothery and Bill Pearson, wrote the book *Metallurgical Equilibrium Diagrams* (Institute of Physics, London, 1952). However, his passion was his masterwork, *The Theory of Transformations in Metals and Alloys*. A work of immense scholarship, the first edition (Pergamon Press,

1965) quickly became the definitive work in its field. The first volume of the enlarged second edition was published in 1975 (Pergamon Press). Partly because of Parkinson's disease, Jack took early retirement in 1988, which allowed him more time to concentrate on the next volume of the book. The manuscript was completed a couple of years before Jack died; it is sad that he did not live to see it in print.

Outside the laboratory, Jack enjoyed the theater, cinema, literature, and hill-walking, particularly in his native Yorkshire.

Jack had extraordinary courage in the face of a debilitating disease, yet he was modest, approachable, and inspiring to all who knew him, especially those of us who had the good fortune to have been his students.

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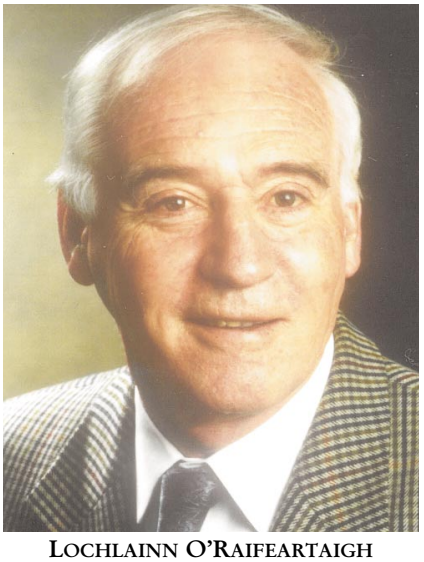
Lochlainn O'Raifeartaigh

Lochlainn O'Raifeartaigh, a senior professor of theoretical physics at the Dublin Institute for Advanced Studies (DIAS), died of liver cancer on 18 November 2000 in Dublin, Ireland.

O'Raifeartaigh was born in Dublin on 11 March 1933. His father, as Ireland's first chairman of the Higher Education Authority, was instrumental in developing university education in Ireland. After O'Raifeartaigh received his master's degree in mathematical physics from University College Dublin in 1956, he entered DIAS, where he studied for one year with the great Irish relativist John L. Synge. O'Raifeartaigh's paper on Fermi coordinates was one of three he wrote during that year.

In 1957, he was given a grant by DIAS to study under Walter Heitler, one of the pioneers of quantum field theory, at the University of Zürich. O'Raifeartaigh received his doctorate in theoretical physics there in 1960. The subject of his thesis was the *S*-matrix in the nonlocal field theory of Edmond Arnous and Heitler.

He returned to DIAS as an assistant professor of physics in 1961. He spent the winter of 1963–64 at the Madras Institute for Mathematical Sciences, where he lectured on local Lie groups and their representations. In the autumn of 1964, he went on extended leave from DIAS to Syracuse University.



LOCHLAINN O'RAIFEARTAIGH

At Syracuse, O'Raifeartaigh made a discovery that established his reputation: He proved, in 1965, that it was impossible to combine internal and geometric (relativistic) symmetries of the Lie group type in a nontrivial way. This result, which became known as O'Raifeartaigh's Theorem, brought to an abrupt end major efforts to effect this combination. Brilliant application of group theoretical methods, as manifested in this work, became a unifying theme in his long and distinguished career.

O'Raifeartaigh spent the 1967–68 academic year at the Institute for Advanced Study in Princeton, New Jersey, to continue his work on mass-splitting theorems. In 1968, he returned to DIAS as a senior professor in the school of theoretical physics. O'Raifeartaigh's teaching style epitomized the principles on which the school was founded—the investigation of the mathematical principles of natural philosophy and the training of advanced students in methods of original research. The excitement of discovery driving discussion at the blackboard late into the evening provided the best training in methods of original research that one could imagine. The school flourished thanks to O'Raifeartaigh's talent for discovery, his infectious enthusiasm, and his ability as a teacher.

As new concepts arose in theoretical particle physics, O'Raifeartaigh made significant contributions to each. In the 1970s, non-abelian gauge theories and supersymmetry grew in importance. The new supersymmetries evaded O'Raifeartaigh's Theorem simply because they were not Lie group symmetries. They required bosons and fermions to exist in mass-degenerate pairs. Because there was no experimental evidence for these mass-degenerate pairs, if these symmetries were to prove useful in constructing models of elementary particles, a method had to be found for breaking the supersymmetries, hopefully spontaneously, as had proved so fruitful for the non-Abelian gauge theories. O'Raifeartaigh showed how this could be done through the mechanism that now bears his name.

In the 1980s, intrigued by Gerard 't Hooft and Alexander Polyakov's discovery that non-Abelian gauge theories predicted the possibility of magnetic monopoles, O'Raifeartaigh explored the general structure of monopoles and made fundamental contributions to the understanding of nonspherically symmetric monopoles. His interest in physics extended to topics that had a fundamental feel or were simply intriguing.

Out of this rich collection of topics were two especially important interests he pursued in the 1990s. The first, in collaboration with Alfredo Iorio, Ivo Sachs, and Christian Wiesendanger, tackled the question, When does scale invariance imply conformal invariance? They discovered a simple algebraic criterion for conformal invariance. This enabled them to determine, for arbitrary spin, which scale invariant Lagrangians are also conformally invariant.

A second outstanding contribution, in collaboration with Renate Flume, Marc Magro, Sachs, and Weisendanger, showed that the Seiberg–Witten effective Lagrangian for the gauge group SU(2) is unique and can be constructed using supersymmetry and analyticity arguments without using duality, as was originally done. The limitations of this approach were also carefully stated. Both contributions demonstrate O'Raifeartaigh's passion for clarity and his ability to get to the essential features of a problem. He was fond of saying that the difficulty of a problem often lies precisely in understanding what the problem is.

In 2000, O'Raifeartaigh was awarded the Eugene Wigner Medal by the Group Theory and Fundamental Physics Foundation.

In addition to being a theoretical physicist, O'Raifeartaigh was a lecturer in great demand, and had friends and collaborators worldwide. He also was an accomplished historian, as is apparent in his book *The Dawning of Gauge Theory* (Princeton University Press, 1997). In the cause of nuclear disarmament, he and Nobel