JOHN F. KNOTT

1938–2017

Elected in 2003

"For advancing our understanding of the mechanisms and microstructure of fracture and fracture mechanics with application to the failure of engineering alloys and structures."

BY ROBERT O. RITCHIE AND JAMES R. RICE

JOHN FREDERICK KNOTT, a leading light in understanding of the mechanics and mechanisms of fracture, with particular application to gas turbine engines and nuclear power, died October 5, 2017, at the age of 78. At the time of his death, he was the Feeney Professor Emeritus of Metallurgy and Materials at the University of Birmingham.

He was born December 9, 1938, to Fred and Margaret (née Chesney) Knott in Bristol, where he spent his teens excelling in math and sciences at the Queen Elizabeth's Hospital school before going to Sheffield University to study metallurgy. He won the school's Mappin and Nesthill Medals and graduated in 1959 with a BMet degree with first-class honors. He then went to Cambridge University to study under Alan H. Cottrell on the notched-bar mechanics of the deformation and fracture of steel. He graduated with a PhD degree in 1963.

After Cambridge, John joined the Central Electricity Research Laboratories (CERL) in Leatherhead to work with a newly formed but well-known group of researchers in the Metallurgical Engineering section under the leadership of

Additional details and photographs are available in the biographical memoir prepared by the Royal Society, https://royalsocietypublishing.org/doi/pdf/10.1098/rsbm.2018.0005.

Edwin (Ted) Smith. Smith's group was focused on failure mechanisms relevant to the power generation industry, allowing John to continue his work on notched-bar mechanics pertinent to brittle cleavage fracture in steels.

In 1967 he left CERL to begin his academic career as a lecturer in the Metallurgy Department at Cambridge University and as Goldsmith's Fellow at Churchill College (he was vice master of the college in 1988–90). His reputation in the field of fracture began to thrive with his work on the mechanistic aspects of ductile, brittle, and fatigue fracture. He continued this work on the micromechanisms of fracture throughout the 1970s and '80s, aided by a cadre of excellent graduate students and several distinguished overseas fellows at Churchill, including Charles McMahon from the University of Pennsylvania and somewhat later Louis Coffin from General Electric. One of us (JRR, then at Brown) met and began collaborating with John via that same Churchill College route.

In 1990 John left Cambridge to become professor and head of the Metallurgy and Materials Department at Birmingham University, where he became dean of engineering (1995–98) and was named Feeney Professor of Metallurgy in 1996.

While at Cambridge John became known as one of first people to develop the metallurgical-mechanistic aspects of the rapidly emerging field of fracture mechanics in metallic materials. In writing the first internationally recognized book on fracture mechanics, *Fundamentals of Fracture Mechanics* (Butterworth & Co. Publishers, 1973), he brought this mechanics-dominated topic into the world of the materials scientist. He was one of the first researchers to embed local fracture criteria, related to metallurgical models of fracture, in continuum fracture mechanics solutions of crack-tip fields; one example was the so-called RKR model for cleavage fracture, developed by John and the authors of this tribute.

By combining materials science and mechanics understanding, John and his students developed micromechanical models for several modes of fracture and were some of the first researchers to formulate such models on a probabilistic basis. He also worked on the topic of fatigue and somewhat

later creep, where he was again able to develop mechanistic understanding of such failures.

His principal contributions to the field of materials engineering can be essentially summed up as bringing materials science into continuum fracture mechanics, providing a metallurgical-mechanistic counterpart to the applied mechanics breakthroughs of George Irwin, John Hutchinson, and others in the early development of fracture mechanics, and establishing the micromechanistic or local approach to modeling fracture.

By integrating a microscopic understanding of mechanisms with a continuum mechanics description of crack-driving forces, John was a pioneer in defining how materials scientists study fracture today, and he was a major proponent of the application of this discipline to help solve problems in the nuclear energy and aircraft gas turbine engine industries.

Even as he remained active at Birmingham, he spent considerable time serving on prestigious and national committees where his extensive knowledge and experience were frequently sought. From 1991 to the end of his life, when he was paralyzed (after a fall in 2015), he was a member of the Marshall committee to assess the safety of pressurized light water nuclear reactors in the UK, a founder (and chair, 2010–17) of the Technical Advisory Group on Structural Integrity (to provide advice to the civil nuclear power industry), and a member of the Graphite Technical Advisory Committee (on the use of graphite in advanced gas-cooled Magnox reactors), the Ministry of Defence Research Programmes Group (to advise on new nuclear propulsion plants for submarines), Nuclear Safety Advisory Committee, and Defence Nuclear Safety Committee.

In addition, he was a member of the research board of the Welding Institute; member and subsequently chair (2000–11) of the Rolls-Royce Materials, Manufacturing, and Structures Advisory Board; and an honorary fellow and president (1993–97) of the International Congress on Fracture (ICF). He also served for a decade as editor of the journal *Materials Science and Technology*.

For his significant contributions, John Knott made the New Year's Honor List in 2004 with the award of an Officer of the

Order of the British Empire (OBE) for services to nuclear safety in the United Kingdom. He was also made a fellow of the Royal Academy of Engineering (FREng; 1988) and Royal Society (FRS; 1990), a foreign member of the National Academy of Sciences of Ukraine (1993), and a foreign fellow of the Indian National Academy of Engineering (2006). He was elected a foreign associate of the US National Academy of Engineering in 2003 and a fellow of the UK Institute of Materials and of the Institution of Mechanical Engineers. He received the L.B. Pfeil Prize for Physical Metallurgy (1973; jointly with Richard Dolby), Rosenhain Medal (1978), Griffith Medal (1999), TWI Brooker Medal (2007), Institute of Materials Platinum Medal (2009), and ICF's Sir Alan Cottrell Gold Medal (2013).

John, or Knotty as he became affectionately known, was described as a "treasured, irreplaceable, and once irrepressible friend" to us all. He was the "life and soul" of so many conferences, banquets, and after-hours discussions, yet he was always *on cue* early the next morning to fully engage in whatever presentations or technical discussions he was scheduled to participate in. He was an avid writer of poems and limericks, which he would gleefully deliver to honor some colleague at a formal event or just to delight whoever would listen. He loved solving crossword puzzles and was enthusiastic about "trad jazz."

He was married twice, first to Chris (née Roberts) in 1963 (they divorced in 1986) and then to Sue (née Jones) in 1990. She survives him along with sons William (Tania) and Andrew (Alison) from his first marriage, stepsons Paul (Yuki) and James from his second marriage, and four grandchildren.

Above all John was an articulate, passionate, yet modest man, who always put his students, postdocs, and close colleagues first. He is sorely missed.