John K. Hulm

1923–2004

BIOGRAPHICAL *Memoirs*

A Biographical Memoir by
John W. Coltman

NATIONAL ACADEMY OF SCIENCES

JOHN KENNETH **HULM**

July 4, 1923–January 16, 2004

Elected to the NAS, 1988

By John W. Coltman

John Kenneth Hulm,[1] an internationally known scientist, engineer, and activist in the field of superconductivity, had the rare distinction of being elected to both the National Academy of Sciences (1988) and the National Academy of Engineering (1980) for his many contributions to the understanding of the fundamental properties of materials at very low temperatures, the development of practical superconducting materials, and their application to high-field magnets.

John was born in the small town of Southport, England, on July 4, 1923. His father, a modestly paid railway worker with little education, was determined that his son would not lack for one. John showed an early interest in science, which was stimulated by a remarkably skillful educator, the headmaster of the local high school, and after graduation he attended Cambridge University. He completed his undergraduate work there in 1943 and then joined the Royal Aircraft Establishment, where he worked on the development of radar until the end of World War II.

After the war he returned to Cambridge as a research fellow to pursue a graduate degree under David Schoenberg, a pioneer and central figure in the field of low-temperature physics. Toward the end of his graduate research at Cambridge's Cavendish Physics Laboratory, he met his wife-to-be, Joan, whom he married in 1948. The results of his Ph.D. thesis on the thermal conductivity of superconductors and the ferroelectric properties of barium titanate were published in *Nature*, the first of some 100 pieces he published during his lifetime.

1. This memoir originally appeared, in slightly different format, in *Memorial Tributes of the National Academy of Engineering* 13 (2010):100-105 and is reprinted with permission.

In the fall of 1949 John traveled from England with his wife and month-old baby to the University of Chicago, where he had a postdoctoral position waiting as a Union Carbide and Carbon (now Union Carbide) Research Fellow. Two years later, he was appointed assistant professor of physics. His highly productive research work there resulted in his discovery, with George F. Hardy, of the A-15 superconducting alloys, binary compounds of elements that exhibited superconductivity at temperatures as high as 17 degrees Kelvin. Together with B. T. Matthias, John published 14 technical papers based on his work in Chicago.

In 1954, John accepted an offer from the Westinghouse Electric Corporation research laboratory in Pittsburgh, where he assembled a team of researchers on the physics of materials, and particularly on superconductivity. In 1956 he was named manager of the lab's Solid State Physics Department. Four years later he became associate director, Material Science, with several departments under his direction. In spite of his administrative duties, which were by no means negligible, he continued to participate actively in the research and development of superconductivity.

Superconductors ordinarily lose their zero resistance in the presence of a small magnetic field, or when they carry any but a small current. John and his team scored a major breakthrough in 1961 with the discovery that a niobium-tin alloy maintained its zero resistance under magnetic fields as high as 10 Tesla, far above the saturation point of iron. Alloys of this type, including niobium-titanium, are called Type II superconductors. When these alloys were properly fabricated into wire, they could sustain currents on the order of 10,000 amperes, thus opening the possibility of producing magnetic fields higher than any achieved before.

At this point, John became an engineer as well as a scientist and administrator. One of his first goals was to produce a high-field solenoid. Using long lengths of wire fabricated from niobium-zirconium and niobium-tin, the group under his direction succeeded in fabricating magnets up to 10 Tesla. By comparison, the best that could be done with an iron magnet is 2 Tesla. Today, magnets as high as 26 Tesla have been produced, and many large superconducting magnets are crucial components of the Large Hadron Collider, which became operational in 2008.

When engineer John Mole returned to Westinghouse from a stay at MIT, he reported on work being done there on superconducting rotating generators. Together, he and John Hulm then initiated a program at Westinghouse to apply superconductivity to power generators. The problems of cooling rotating parts with liquid helium were substantial, but by 1972 a group under Mole and James Parker had successfully demonstrated a 2-pole, 5-megawatt superconducting generator. Westinghouse obtained a contract from the Air Force to design and develop a superconducting generator for aircraft, and with the participation of engineers from operating divisions and the leadership of Richard Blaugher, a 14,000-rpm rotor was successfully tested. Westinghouse also entered into a jointly funded program with the Electric Power Research Institute directed toward the eventual construction and testing of a prototype 300-megawatt generator. However, because of the poor business climate for power equipment at the time, the program was terminated by mutual agreement. Although John's support and interaction with these outside agencies was important, he took no direct part in the engineering itself.

In 1974, John took a two-year leave of absence from Westinghouse to become the science attaché at the U.S. Embassy in London. This change of scene gave him an opportunity to renew his many acquaintances and connections there. He returned to Westinghouse as manager of the Chemical Sciences Department, and in 1980 he was named director of corporate research and R&D planning. He retired in 1988 as Chief Scientist.

Because of John's prominence in his field, his communication skills, and his organizational abilities, he was often called upon as an investigator, advisor, and organizer. Among his activities were membership on several committees of the National Science Foundation and the National Academy of Sciences; program chairman of two Applied Superconductivity Conferences, of which he was a founding member; participation in a number of advisory and visiting committees for government and university organizations; and member of the boards of physics societies and journals. In 1989 he accompanied Mildred Dresselhaus, chair of the Japanese Technology Evaluation Center (JTEC) Superconductivity Panel, to Japan to evaluate that country's superconductivity research. Upon his return, he briefed the President's Science Advisory Council on the results of the JTEC study and their implications for the U.S. superconductivity research program. The President subsequently announced a renewed U.S. initiative in high-temperature superconductivity research and applications.

John received many honors for his contributions: the John Price Wetherill Medal of the Franklin Institute, the American Physical Society's International Prize for New Materials, the Westinghouse Order of Merit, and election to the national academies mentioned above. But perhaps he appreciated as much or even more the informal celebrations in his honor given by his co-workers, associates, and well-wishers. John was both sociable and witty, and those who accompanied him on his many excursions always welcomed the opportunity to be with him. Family life was important to him, and after retirement he was able to spend more time with his wife Joan and their son and four daughters. He doted on his children and helped them to obtain the best education possible. He and Joan also enjoyed traveling, especially to England to visit relatives and former colleagues. Having come from a railroad family, John always loved trains, so wherever they traveled they explored local train history and often traveled by train. He especially liked to learn about old railroads, steam engines, and rolling stock.

In January 1991 John suffered a severe stroke that significantly limited his activities. He fought his way back, however, and kept up with advances in science and engineering for another six years, during which he met often with former colleagues and kept in touch with his eminent scientific friends, with whom he continued to make scientific contributions. He also continued to attend scientific conferences, and traveled to England, where he attended a reception at his alma mater, Cambridge, for the opening of its new library.

John died on January 16, 2004, at the age of 80. He had played a prominent role in advancing the progress of superconductivity from a little-understood phenomenon in pure science to advanced technology and important applications. His activism, his inspiring leadership, and his technical contributions will be long remembered.

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