Marshall Stoneham

(1940–2011)

Theoretician who contributed widely to condensed-matter physics.

Marshall Stoneham was a theoretical physicist, most noted for his work on defects in solids, who made wide-ranging contributions to condensed-matter science. He was a leading figure in the Atomic Energy Research Establishment (AERE) near Harwell, UK, when the key challenges to the nuclear industry became materials and waste disposal as much as nuclear physics. He died on 18 February, aged 70.

Born in 1940 in Barrow-in-Furness, in northern England, Stoneham was educated at Barrow Grammar School for Boys, which produced three future Fellows of the Royal Society (of whom he was one), all in engineering and physical sciences, in the space of 15 years. He studied physics at the University of Bristol and remained there to do a PhD, under the supervision of Maurice Pryce, in the theory of spin–lattice relaxation — how the spins of ions in a solid interact with the host crystal lattice — a topic of current importance in quantum information.

In 1964 he joined the Theoretical Physics Division at AERE Harwell, then one of the world's foremost physical-sciences laboratories. The division, built up by Walter Marshall and Alan Lidiard, included leading figures such as Ron Bullough (in the theory of elasticity in metals), Tony Lane (in nuclear theory) and John Hubbard (in strongly correlated electron physics). Its work was stimulated by the needs of the nuclear industry, and Stoneham flourished in this challenging environment.

He worked mainly on defects in solids, because these determined many properties of materials important in nuclear applications and in the emerging semiconductor industry. He was particularly known for explaining, with Pete Flynn at the University of Illinois at Urbana-Champaign, how hydrogen atoms move rapidly through metals and hence contribute to brittleness. This was typical of his style, combining a sharp fundamental insight (how the diffusing quantum atom interacts with the thermal environment) with the solution to an important applied problem.

In 1975, he published the influential monograph *Theory of Defects in Solids,* which rationalized the vast phenomenology of the subject and explained it in terms of the underlying quantum mechanics, giving the field an interpretative tool that is still valuable today. Collaborators who came to know him in subsequent years were struck by his astonishing memory — he often answered questions in the form of a page reference to the book!

During the 1970s, the Harwell theory team had a leading role in the development of condensed-matter computational physics, enabled by the availability of mainframe computers. Although Stoneham was at heart an analytical theoretician, he appreciated this new capability. His solid-state and quantum-physics group exploited Harwell's HADES code to model defects in solids, including their formation and migration energies and key structural properties. The influence of this code, and Stoneham's group, extended beyond defect physics into

solid-state chemistry, especially the chemistry of non-stoichiometric compounds — the component elements of which are not present in simple proportions, usually indicating the presence of defects. Indeed, the group became a magnet in the 1970s and 1980s for those working on defects in materials, and the work extended to surfaces and interfaces, and made key predictions of the structures and stabilities of oxide surfaces.

Stoneham's group made advances in the physics and chemistry of nuclear fuels and, as the remit of Harwell broadened, in a wider range of problems. One such was Tony Harker's work on non-destructive inspection of gas pipelines using ultrasound. Stoneham embraced the increasing commercial emphasis of what was by then AEA Industrial Technology, and in the early 1990s became AEA's chief scientist. Throughout his career he was a leading expert on, and exponent of, fission nuclear power. Just last year he wrote a masterly article (A. M. Stoneham *Phil. Trans. R. Soc. A* **368,** 3295–3313; 2010) on the history of the UK nuclear-energy programme and its prospects and challenges.

Nevertheless, with the environment at Harwell becoming less conducive to fundamental research, in 1995 Stoneham became the first Massey professor of physics at University College London and director of its Centre for Materials Research. He loved the wide range of materials-related work there and developed projects in areas as diverse as minimally invasive dentistry, odour recognition, diamond film growth and quantum information science, where his ideas on optically controlled gates led to a substantial and ongoing research programme.

Stoneham was a major figure in the UK and international physics communities, with awards to match. He was for several years editor of *Journal of Physics: Condensed Matter* and last year became president of the Institute of Physics. He also inspired the many scientists who worked with him and guided them at crucial stages in their careers. He was exceptionally supportive of his junior collaborators, and enjoyed challenging them to solve problems, using modern computational methods, more quickly and accurately than he could with his ingenuity and his slide rule.

Marshall's wife Doreen and two daughters are all physical scientists — a fact in which he took considerable pride, and with Doreen he founded Oxford Authentication, a company that uses thermoluminescence to date fine-art ceramics.

His scientific range was broad, but his interests extended even further. He was an accomplished horn player and the author of a book on music for wind ensembles. He was always stimulating company and he seemed to know something interesting about — and held a strong opinion on — almost any subject. He gained and retained the respect and affection of all who worked with him and he leaves behind an enduring contribution to physics and to physicists. ■

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