(MICHAEL) JAMES LIGHTHILL

1924–1998

Elected in 1977

"For contributions to aerodynamics, and in recognition of an outstanding career in teaching and research management."

BY SHON FFOWCS WILLIAMS
SUBMITTED BY THE NAE HOME SECRETARY

JAMES LIGHTHILL, as Professor Sir M. J. Lighthill was known to his friends, died on July 17, 1998, at the age of 74. He suffered a heart attack while swimming around Sark, a swim he had been the first person to do and one that he had previously completed five times. He was considered the dominant mathematical aerodynamicist of his day.

James was the youngest son of doting parents who educated him at the best private schools and saw that he lacked for little. His father, a retired mining engineer who had changed the family name from Lichtenberg during the First World War, moved the family from Paris to London in 1927. James read a great deal and, at an early age, demonstrated impressive feats of memory and high musical talents. James always knew he was clever and found most challenge in mathematics, a subject he was allowed to develop at his own pace, a pace much faster than that of his contemporaries. He won a scholarship to Winchester at the age of 12.

At Winchester he quickly made friends with a boy of remarkably similar age and ability. His friendship with Freeman Dyson had a terrific effect on the mathematical development of both of them. The school knew that they were smarter than most and allowed them to choose the rate and direction of their studies. Both won arts scholarships to Cambridge but, being only 15, were too young to go. They read the same books, mostly about mathematics, and by the time they were 17, they started to study mathematics on scholarships to Trinity in 1941. Both had already covered most of the undergraduate material. The two of them attended Part III lectures only and graduated with distinction in 1943.

Mathematics graduates were required in wartime Britain to support the war effort, and James was sent to work under Sydney Goldstein in the Aerodynamics Division of the National Physical Laboratory (NPL). James was initially fed up with that, for his girlfriend Nancy, also a Cambridge mathematician, had been sent to Farnborough on aerodynamics research work, and James would have liked a similar posting. Goldstein, whom James quickly learned to like and admire, used mathematics to illuminate details of aerodynamic flow. He took a great interest in James and inspired him, advising him to learn what he could about supersonic and viscous flow.

Before the war most supersonic flow and boundary layer work had been done and written up by German aerodynamicists. James quickly understood and extended their work and clearly liked it. The reports on that work, written by James at the NPL and later submitted to Trinity, gained him a Prize fellowship, allowing him to return to Cambridge and resume his research into pure mathematics. But he was beginning to appreciate applied mathematics almost as much, and many people whom James admired showed such interest and curiosity about his wartime work and what he might do for aerodynamics that he hardly had the inclination or time to resume his old life. He married Nancy before the end of the war and moved to Cambridge but would not stay there long, nor, finally, would he emerge as a pure mathematician.

Sydney Goldstein left the NPL to become professor at Manchester in 1946 and invited James to go there with him as a senior lecturer in mathematics. In accepting that post he implicitly accepted also the challenge of developing the mathematics most useful in aerodynamics. James did most things that Goldstein advised and usually took note of what Goldstein said. He shared with friends Goldstein's speculation that there then existed, somewhere, several people as clever as Isaac Newton and that such clever people might well appear somewhat strange. He warned that, if ever Cambridge were lucky enough to meet but fail to recognize that modern genius, Cambridge would become an academic laughing stock but would raise no eyebrows by tolerating strange behavior or by failing to understand difficult concepts. Very bright and occasionally strange himself, James understood that view very well.

At Manchester James threw himself into teaching mathematics by applying it to aerodynamics and by ensuring that his colleagues had more interest and time for research than was normal. He was the most active and by far the brightest member of the Fluid Motion Committee of the Aeronautical Research Council, Britain's body most involved in aeronautical problems and new developments. James bristled with new ideas for solving those problems and for involving his colleagues and students.

Sydney Goldstein went to Israel in 1950 and, young as he was, James Lighthill was the obvious choice for his successor. He became the Beyer professor and head of the mathematics department at Manchester when only 26 years old.

Lighthill was a big man who towered above his contemporaries and had little patience with those who failed to recognize their relative standing. He had a vicious tongue for some, but generally they kept their distance relating their experience privately to others and creating for James an aura of respect and terror. But to those who tried hard to understand and cope with real problems, James seemed always available, helpful, and encouraging. His students were devoted to him, as were his close colleagues.

This phase has been described by Tim Pedley, Lighthill's Royal Society biographer and former Imperial student, as the Golden Years. One can easily see why by noting the large increase in the department's activity, the unusually high output of published papers, and by seeing a large number of Manchester mathematicians later became famous. Lighthill naturally developed his wartime interests at Manchester. He extended work on supersonic flow and was the first to explain how free-stream disturbances affected heat transfer and skin friction in boundary layers. He demonstrated that some flows could be better understood by specifying them in terms of vorticity. The Manchester school led the world of fluid mechanics at that time, due largely to Lighthill's extraordinary energy and ability. He had accepted an invitation to address the 1948 Congress for Applied Mechanics at the age of 24, and he accepted also an invitation to contribute a 147-page article entitled "Higher Approximation" to the Princeton series on High-Speed Aerodynamics and Jet Propulsion. It was largely James Lighthill's own effort that led to the founding of the British Theoretical Mechanics Colloquium, a popular annual meeting first held in Manchester in 1958, and it was definitely James's drive that brought the Institute of Mathematics and its application into being.

Whether James was particularly attracted by high-speed aircraft or swayed by the importance of containing jet noise, the most significant output of the Manchester school, and what was most probably James's masterpiece, was his completely original theory explaining how and why sound was created aerodynamically. That work appeared in the *Proceedings of the Royal Society* in a remarkable 1952 paper that neither had nor needed any reference. This premier British society would elect him a fellow the following year and would later invite him to summarize the subject of aerodynamic noise in the Bakerian Lecture of 1961, a prize lecture of the society. Lighthill's first paper on the subject continues to be the dominant reference, not only because it is so relevant to an important practical subject but mainly because it is clear and precise. No approximation is made in unraveling the details of aerodynamic sound generation. In fact, it is easily argued that the best modern studies of waves in compressible fluids are actually extensions of work that Lighthill might well have done himself.

No applied mathematician could fail to value Lighthill's book *An Introduction to Fourier Analysis and Generalized Functions* (Cambridge University Press, 1958) or admire the 100-page chapter "Viscosity Effects in Sound Waves of Finite

Amplitude," which he contributed to the book *Surveys in Mechanics*, honoring G. I. Taylor on his 70th birthday. The first book was inspired by Paul Dirac, but he drew on the work of his team at Manchester for the long chapter, which probably initiated the vigorous new discipline of nonlinear acoustics. Many papers and lectures followed, on large-amplitude waves and viscous water waves in particular.

James's lecturing style attracted many comments, most of them complimentary. He would invariably prepare his lectures thoroughly and took enormous pains over elaborately handdrawn blackboards and over his carefully rehearsed flamboyant style of delivery, with which no doubt Nancy helped him. His widespread scientific appeal was enormous at the end of the 1950s and probably encouraged him to become ever more striking in public lectures, but at that time James was beginning to look for a new challenge.

The change came when he was appointed director of the Royal Aircraft Establishment (RAE), headquartered at Farnborough but having several outlying sites. Friends worried that a magnificent mind was about to become cluttered with the administrative duties of supervising about 8,000 staff members. But James was determined to spend most of his energy at the RAE in raising the establishment's scientific output. He wrote many scientific papers and created there a new "director's" series of reports. He appeared to enjoy administration and even enjoyed bringing new technology into government departments, but applied mathematics was his first love and that received most of his attention. His appointment was enormously popular with Farnborough's scientific staff, each of whom seemed to benefit from the director's attention, their visibility and morale rising spectacularly. Of course, James was involved with the establishment's main activity in new aircraft, but it was science that benefited most, and it was science that after five years drew him back to academic life on his appointment as the Royal Society research professor at Imperial College.

Lighthill took new offices at the top of Imperial College's new building opposite the mathematics department. He took on new research students, new disciplines, and the new practice of giving a series of lectures on what research he was then interested in. Those lectures were a spectacular success, and he enjoyed giving them. They were mainly presented in the math department and attracted several staff members and the most aspiring research students from across the college, who could see and learn from the *master* about *Fluids, The Swimming of Fish, Group Velocity, Geophysical Flows,* and *Biological Fluid Mechanics.* James also took great pride and interest in the Physiological Flow Studies Unit he had helped Colin Caro establish at Imperial College. Though very busy at that time, James seemed always to be in evidence, a familiar figure at the college and at scientific meetings in London, England, and around the world. Few who met him and certainly none who knew him well were surprised when James's next position was announced. He had been elected to the Lucasian chair of mathematics at Cambridge.

He was thrilled to bits by the thought that in that chair he would succeed Isaac Newton and that Gabriel Stokes and Paul Dirac had been there also. When it was pointed out to James around that time that a shot he was about to make in croquet was mechanically impossible, he quickly quipped that the Lucasian professor is immune to mechanical laws because he makes them; he promptly demolished the hoop!

Initially, James liked being back in Cambridge, but following the death of a close colleague, he became bored with it. His big book, *Waves in Fluids* (Cambridge University Press, 1978), was the main product of his 10-year stay. He had lost none of his mischievous qualities at this time nor his love of mystery and the use of very long words. Few knew at the time what he meant by reference to his pulchritudinous hostess. And when he was an editor of *JFM,* a journal that prides itself on having two independent referees for every paper, he was notorious to some for being both. He formed definite views very quickly. On the occasion of his 60th birthday, he was presented before dinner with a 380-page volume of the *IMA Journal of Applied Mathematics,* comprising 18 new research papers written by friends and colleagues in his honor. During dinner he read them, and in an after-dinner speech made only a couple of hours after first seeing the material, he gave a critical review of each paper. The fact that diners cheered loudly spoke volumes about his popularity.

He left Cambridge to become provost of University College, London, where he was both popular and successful. Under James the college grew in size and stature. He got to know professors personally and brought many new scholars into their ranks. He eventually retired at the end of a brilliant career and became a research assistant at University College, Nancy sharing an office with him.

James was much honored throughout the world. He had some 24 honorary degrees, and his many publications were collected and published by Oxford University Press. He was knighted by the Queen and appointed to the best British and foreign academies. James was survived by his widow, Nancy, and their five children, but Nancy died in 2010.