

## Obituary

Fluid dynamics developed and has continued to thrive through its applicability to fields of great practical importance. Dominant among these, during the first half of this century, was aerodynamics, which grew from an embryonic understanding of boundary-layer theory, flow instability, and subsonic and supersonic flow. Since about 1960, the dynamics of ocean and atmosphere, with its intricate interplay of wave-motion and turbulence, has emerged as a field of comparable vitality. And since about 1970, the fluid dynamics of biological systems has developed as a field of immense challenge now ripe for rapid growth.

James Lighthill's meteoric career was characterized by pioneering contributions in each of these areas. His work was based on classical techniques of applied mathematics, but his style involved strenuous efforts to interpret the mathematics, however complex, in terms of fundamental physics. It was this aim, so successfully achieved, that gave his papers their renowned lucidity and impact.

Michael James Lighthill was educated at Winchester College and Trinity College, Cambridge, where he read mathematics for the accelerated two-year wartime degree, graduating in 1943. His inclination was to undertake research in pure mathematics, but wartime imperatives dictated otherwise, and he moved directly to the National Physical Laboratory to work on supersonic aerodynamics. There he worked with ferocious intensity. Elected to a research fellowship at Trinity College in 1945, he was attracted in the following year to the University of Manchester by Sydney Goldstein, where he remained until 1959; he succeeded Goldstein as Beyer Professor of Applied Mathematics in 1950 at the exceptionally early age of 26.

By that time, the hazard of noise from jet aircraft was already recognized, and it was here that Lighthill made what many will consider his greatest contribution. In two papers, published in 1952 and 1954, he laid the foundations for all subsequent work on the subject. Recognizing that the turbulence in a high-speed jet is equivalent to a distribution of quadrupole sources, Lighthill was able to calculate the intensity (an eighth-power law) and directional distribution of the radiated sound field. An understanding of this mechanism of noise production was essential to the design of



jet engines whose noise output could be reduced to tolerable levels. Lighthill achieved worldwide recognition for this seminal work, and at the age of 29 was elected a fellow of the Royal Society.

From 1959 to 1964, Lighthill served as director of the Royal Aircraft Establishment at Farnborough, Hampshire. Despite the burdens of this post, he retained close contact with the wider research community, and indeed published papers in both geophysical and biological fluid dynamics, a foretaste of the interests that were to become his main preoccupation. These interests were given lease through his appointment in 1964 to a Royal Society professorship at Imperial College, London, and his subsequent appointment in 1969 as Lucasian Professor of Mathematics at Cambridge, a post he held for the next decade.

His great work during this period was concerned with waves in fluids (particularly fluids in rotation, as in the geophysical context) and also, most notably, with the subject that he named 'biofluidynamics'. Lighthill's interest in this topic had been stimulated much earlier by the Cambridge zoologist Sir James Gray; but it was only through his survey article, "Hydrodynamics of Aquatic Animal Propulsion", published in 1969, that the field really opened up. Lighthill himself emphasized the need for an interdisciplinary approach: "... if I was to help in classifying the hydrodynamics of aquatic animal locomotion I must talk to zoologists and go on talking to them; read their works and go on reading them; study their collections (in museums and aquaria

and go on studying them!" And so he did. It was through this total immersion that a new realm of scientific endeavour was defined, explored and revealed to the fluid dynamics community.

In biofluidynamics, Lighthill contributed equally to our understanding of the flight of birds and of insects, topics for which his mastery of aerodynamics was well adapted. His appointment as provost of University College London (1979–89) did nothing to diminish his formidable research output. Again, his interaction with zoologists was of key importance. One such collaboration stands out — that with Torkel Weis-Fogh, a successor of James Gray at Cambridge — which led to elucidation of the mechanism of lift-production in small hovering insects. This is the clap-fling-sweep sequence by which circulation round each wing, and so lift, is generated by an essentially inviscid mechanism. Thus does the chalcid wasp *Encarsia formosa* achieve a lift coefficient greater than that of any man-made flying machine.

Lighthill was knighted in 1971, exactly halfway through his long research career. He was in great demand as a plenary lecturer at international meetings, and he would invariably rise to such occasions with gusto. His style was magisterial and he would present his material with total authority and little respect for any constraint of time. His lectures conveyed a passionate commitment to his subject, and rapier thrusts abound. Thus, for example, in 1962 when the magnetohydrodynamic bandwagon was in full swing: "It needs categorically to be reaffirmed that the continuum mechanics of a fluid innocent of electric current has as vital and exciting a present and future as any other branch of physical science". Lighthill's own work testified to the enduring truth of this statement.

Sir James Lighthill died on 17 July, at the age of 74, having almost completed a swim, in choppy seas, around the island of Sark in the English Channel, a feat that he had first accomplished 25 years earlier. He was a compulsive island circumnavigator, and his major source of pride in this respect was to have swum around Stromboli while it was erupting. Not for him the timid security of the seashore; he died as he had lived, with style and bravado. He is survived by his wife Nancy Dumaresq, to whom he was married for 53 years, and by one son and four daughters.

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