Preface

Sir James Lighthill (l924-l998) was one of the towering figures in twentieth century applied mathematics and fluid mechanics, internationally recognized as founder of aeroacoustics and biofluid dynamics. He was one of the most brilliant and influential persons who produced some of the most significant applied mathematicians and fluid dynamists in many fields of mathematical sciences. He was notable for the originality, diversity, versatility and independence of his critical thinking. He made outstanding contributions to fluid mechanics, applied mathematics and their applications to physical oceanography, meteorology, geophysical fluid dynamics, biofluid mechanics, and hydrology. He has provided a unique leadership with tremendous interest in diverse uses of mathematics in natural sciences, economics, finance, business, and world modeling and made an attempt to stimulate interest in mathematics among the general public of the world.

Michael James Lighthill was born on January 23, 1924 in Paris. In 1936, he won a prestigious scholarship to Winchester College and then in 1939, was awarded a major scholarship by Trinity College of Cambridge University. After graduating from Trinity College in 1943 with a B.A. degree, Lighthill joined the British National Physical Laboratory as Junior Scientific Officer in the Aerodynamic Division. In 1945, he became a Fellow of the Trinity College. In 1950, at the age of 26, he was appointed to the Beyer Chair of Applied Mathematics at the University of Manchester. In 1953, at the age of 29, he was elected Fellow of Royal Society of London. In 1964, he was appointed Royal Society Research Professor at Imperial College of Science and Technology, London. In 1969, Sir James Lighthill was elected Lucasian Professor of Applied Mathematics at the University of Cambridge to succeed Physics Nobel Laureate, P.A.M. Dirac who held the Lucasian Professorship from 1932 to 1969. The Lucasian Chair once

held by Sir Isaac Newton, and the present holder is Stephen Hawking. In 1979, he accepted the position of Provost of the University College London (UCL). After retirement from the position of Provost in 1989, he remained at UCL as Honorary Research Fellow until his death on July 17, 1998.

The devotion of time and energy to mathematics education as well as mathematics instruction was not widely thought to be a worthy pursuit for a serious research mathematician. Sir James characteristically ignored the prevailing view and in 1971-1975 he went further by serving as President of the International Commission on Mathematical Instruction (ICMI) to upgrade mathematics teaching and learning at all levels. Through his presentations and publications of articles on pedagogy, Sir James provided a unique leadership role in promoting the importance of teaching and learning at all levels, and the interaction between mathematics and society. In addition, he helped organize a number of symposia that include 'New topics in applicable mathematics in secondary schools' in Luxembourg in 1973, and 'Mathematics and Language' in Kenya in 1974. As President of ICMI which was then a sub-commission of the International Mathematical Union (IMU), Lighthill had a profound influence on teaching of mathematics and science with newer applications in modern time.

His deep and enduring concern on enormous loss of human lives, economic and marine resources by natural hazards including tropical cyclones, hurricanes, tsunamis, floods, thunderstorms, earthquakes, underwater explosions, landslides and volcanic eruptions reveals the unique character of this man. He spent considerable time and energy to deliver lectures and helped organize topical conferences and symposia on tropical cyclone disasters, monsoon dynamics, weather forecasting, and related areas at national and international levels for the benefit of the developed and developing countries of the world. His leadership role not only provided the research challenge for the multinational and multidisciplinary group of scientists, but also for publication of Proceedings of the topical symposia which brought together current developments as well as possible new directions of advance. Coastal flooding by storm surges and river valley flooding both of tropical cyclones origin are especially disastrous in many countries of Southeast Asia including Bangladesh, China, India and Japan. Sir James responded to this challenge with enthusiasm; organizing international symposia on Monsoon Dynamics in India in 1977, and on Tropical Cyclone Disasters in China in 1992.

Sir James Lighthill stands in great world tradition represented by many giants in continuum mechanics including George Biddell Airy (1801-1892),

J.M. Burgers (1895-1981), Lord Kelvin (1824-1907), Theodore von Kármán (1881-1963), A.N. Kolmogorov (1903-1987), Ludwig Prandtl (1875-1953), L.D. Landau (1908-1968), Lord Rayleigh (1842-1919), John Scott Russell (1808-1882), Osborne Reynolds (1842-1912), G.I. Taylor (1886-1975) and George Gabriel Stokes (1819-1903).

Indeed, Sir James has done more than anyone in the last century to advance applied mathematics and change the stature of fluid mechanics. His stimulating lecture on Fluid Dynamics as a Branch of Physics at the Fluid Dynamics Division of the American Physical Society in 1960 as well as its subsequent publication in volume 15 of *Physics Today* in 1962 is a wonderful example. The concluding statement of this article is a delight to quote: "... by summing up my lecture in a single sentence: 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."

In his famous and authorative chapter published in the Encyclopedia of Twentieth Century Physics in 1995, Sir James described fluid mechanics as a subdiscipline of physics with special emphasis that it is, indeed, another great success story of twentieth century physics. This is one of his most influential articles ever written on fluid mechanics. As global advocate, Lighthill described many major theoretical, experimental and computational progress on the subject during the twentieth century, and cited many unsolved problems and open questions in this rapidly growing field with a number of possible new directions of advance for the 21st century.

In his memorable lecture at the discussion meeting held jointly by the Royal Society and the British Academy in 1986 on Predictability in Science and Society, Sir James Lighthill vigorously criticized the view that dynamical systems governed by Newton's laws of motion do not necessarily exhibit the predictability property. At the same time, he provided the first systematic and persuasive arguments in support of the complete predictability of systems governed by the equations of Newtonian dynamics.

Throughout his research publications and writings, Sir James was perhaps influenced by the emphasis which Lord Rayleigh expressed as follows: "In the mathematical investigation I have usually employed such methods as present themselves naturally to a physicist. The pure mathematician will complain, and (it must be confessed) sometimes with justice, of deficient rigor. But to this question there are two sides. For, however important it may be to maintain a uniformly high standard in pure mathematics, the physicist may occasionally do well to rest content with arguments, which

are fairly satisfactory and conclusive from his point of view. To his mind, exercised in a different order of ideas, the more severe procedure of the pure mathematician may appear not more but less demonstrative. And further, in many cases of difficult to insist upon highest standard would mean the exclusion of the subject altogether in view of space that would be required."

Sir James Lighthill was undoubtedly one of the most brilliant and influential fluid dynamists of the twentieth century. He revolutionized applied mathematics with his remarkable contributions to modern fluid dynamics. There is no doubt at all about Lighthill's profound and everlasting impact on mathematical sciences and the scientific community of the world. His lifelong concern for quality mathematics instruction at national and international levels, and for inevitable loss by natural hazards reveals the unique character of this man. He will be remembered forever not only for his great scientific achievements, but also his unique contributions to the welfare of the human race. In many ways, Sir James was the epitome of the applied mathematical community.

This short book is intended as a memorial tribute to this great man and the mathematical scientist of the twentieth century. So my desire as well as interest in writing this book commemorating Sir James Lighthill the man and the mathematical scientist is founded solely on my deep respect and admiration for this great man and renowned applied mathematician whom I had the opportunity of knowing very well for a long period of time.

It is my pleasure to express my grateful thanks to many friends, colleagues, and students around the world who offered their suggestions and help at various stages of the preparation of the book. My special thanks to Ms. Veronica Chavarria who cheerfully typed the manuscript with constant changes and revisions. In spite of the best efforts of everyone involved, some typographical errors doubtless remain. I wish to thank Ms. Anna Tong and Ms. Lai Fun Kwong of Imperial College Press, London for their help and cooperation. Finally, I am deeply indebted to my wife, Sadhana for her understanding and tolerance while the book was being written.

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