

Michael Faraday

AND THE ROYAL INSTITUTION

**THE GENIUS
OF MAN
AND PLACE**

**JOHN MEURIG
THOMAS**



FOREWORD BY SIR BRIAN PIPPARD



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**MICHAEL FARADAY
AND THE ROYAL INSTITUTION**

(The Genius of Man and Place)



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(The Genius of Man
and Place)

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For Margaret

MICHAEL FARADAY
1791 Bicentenary Year 1991



THE ROYAL INSTITUTION
OF GREAT BRITAIN

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Foreword

by
Sir Brian Pippard, FRS,
Cavendish Laboratory,
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The speaker at one of the Royal Institution's Friday Evening Discourses observed that, of all places on Earth, the Institution has seen the greatest number of discoveries per square metre. This must surely be true and, of all the eminent scientists who have worked there, pre-eminent is Michael Faraday, a self-educated man whose inability to master mathematical methods might be thought to rule out a career in the physical sciences. But his genius for experiment, his instinct for the right attack on a problem, his capacity for hard work and, above all, his passion for leaving no loose ends in the solution made of the poor apprentice the most eminent scientist of his time. He early formed the habit (and how rare it is) of recording all his observations as he made them, and adding his immediate thoughts on what they signified. As a result we can probably build up a more complete picture of him than of any other who has changed the course of history to a comparable degree.

Faraday took great trouble to make the latest discoveries of science, his own and those of others, intelligible to the layman, and the tradition he fostered has been kept alive ever since, so that the Royal Institution is as well known for its contributions to education as for its research. The present book is written in the spirit of that tradition, to help meet a need that is greater now than in Faraday's time. The founder, Benjamin Thompson (Count Rumford), aimed to apply science to improve the lives of ordinary citizens in an age when it was perhaps easier than it is now to overlook the risks inseparable from discovery, and to welcome the obvious benefits. Nowadays, however, science has many critics whose views, sometimes ill-founded, command support; and all too often their criticisms pass unanswered, or the answers are lost in the general hubbub. Without determined efforts by scientists to explain what they are doing and why it matters, and to show the sort of people they are, there is a danger that science and technology will cease to attract imaginative young people with something of Michael Faraday's dedication and integrity. If that should happen, we shall all be the poorer, for the quality of civilized life has come to depend on science for its very maintenance, let alone improvement.

Readers of this book will enjoy finding out in how many ways we are indebted to Faraday for his prodigious researches, and will discover why his fellow scientists revered him, and why his many friends loved him. His generosity and singular goodness of heart, as well as his creative intelligence, speak to us across the years and one can never tire of hearing about them again, especially when the tale is told with the understanding and gusto that Professor Thomas has brought to the telling.

Preface

Michael Faraday and The Royal Institution

Having lived and worked for five years in Michael Faraday's home and laboratory, my initial interest in, and curiosity about, the great scientist has developed into a passionate admiration for all that he stood for and achieved. His scientific and spiritual presence at the Royal Institution confers a unique aura that pervades the whole place. One cannot escape it. This book is meant to share with others my enthusiasm and admiration for the man, the scientist and the place.

Because of the enormous significance of his work, the sheer brilliance of its pursuit, execution and description, and because he was a humble, self-educated man who conquered and transformed the world, most people are aware of who Faraday was. But not everyone knows that Michael Faraday was one of the most remarkable men of all time. The greatest of my predecessors as Director of the Royal Institution, which houses the oldest continuously used scientific laboratory and the foremost repertory theatre for the popularization of science in the world, Faraday lived here for nearly fifty years and worked here for a somewhat longer period.

In this comparatively slim volume I outline the trajectory of Faraday's exceptional career, analyse and interpret the essence of his discoveries, and examine afresh the wellsprings of his genius. I have endeavoured to do so in such a way as to make the book accessible to all layfolk interested in, but not well-informed about, modern science and especially young people in the arts and in all branches of the sciences who are about to enter tertiary education.

I am greatly indebted to Margaret Gowing, formerly Professor of the History of Science, University of Oxford and Sir Brian Pippard, formerly Cavendish Professor at the University of Cambridge who, having read the first draft, gave me much encouragement, guidance and advice; to Mrs Irena McCabe, Archivist and Librarian at the Royal Institution for invaluable advice and assistance in guiding me to sources on Faraday's life and work here; to Drs Frank James and Brian Bowers for their comments on Chapter 4 and to Mr Peter Branch and Mrs Jean Conisbee for expert help with the illustrations. Miss Sue Horrill has coped magnificently and with equanimity with the conversion of my disjointed original text into a streamlined format. Mrs Maureen Clarke and Mr Al Troyano at Adam Hilger have given exemplary advice on editorial matters, for which I am most grateful. I appreciate the help and support of all these, but of none more so than my wife Margaret who read the entire text and whose concern for clarity and economy greatly improved it. I fondly dedicate this book to her.

Any shortcomings or infelicities that remain however are wholly mine.

Chapter 1

Setting the Scene

Michael Faraday is generally held to be one of the greatest experimental philosophers of all time. According to Albert Einstein he was also responsible along with Clerk Maxwell, for the greatest change in the theoretical basis of physics since Newton. Such was the prodigality of his output and the diversity of his skills that modern chemists, no less than physicists, engineers and materials scientists, regard him as one of the founders of their subjects: some sciences and technologies owe their very existence to his work. No name stands higher in the general esteem of scientists the world over than that of Faraday; and few names are encountered more frequently by first year university students of science than his. He bequeathed to posterity a greater body of pure scientific achievement than any other physical scientist, and the practical consequences of his discoveries have profoundly influenced the nature of civilised life.

Faraday was self-taught: he left school at the age of twelve, and started his career as an errand boy and then as a bookbinder. In none of his four hundred and fifty publications is there a single differential equation, for he knew no mathematics. But calculus, as Clerk Maxwell remarked, is but a part of mathematics, and,

according to him, Faraday was 'in reality a mathematician of a very high order — one from whom the mathematicians of the future may derive valuable and fertile methods.'

The story of Faraday's life and work is one of the most romantic and successful in the annals of science; and it is inextricably mingled with the fortunes of the Royal Institution, which he first entered as the result of a chance occurrence in 1812, and where he subsequently lived and worked for nearly fifty years. All his discoveries were made there, initially under the aegis of his brilliant mentor, Humphry Davy; all his educational initiatives, successful to this day, were mounted there.

He worked in the quiet of his basement laboratory. He built his own equipment and he often designed and constructed his own instruments. All but two of his papers were authored solely by him. They are masterpieces of lucidity, self-criticism and insight, and still serve as models for both aspiring and mature scientists. His voluminous notebooks, which detail his ambitions and doubts, successes and failures, and constitute a day-to-day record of the vicissitudes in his experimental work, are likewise a mine of information, of value both to the working scientist and the historian.

In the mid 1820s, Faraday initiated two brilliantly successful educational ventures in the public understanding and popularization of science: the Friday Evening Discourses for lay audiences and the Christmas Lectures for children, both of which still continue at the Royal Institution. Faraday gave the Christmas Lectures on nineteen occasions. His most famous series on *The Chemical History of a Candle*, first published in 1860, has become a classic translated

into many languages. (It is still recommended reading in the summer vacation for Japanese schoolchildren.) Faraday himself, through his experiences with young and old audiences at the Royal Institution, became one of the foremost lecturers of his time.

Though of a retiring, almost reclusive nature, and profoundly religious, Faraday was a leading figure in Victorian England. Prince Albert befriended him and among those with whom he interacted were the painters Turner and Constable, the writers Dickens and Ruskin, and the eminent biologists and champions of evolution Charles Darwin and T H Huxley. To these must be added Fox Talbot, one of the founders of photography, Roget, the originator of the thesaurus that bears his name, the polymathic scientists Lord Kelvin and William Wollaston (physician, geologist, chemist), and the philosopher William Whewell, later Master of Trinity College, Cambridge. Several of these gave Friday Evening Discourses at the Royal Institution, which, for much of the period when Faraday was Director there, was the focus of the intellectual, cultural and scientific life of London.

Apart from his towering scientific achievements, Faraday's contributions extended to many other fields. He was an early advocate of science teaching; he advised the National Gallery on the conservation of paintings, the British Museum on the cleaning of the Elgin Marbles and the Corporation of Trinity House on the illumination of lighthouses. He was the founding secretary of the London club, The Athenaeum.

Faraday combined singular gifts of intellectual power, technical virtuosity, intuition and moral perfection. Ben Jonson's remark about Shakespeare applies: 'He was not of an age, but for all time!'