MAGNETISM AND ELECTRICITY
By courtesy of the Metropolitan-Vickers Electrical Co. Ltd.

A million volt power frequency arc.
MAGNETISM AND ELECTRICITY

by

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“The beauty of electricity...is not that the power is mysterious or unexpected...but that it is under law...”

MICHAEL FARADAY

CAMBRIDGE

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PREFACE

This volume completes my series of school certificate physics text-books.

It is, like the others, a learning rather than a teaching manual—a readable book for the boy. Some historical detail has been included to give an impression of the way science grows, and to stress the cultural rather than the technical aspect of the subject.

Magnetism and electricity lends itself, perhaps more than any other branch of elementary physics, to the exposition of the role of hypothesis and theory in the progress of science: Faraday’s theory of lines of force, the molecular theory of magnetism, the two-fluid, one-fluid, and electron theories of electricity, the ionic theory, theories of terrestrial magnetism, the disintegration theory of Rutherford and Soddy—most of these have a fascinating historical background of controversy and development.

The order of presentation of the subject calls, perhaps, for brief comment. The bulk of electrostatics is postponed till a late chapter but, in the interest of logical development, enough electrostatics (as far as induction) is presented at the outset to justify the use of the terms positive and negative and to give meaning to the conception of current as a flow of electrons. Magnetometry and the tangent galvanometer are also treated near the end of the book. Ohm’s law, in view of its fundamental importance, is given at the beginning of current electricity, omitting at this stage the drop in potential difference of a cell on closed circuit.

Wireless telegraphy has been omitted, owing to the exigency of space. I have, however, devoted a chapter to signalling along wires, and another to the transmission of electricity and the Grid.

I am very much indebted to my former colleague, Mr R. E. Williams, who has read the manuscript and made numerous suggestions, and also to my pupil Mr J. W. G. Porter, who has worked out the answers to the examples.

My explanation of the action of a simple cell was suggested by Prof. W. L. Bragg’s book, Electricity.

My thanks are due to Mr B. F. Brown, who has taken for me, in the Repton laboratories, photographs of filing fields of magnets and currents, the electric arc deflected by a magnet, cathode rays casting a shadow, the Wimshurst machine, etc.
X

PREFACE

Dr R. J. Van de Graaff, of the Massachusetts Institute of Technology, kindly sent me photographs of his electrostatic generator, and the Copper Development Association obtained for me a photograph to illustrate the refining of copper from the Ontario Refining Company. Messrs Geo. Newnes, Ltd. have given me permission to reproduce certain illustrations, Figs. 54, 56, 134, 180, 287, 288 and 289, from their publication, *The Principles of Electrical Engineering*.

The following also have assisted me by providing photographs and information: Professor Carl Stermer, the General Electric Co. Ltd., the British Thomson-Houston Co. Ltd., the Metropolitan-Vickers Electrical Co. Ltd., the English Electric Co. Ltd., Messrs Ferranti Ltd., the Central Electricity Board, the Western Union Telegraph Co., the Cambridge Instrument Co. Ltd., the American Telephone and Telegraph Co., the G.P.O., Messrs Kelvin, Bottomley and Baird Ltd., the Westinghouse Brake and Saxby Signal Co. Ltd., the Igranic Electric Co. Ltd., Messrs Crompton, Parkinson Ltd., Messrs Siemens Bros. and Co. Ltd., the Royal Institution, the Science Museum, Messrs W. Canning and Co. Ltd., the London Power Co. Ltd., the Royal Meteorological Society, the Southern Railway, the Director of the National Portrait Gallery, Prof. Blackett and the Royal Society, the Editor of *The Welder*, Messrs Watson and Sons (Electrical Medical Ltd.), Messrs Williams and Wilkins Co. of Baltimore, U.S.A., the Tella Co. Ltd., and Messrs Imperial Airways.

I have taken considerable care in devising and collecting problems and questions, as I regard these as a most important feature of a science text-book. I must express my thanks to the following Examining Bodies for permission to reproduce School Certificate questions: the Oxford and Cambridge Joint Board (O. and C.), the Northern Universities Joint Matriculation Board (N.), the University of London (L.), the Cambridge Local (C.) and the Oxford Local (O.) Examination Syndicates. The letters in brackets will be found printed after the questions to designate their source.

A. E. E. M.

*Repton, November 1897*

In this edition the term “resistivity” is used in preference to “specific resistance”, and “oersted” instead of “gauss” as the unit of magnetic field strength.

*July 1944*