Energy, Force, and Matter

CAMBRIDGE HISTORY OF SCIENCE

Energy, Force, and Matter

The Conceptual Development of Nineteenth-Century Physics

P. M. HARMAN
Department of History, University of Lancaster

CAMBRIDGE UNIVERSITY PRESS
CAMBRIDGE
LONDON NEW YORK NEW ROCHELLE
MELBOURNE SYDNEY

Published by the Press Syndicate of the University of Cambridge
The Pitt Building, Trumpington Street, Cambridge CB2 1RP
32 East 57th Street, New York, NY 10022, USA
296 Beaconsfield Parade, Middle Park, Melbourne 3206, Australia

www.cambridge.org
Information on this title: www.cambridge.org/9780521246002

First published 1982

Library of Congress Cataloging in Publication Data
Harman, P. M. (Peter Michael), 1943–
Energy, force and matter.
(Cambridge history of science)
Bibliography: p.
Includes index.
1. Physics – History. 2. Force and energy – History.
I. Title. II. Series.
QC7.H44 530'.09'034 81–17029

ISBN-13 978-0-521-24600-2 hardback
ISBN-10 0-521-24600-8 hardback

ISBN-13 978-0-521-28812-5 paperback
ISBN-10 0-521-28812-6 paperback

Transferred to digital printing 2005

For Juliet and Timothy

Contents

Preface

The period circa 1800–1900 corresponds to a distinctive phase in the conceptual development of physics, bounded by the increasing dominance, from the late eighteenth century on, of quantification and the search for mathematical laws, together with the emergence of a unified physics based on the programme of mechanical explanation, and by the development in the early twentieth century of the quantum and relativity theories. I have aimed to provide a study of the development of physics in the nineteenth century in a form accessible to the reader without a specialised knowledge of physics and mathematics. The argument of the book is structured around the major conceptual problems of nineteenth-century physics: the emergence of energy physics and thermodynamics, the theory of the luminiferous and electromagnetic ether and the concept of the physical field, molecular physics and statistical thermodynamics, and the dominance of the programme of mechanical explanation. The book begins with an account of the transformation in the scope of the science of physics in the first half of the nineteenth century.

I am grateful to John Heilbron for reading a portion of the manuscript and to Crosbie Smith for reading the whole manuscript of this book, and for their helpful comments. I am also grateful to the Syndics of the Cambridge University Library for their kind permission to reproduce documents in their keeping, and to the Council of the Royal Society for the award of a grant for research undertaken in the preparation of this book.