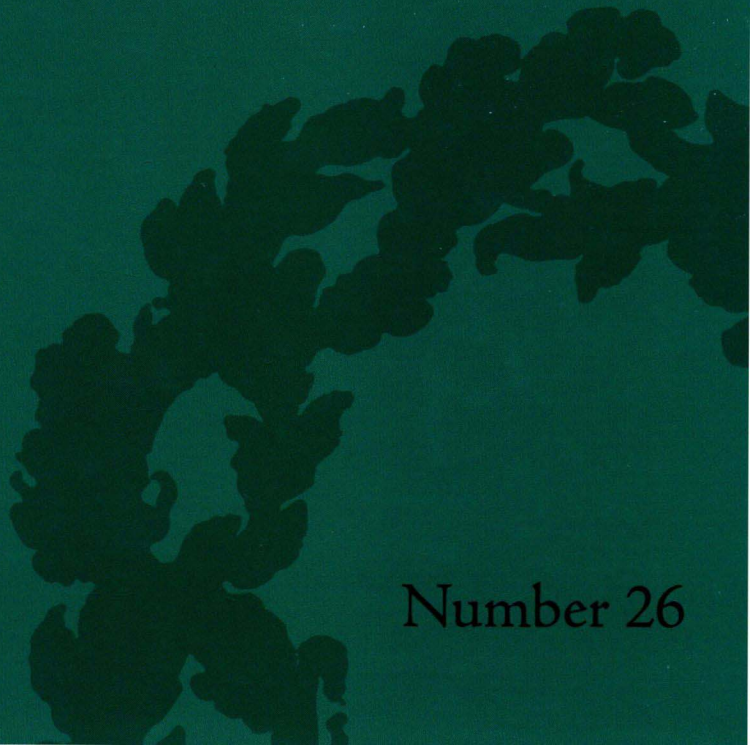
Science and Culture in the Nineteenth Century

Victorian Literature and the Physics of the Imponderable

Sarah C. Alexander



Number 26

Victorian Literature and the Physics of the Imponderable

Sarah C. Alexander

The Victorians were obsessed with the empirical but were frequently frustrated by the sizeable gaps in their understanding of the world around them. This study examines how literature and popular culture adopted the emerging language of physics to explain the unknown or 'imponderable'. Writers such as Charles Dickens, William Morris and Joseph Conrad used recent concepts such as energy, entropy and atom theory to explore key issues of capitalism, imperialism and social unrest. In doing so, they created a fresh vocabulary, helping to make sense of the new experiences of modernity.

Science and Culture in the Nineteenth Century

Series Editor: Bernard Lightman

This monograph series focuses on the history of science during the nineteenth century. An era of exciting and transformative scientific discoveries, it was also a period when significant features of the relationship between contemporary science and culture first assumed form. The series includes studies of major developments within the disciplines, from geology and botany, to astronomy and medicine, as well as works on popular science. The evolution of scientific ideas is placed in its social, political, religious, cultural, imperial and international contexts.

ISBN: 978 1 84893 566 2

PICKERING & CHATTO

www.pickeringchatto.com

26

Victorian Literature and the Physics of the Imponderable

Sarah C. Ale

P&C

VICTORIAN LITERATURE AND THE PHYSICS OF THE IMPONDERABLE

BY

Sarah C. Alexander

PICKERING & CHATTO
2015

Published by Pickering & Chatto (Publishers) Limited
21 Bloomsbury Way, London WC1A 2TH

2252 Ridge Road, Brookfield, Vermont 05036–9704, USA

www.pickeringchatto.com

BRITISH LIBRARY CATALOGUING IN PUBLICATION DATA

Alexander, Sarah C., author.
Victorian literature and the physics of the imponderable. – (Science and culture in the nineteenth century)
1. English literature – 19th century – History and criticism. 2. Physics in literature.
I. Title II. Series
820.9'36-dc23

ISBN-13: 9781848935662
Web-PDF: 9781781447901
ePUB ISBN: 9781781447918

This publication is printed on acid-free paper that conforms to the American National Standard for the Permanence of Paper for Printed Library Materials.

Content Management Platform by Librios™
Typeset by Pickering & Chatto (Publishers) Limited
Printed and bound in the United Kingdom by CPI Books

VICTORIAN LITERATURE AND THE PHYSICS OF THE IMPONDERABLE

Science and Culture in the Nineteenth Century

Series Editor: Bernard Lightman

Titles in this Series

1 Styles of Reasoning in the British Life Sciences: Shared Assumptions, 1820–1858
James Elwick

2 Recreating Newton: Newtonian Biography and the Making of Nineteenth-Century History of Science
Rebekah Higgitt

3 The Transit of Venus Enterprise in Victorian Britain
Jessica Ratcliff

4 Science and Eccentricity: Collecting, Writing and Performing Science for Early Nineteenth-Century Audiences
Victoria Carroll

5 Typhoid in Uppingham: Analysis of a Victorian Town and School in Crisis, 1875–1877
Nigel Richardson

6 Medicine and Modernism: A Biography of Sir Henry Head
L. S. Jacyna

7 Domesticating Electricity: Technology, Uncertainty and Gender, 1880–1914
Graeme Gooday

8 James Watt, Chemist: Understanding the Origins of the Steam Age
David Philip Miller

9 Natural History Societies and Civic Culture in Victorian Scotland
Diarmid A. Finnegan

10 Communities of Science in Nineteenth-Century Ireland
Juliana Adelman

11 Regionalizing Science: Placing Knowledges in Victorian England
Simon Naylor

12 The Science of History in Victorian Britain: Making the Past Speak
Ian Hesketh

13 Communicating Physics: The Production, Circulation and Appropriation of Ganot's Textbooks in France and England, 1851–1887
Josep Simon

14 The British Arboretum: Trees, Science and Culture in the Nineteenth Century
Paul A. Elliott, Charles Watkins and Stephen Daniels

15 Vision, Science and Literature, 1870–1920: Ocular Horizons
Martin Willis

16 Popular Exhibitions, Science and Showmanship, 1840–1910
Joe Kember, John Plunkett and Jill A. Sullivan (eds)

17 Free Will and the Human Sciences in Britain, 1870–1910
Roger Smith

18 The Making of British Anthropology, 1813–1871
Efram Sera-Shriar

19 Brewing Science, Technology and Print, 1700–1880
James Sumner

20 Science and Societies in Frankfurt am Main
Ayako Sakurai

21 The Making of Modern Anthrax, 1875–1920: Uniting Local, National and Global Histories of Disease
James F. Stark

22 The Medical Trade Catalogue in Britain, 1870–1914
Claire L. Jones

23 Uncommon Contexts: Encounters between Science and Literature, 1800–1914
Ben Marsden, Hazel Hutchison and Ralph O'Connor (eds)

24 The Age of Scientific Naturalism: Tyndall and his Contemporaries
Bernard Lightman and Michael S. Reidy (eds)

25 Astronomy in India, 1784–1876
Joydeep Sen

Forthcoming Titles

Victorian Medicine and Popular Culture
Louise Penner and Tabitha Sparks (eds)

Adolphe Quetelet, Social Physics and the Average Men of Science, 1796–1874
Kevin Donnelly

www.pickeringchatto.com/scienceculture

ACKNOWLEDGEMENTS

This project has benefitted from many colleagues and friends who have read and responded to various drafts of these chapters. I am very grateful to Kate Flint, who advised my dissertation at Rutgers University where some of the earliest pieces of this project were conceived. Kate has been a generous mentor and advisor, and she has left an indelible mark on my scholarship. I also want to thank Jonah Siegel and Carolyn Williams, who served on my dissertation committee and whose guidance continues to influence my work. Thanks are due to many friends and advisors at Rutgers who supported this project, including Sarah Balkin, Sean Barry, Barbara Bender, Joshua Gang, Craig Iturbe, Seth Koven, Rick Lee, George Levine, Richard Miller, Barry Qualls and Cheryl Robinson.

My colleagues at the University of Vermont have been enormously supportive of my work. I am especially grateful to Elizabeth Fenton and Valerie Rohy for reading drafts, offering useful suggestions for revision and generally encouraging the process. I also want to thank Jean Bessette, Isaac Cates, Jinny Huh, Tony Magistrale, Jennifer Sisk and Chris Vacarro. I am grateful to my students, who are a constant source of inspiration. Thanks are also due to Loren Alexander and Christine Alexander for their encouragement and support.

I want to thank Mark Pollard at Pickering & Chatto. I am indebted to Bernard Lightman, the series editor, who offered important guidance in completing and revising the manuscript. I am also thankful to Barri J. Gold and Sally Shuttleworth, who refereed the initial manuscript and provided immensely generous and useful suggestions for revision.

It would be impossible to overstate the importance of Liz Reich and Megan Ward to this project. Not only did they read every word of my manuscript at each stage of revision over several years, but they also engaged my ideas and pushed my thinking time and time again.

This project was supported in its early stages by an American Council of Learned Societies Dissertation Completion Fellowship.

A version of chapter two was published in *Nineteenth-Century Contexts*, 35:2 (2013), pp. 99–120.

CONTENTS

INTRODUCTION: IMPONDERABLE MATTER

> In studying this Fourth state of Matter, we seem at length to have within our grasp and obedient to our control the little indivisible particles which, with good warrant, are supposed to constitute the physical basis of the universe. We have seen that in some of its properties Radiant Matter is as material as this table, whilst in other properties it almost assumes the character of Radiant Energy. We have actually touched the border land where Matter and Force seem to merge into one another, the shadowy realm between Known and Unknown, which for me has always had peculiar temptations. I venture to think that the greatest scientific problems of the future will find their solution in this Border Land, and even beyond; here, it seems to me, lie Ultimate realities, subtle, far-reaching, wonderful.
>
> William Crookes, 'Radiant Matter' (1879)

In an 1852 article in *Household Words*, Henry Morley insists,

> We are in the present day upon the trace of a great many important facts relating to the imponderable agencies employed in nature. Light, heat, and electricity are no longer the simple matters, or effects of matter, that they have aforetime seemed to be. New wonders point to more beyond.[1]

In the article called 'New Discoveries in Ghosts', Morley refers to a widely accepted concept within the Victorian physical sciences to posit evidence of the existence of ghosts: imponderable matter. Morley goes on to cite the work of Austrian chemist Baron Karl von Reichenbach, who claimed that an 'imponderable' substance, which he called 'odyle', is emitted by all forms of matter in the universe and resembles light, heat and electricity. Odyle, according to Morley's reading of Reichenbach, can be perceived by certain people he calls 'sensitives' and 'is generated among other things by heat, and by chemical action. It is generated, therefore, in the decomposition of the human body'.[2] Reichenbach's experiments with sensitives, who claimed to be able to see light coming from graves, led Morley to claim, 'in plain words ... I do believe in ghosts – or, rather spectres – only I do not believe them to be supernatural'.[3]

Morley's belief in ghosts (and, indeed, Reichenbach's, and that of many Victorians) requires not – as he acknowledges – a belief in the supernatural. Rather, it necessitates the existence of imponderable matter. At once ghostly and material, imponderable matter was a concept central to the Victorian physical sciences. Many physicists believed that light, heat, electricity and magnetism were forms of imponderable matter. In his 1839 *Elements of Natural Philosophy*, Golding Bird explains that most natural philosophers believe that the space between bodies is filled with some form of imponderable matter, which is '700,000 times less dense than air; and that its elastic force, as compared to its density, must be, at the lowest estimate, 490,000,000,000 times greater than that of air'.[4] This nearly weightless and highly elastic substance was, according to Bird and many natural philosophers, responsible for the propagation of light and heat and many other thermal phenomena. He explains,

> The subtle and invisible forms of ethereal matter, when caused to assume a vibratory or undulatory movement with sufficient rapidity, produce a peculiar set of phenomena, whose effects are known by the terms of light and heat; effects of vast importance, for without them nature would be dead to us, its beauties no longer apparent, and this world a cheerless waste.[5]

Imponderable matter, then, was for the Victorians invisible, undetectable, yet the very fabric of the cosmos. It could explain simple phenomena such as the transmission of light and heat, and it could provide physical explanation for what once seemed supernatural.

British natural philosophers shifted their focus from mechanics to 'imponderable' or 'ethereal' matter or fluids during the second half of the eighteenth century in order to explain electrical, optical and magnetic phenomena. These substances were not like other kinds of matter or fluids because they were believed to be weightless and undetectable. Imponderable matter was thought to be composed of particles with repulsive forces. Eighteenth-century theories of imponderable fluids were based on a theory of ether that Newton had proposed in his 1717 *Opticks* to explain, for example, gravitational attraction. As Cantor and Hodge note, although Newton 'constructs several different, even incompatible theories', 'on his main account ether consisted of very minute particles that (1) repelled one another, and (2) repelled and were repelled by particles of gross matter'.[6] Larry Laudan points out that imponderable fluid theories were pervasive during the latter half of the eighteenth century:

> In the 1740s alone, there were at least half a dozen major efforts to explain the behaviour of observable bodies by postulating a variety of invisible (and otherwise imperceptible) elastic fluids ... [B]y the 1770s, ethereal or subtle fluid explanations were very widespread among natural philosophers ... [S]uch explanations invariably violated the prevailing epistemological and methodological strictures of the age,

> strictures that ... would not countenance the use of theoretical or 'inferred' entities to explain natural processes.[7]

By the beginning of the nineteenth century, then, the physical sciences in Britain were increasingly dependent upon the theoretical rather than the empirical, and the invisible rather than the detectable, as imponderable matter theories became central to the study of mechanics.

Although these theories were widespread among natural philosophers, as William Thomas Brande demonstrated in his 1819 *A Manual of Chemistry*, detection of imponderable matter was understood to create considerable difficulty:

> Of the substances belonging to our globe, some are of so subtle a nature as to require minute and delicate investigation to demonstrate their existence; they can neither be confined, nor submitted to the usual modes of examination, and are known only in their states of motion as acting upon our senses, or as producing changes in the more gross forms of matter. They have been included under the general term of Radiant or Imponderable Etherial Matter, which, as it produces different phenomena, must be considered as differing either in its nature or affections.[8]

In an 1816 lecture on radiant matter, Michael Faraday similarly claimed,

> Assuming heat and similar subjects to be matter, we shall then have a very marked division of all the varieties of substance into two classes: one of these will contain ponderable and the other imponderable matter. The great source of imponderable matter, and that which supplies all the varieties, is the sun, whose office it appears to be to shed these subtle principles over our system.[9]

What is remarkable about these theories of imponderable matter is that they were prevalent in a scientific climate dominated by an empirical imperative.

By the middle of the nineteenth century, many natural philosophers believed that the various forms of imponderable matter that had been theorized earlier were really just a single form of imponderable matter: luminiferous ether. In an 1865 *Fortnightly Review* article, 'The Constitution of the Universe', prominent physicist John Tyndall asks, 'Are the stars themselves hung *in vacuo*? Are the vast regions which surround them, and across which their light is propagated, absolutely empty?'[10] Tyndall, like many scientists of his day, believed that the space between the stars was not empty, and claimed that luminiferous ether was an interstellar medium that fills space and conveys light. In the same article, Tyndall describes the ether, insisting, 'The notion of this medium must not be considered as a vague or fanciful conception on the part of scientific men. Of its reality most of them are as convinced as they are of the existence of the sun and moon'.[11] He goes on to claim that the ether has 'definite mechanical properties':

> It is almost infinitely more attenuated than any known gas, but its properties are those of a solid rather than of a gas. It resembles jelly rather than air. This was not the first

> conception of the ether, but it is that forced upon us by a more complete knowledge of its phenomena. A body thus constituted may have its boundaries; but, although the ether may not be coextensive with space, it must at all events extend as far as the most distant visible stars. In fact it is the vehicle of their light, and without it they could not be seen. This all-pervading substance takes up their molecular tremors, and conveys them with inconceivable rapidity to our organs of vision. It is the transported shiver of bodies countless millions of miles distant, which translates itself in human consciousness into the splendour of the firmament at night.[12]

Tyndall is concerned here with the material properties of this invisible and undetectable medium. Scientists believed that the luminiferous ether subtended radiant energy and governed phenomena such as the movement of light across space. Although luminiferous ether could not be confirmed empirically, the substance, claimed scientists, was the medium responsible for the propagation of light and heat and could explain the interaction between two objects separated in space. Nineteenth-century physics – especially dynamics, the science of force and motion – often depended on what could not be observed, and Victorian physicists were particularly at ease with non-empirical methods of enquiry and concepts such as imponderable matter. The ether came to stand as a model for the interaction between other kinds of material and immaterial phenomena. In his 1855 *The Principles of Psychology*, Herbert Spencer used the concept of imponderable matter as an analogy for the relationship between mind and body. 'A materialist of the cruder sort', Spencer claims, can 'elevate Matter to a level with Mind'[13] by suggesting that the relationship between matter and mind is analogous to that between matter and imponderable matter:

> That the ether so extreme in tenuity that we can scarcely represent it to ourselves as having materiality, is nevertheless composed of units which move in conformity to mechanical laws, is now a common-place of science. Hypothetically endowing these units with momenta, and assuming that in each undulation their courses are determined by composition of forces, mathematicians long ago found themselves able not only to interpret known properties of the light constituted by ethereal undulations, but to assert that it had unobserved properties; which were thereupon proved by observation to exist. Far greater community than this has been disclosed between the ponderable and the imponderable: the activities of either are unceasingly modified by the activities of the other. Each complex molecule of matter oscillating as a whole – nay, each separate member of it independently oscillating, causes responsive movements in adjacent ethereal molecules, and these in remoter ones without limit; while, conversely, each ethereal wave reaching a composite molecule, changes more or less its rhythmical motions, as well as the rhythmical motions of its component clusters and those of their separate members.[14]

For Spencer, imponderable matter provides a model for all other undetectable phenomena, including the working of the human mind. Moreover, imponderable matter is characterized by its ability to invisibly influence and be influenced