QUAKERS, JEWS, AND SCIENCE

Religious Responses to Modernity and the Sciences in Britain, 1650–1900

GEOFFREY CANTOR

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UNIVERSITY PRESS

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Great Clarendon Street, Oxford OX2 6DP

Oxford University Press is a department of the University of Oxford.
It furthers the University's objective of excellence in research, scholarship,
and education by publishing worldwide in

Oxford New York

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Kuala Lumpur Madrid Melbourne Mexico City Nairobi
New Delhi Shanghai Taipei Toronto

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Argentina Austria Brazil Chile Czech Republic France Greece
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Published in the United States
by Oxford University Press Inc., New York

First published 2005

British Library Cataloguing in Publication Data

Data available

Library of Congress Cataloguing-in-Publication Data

Cantor, G. N., 1943-
Quakers, Jews, and science: religious responses to modernity and the sciences in
Britain, 1650–1900/Geoffrey Cantor.
p. cm.
Includes bibliographical references and index.
ISBN 0–19–927668–4 (alk. paper)
1. Religion and science–Great Britain–History–17th century. 2. Religion and
science–Great Britain–History–18th century. 3. Religion and science–Great
Britain–History–19th century. 4. Society of Friends–Doctrines. 5. Judaism–
Doctrines. I. Title.
BL240.3.C36 2005
201′.65′09410903–dc22

2005019301

Typeset by SPI Publisher Services, Pondicherry, India
Printed in Great Britain
on acid-free paper by
Biddles Ltd., King's Lynn

ISBN 0-19-927668-4 978-0-19-927668-4

1 3 5 7 9 10 8 6 4 2

PREFACE

The generous assistance of many individuals and institutions has made this book possible. It is with great pleasure that I acknowledge the financial help of the Leverhulme Trust, which awarded me a Major Research Fellowship, the Sir James Reckitt Charity, the Royal Society of London, and the Sir John Templeton Foundation. An early part of the research was conducted during my tenure of a Research Fellowship at the Dibner Institute for the History of Science and Technology (at MIT), where I enjoyed the company of many able scholars and access to such excellent libraries as the Widener Library and the library of the Museum of Comparative Zoology at Harvard. I am also greatly indebted to the School of Philosophy at the University of Leeds, especially to my supportive and congenial colleagues John Christie, Steve French, Graeme Gooday, Jonathan Hodge, Chris Kenny, Greg Radick, Jonathan Topham, and Adrian Wilson.

Research for this book has depended on access to many first-rate libraries and archives and on the assistance of knowledgeable librarians and archivists. Moreover, I am grateful to a number of libraries for granting me permission to quote or reproduce material from their collections. Hence I would like to express my appreciation to the Bodleian Library, Bootham School, the Borthwick Institute of Historical Research, the British Library, Cambridge University Library, Cumbria Record Office at Whitehaven, the Dean and Chapter Library (York), the University of Durham Archives, the Archives of the University of Edinburgh, the Hartley Library (University of Southampton), Imperial College Archives (and the archivist Anne Barrett), the John Rylands Library (University of Manchester), the Archives of King's College London, the Leeds Library (especially Geoffrey Forster and his colleagues), the Leeds Library and Information Services (which houses the Porton Collection), the Linnaean Society (and the librarian Gina Douglas), the Library of the London School of Jewish Studies, Oxford University Museum (and the archivist Stella Brecknell), the Library of the Religious Society of Friends and the Library Committee of the Religious Society of Friends in Britain, the Library of the Royal Anthropological Institute, the Library of the Royal Astronomical Society (and the librarian Peter Hingley), the Library of the Royal College of Surgeons, the Library of the Royal Institution, the Library of the Royal Society of Arts, the Library and Archives of the Royal Society of London, the Scottish Record Office, the Society of Antiquaries, the Archives of the Spanish and

Portuguese Jews' Congregation (and its archivist Miriam Rodrigues-Pereira), Tyne and Wear Record Office, the Library and Archives of University College London, and the Library and Archives of the Wellcome Institute for the History of Medicine. My greatest debt is to Leeds University Library, which I have used on an almost daily basis, and especially to Chris Sheppard and his colleagues in Special Collections.

I am most grateful to a number of individuals who have freely given their advice and assistance on a wide variety of topics, including Thelma Amer, Yaakov Atik and Ruth Bender-Atik, John Hedley Brooke, Ben Pink Dandelion, Israel Finestein, Eva Frojmovic, John Greig, Douglas Gwyn, Alex Keller, Thomas Kennedy, Ben Marsden, Stephen Massil, Edward Milligan, Jack Morrell, Geoffrey Morries, Jean Mortimer and the late Russell Mortimer, Helen Roberts, David Robinson, Michael Ruse, Jacqui Stewart, Marc Swetlitz, Hugh Torrens, and two anonymous referees.

It has been a pleasure dealing with Oxford University Press and with the commissioning editor for religion, Lucy Qureshi, and her assistant, Dorothy McCarthy. For editorial advice and assistance I would like to thank Enid Baker and Jean van Altena.

Finally, for her constant support and encouragement throughout this long research project and for her many suggestions for improving the style and content of this book, I would like to express my inestimable gratitude to Barbara Cantor. All errors, all shortcomings of interpretation, and all infelicities of style are, however, my own.

CONTENTS

LIST OF ILLUSTRATIONS

LIST OF ABBREVIATIONS AND CONVENTIONS

AM	*Annual Monitor*
BAAS	British Association for the Advancement of Science (founded 1831)
BF	*British Friend*
BJHS	*British Journal for the History of Science*
BL	British Library (Manuscripts)
Calendar	Frederick Burkhardt *et al.*, *Calendar of the Correspondence of Charles Darwin* (New York: Garland, 1985), followed by reference number assigned to the letter
CM	Council Minutes of the Royal Society of London, followed by volume number (in Roman numerals) and page number. Thus CM ii. 142. Deposited in RSL.
Correspondence	Frederick Burkhardt *et al.* (eds.), *The Correspondence of Charles Darwin* (Cambridge: Cambridge University Press, 1985–)
EMdC	Correspondence of Emanuel Mendes da Costa, BL Add. MSS 28,534–44 (= vols. i–xi). References will be given as follows: EMdC, volume number, folio number. Thus EMdC iii. 46 refers to BL Add. MS 28,536, fol. 46.
FQE	*Friends' Quarterly Examiner*
FRS	Fellow of the Royal Society of London
HFP	Hodgkin Family Papers, Wellcome Institute for the History of Medicine
HO	*Hebrew Observer*
IEE	Institution of Electrical Engineers
JB	Journal Books of Scientific Meetings of the Royal Society of London, followed by volume number (in Roman numerals) and page number. Thus JB xii. 273. Deposited in RSL.
JC	*Jewish Chronicle*
JFHS	*Journal of the Friends' Historical Society*
JFS	Jews' Free School
JGLSI	Jews' and General Literary and Scientific Institution
JR	*Jewish Record*
JRU	Jewish Religious Union

JW	*Jewish World*
KCL	King's College London
LMS	London Mathematical Society
LSF	Library of the Religious Society of Friends, Friends House, London
MF	*Manchester Friend*
MJHSE	*Miscellanies of the Jewish Historical Society of England*
MNRAS	*Monthly Notices of the Royal Astronomical Society*
Nichols	John Nichols, *Illustrations of the Literary History of the Eighteenth Century*, 8 vols. (London: Nichols, Son, and Bentley, 1817–58)
NHJ	*Natural History Journal (and School Reporter)*
NRRSL	*Notes and Records of the Royal Society of London*
PCLS	Typescript of Peter Collinson's correspondence prepared by A. W. Armstrong and Lady J. O'Neill and deposited in the Library of the Linnean Society, London
PT	*Philosophical Transactions of the Royal Society of London*
RSL	Library and Archives of the Royal Society of London
SRO	Scottish Record Office
TJHSE	*Transactions of the Jewish Historical Society of England*
UCL	University College London
VoJ	*Voice of Jacob*

A NOTE ON DATES

Objecting to the heathen names of the months, such as March (based on Mars, the Roman god of war), Quakers instead referred to the months by their numbers. Thus, 7 March 1840, would be written as 7th day, 3rd mo., 1840, or 3rd mo, 7th day, 1840. For the sake of consistency the first of these forms will be used. An added complication occurs with dates before the change from the Julian to the Gregorian calendar in 1752. In the Julian calendar the year began on 25 March, the feast of the Annunciation, which was therefore denominated the 1st month. On this scheme, April was the 2nd month, January the 11th month, and February the 12th month. In citing pre-1752 dates I have retained the mode of dating used by the author of the relevant document.

It should also be noted that Quakers were not very consistent in dispensing with the heathen names of the months, particularly when writing to non-Quakers. Moreover, by the latter decades of the nineteenth century most Quakers had adopted the names of the months used by the population at large. In the text and notes I will use the form of date given in the original document, whether Quaker or 'heathen'.

The Hebrew calendar will be discussed in section 8.1. As the Jewish New Year falls in either September or early October, the Hebrew and civil years do not correlate. Instead, they differ numerically by either 3,760 or 3,761 years. Thus a specific date in the civil year 1851 will fall in either 5611 or 5612, and a date in the Hebrew year 5611 will fall in either 1850 or 1851.

1

Introduction: Science in 'Dissenting' Religious Communities

Both religion and science have played major roles in shaping our lives. Yet contemporary modes of thought encourage the view that science and religion are not only separate but are inexorably in conflict. Indeed, the term 'science and religion' might conjure up images of Bible-waving fundamentalists attacking Darwin's theory of evolution and of secular scientists mounting anti-religious diatribes. Although such manifest conflicts may attract the attention of the media, they represent opposite ends of a broad spectrum of opinion, within which numerous less strident voices have intermixed science and religion in a variety of ways; indeed, many of the more subtle interactions between science and religion may be missed if we are diverted by the raucous public pronouncements of the extremists. One of the main aims of this study is to examine closely a range of science–religion discourses in order to display their richness and to analyse their historical significance.

Many of the main difficulties encountered in writing about 'science and religion' arise from the words 'science' and 'religion' themselves. They defy easy definition, and the difficulty of delineating either term increases when we address earlier centuries or cross-cultural divides. For example, historians working in the medieval and early modern periods find modern notions of science largely irrelevant to understanding the material on which they work. Moreover, in this and in many other instances the present-day notion that science and religion are separate spheres does not apply. Even in the contemporary context the word 'science' can possess many meanings: for example, it can refer simply to organized knowledge (reflecting the word's etymology), or to the authoritative pronouncements of scientists, or to the research methods they employ, or the specific theories they use. Likewise, 'religion' is subject to many meanings and continual dispute.[1] At the outset, then, it is vital to be aware that our central terms, 'science' and 'religion', do not possess fixed and atemporal meanings but are problematic and depend on the historical context.

[1] Brooke, *Science and Religion*, 6–11; Brooke and Cantor, *Reconstructing Nature*, esp. 43–72. An interesting but controversial proposal has been put forward in Clouser, *Myth of Religious Neutrality*, 9–34.

A second set of problems arises when we try to determine the relationship(s) between science and religion. Theologians, philosophers, and scientists often reduce this problem to the relationship between scientific theories and theological systems. Thus Darwin's theory of evolution may be set against the Creation narrative contained in the opening verses of Genesis. Another example, but one that is often used to support the coherence between science and religion, lies in the claim that the Judaeo-Christian account of Creation postulates a rational God who created a law-like universe. Although such essentialist approaches provide some valuable insights, they offer static views of science–religion relations and ignore the many levels of complexity that historians have had to confront. For example, historians studying early responses to evolution have found that scientists and religious thinkers held a wide range of views about how evolution and Christianity interrelate; for some this was a paradigm example of conflict, while for others evolution was not only compatible with their religious positions, but science and religion were mutually reinforcing.[2] As historians have stressed, close attention needs to be paid to historical and local contexts in order to appreciate the ways in which science and religion have been interrelated. More generally, an historical lens enables us to appreciate the richness, variety, and complexity of science–religion interactions.[3]

In adopting a historical approach to the science–religion domain, we have to confront a further problem: what kind of historical framework should we utilize? It is helpful here to consider the issue of scale. At one extreme are the macro theses seeking to relate science (often the rise of modern science in seventeenth-century Europe) to the dominant religious ethos (in this case the new religious outlook engendered by Protestantism). Thus writers as diverse as the American sociologist Robert Merton and the Dutch Calvinist historian Reijer Hooykaas have articulated the connections between the 'new learning' that was central to the Scientific Revolution and the 'new doctrine' of reformed Protestantism.[4] While analyses developed by Merton and Hooykaas require a large historical canvas, other scholars have sought to understand science–religion relations by examining the lives and works of specific individuals who engaged both areas. Thus, from a close study of Isaac Newton's writings, historians have been able to identify with considerable precision the many points of contact not only between his published scientific innovations

[2] E.g. Ellegård, *Darwin and the General Reader*; Livingstone, *Darwin's Forgotten Defenders*; Numbers and Stenhouse (eds.), *Disseminating Darwinism*.

[3] See esp. Brooke, *Science and Religion*; Brooke and Cantor, *Reconstructing Nature*.

[4] Merton, *Science, Technology and Society*; Hooykaas, *Religion and the Rise of Modern Science*. For an important recent attempt to articulate the role of Protestantism in the rise of science see Harrison, *Bible, Protestantism, and the Rise of Natural Science*.

and his rather idiosyncratic religious beliefs but also his more private explorations of alchemy, biblical chronology, and prophecy.[5] Indeed, the biographical approach provides a particularly appropriate lens through which to analyse how individuals navigate between the scientific and the religious. Although biographically based studies of science and religion have tended to concentrate on eminent scientists, including Kepler, Newton, Boyle, and Faraday, increasing attention is being paid to lesser-known figures, such as Robert Dick (1774–1857), the author of a number of popular works that extolled the value of science for evangelicals.[6]

Although we can learn a great deal from these biographical studies, the perspective they provide is necessarily restricted. Since scientists have often adopted rather unconventional positions on religion, we may not be able to infer any wider conclusions about how their contemporaries sought to engage issues of science and religion. For example, far from holding theological views that were widely shared among his contemporaries, Newton was a closet Socinian, and in denying the divinity of Christ, he espoused a doctrine that was generally considered heretical. Likewise, Faraday subscribed to a primitive form of Christianity and belonged to a small sect called the Sandemanians. Yet among early Victorian Sandemanians (who numbered fewer than a thousand) Faraday was the only scientific luminary, while three or four others were relatively minor figures in the scientific community. Most of the remainder, two-thirds of whom were women, appear not to have participated in science. Thus, within his own religious community Faraday appears anomalous, and from studying him we can infer little about how Sandemanians engaged contemporary science.[7]

In the present study I shall try to develop an intermediate approach between the big picture narratives of Merton and Hooykaas and the micro studies provided by biography. Between these two extremes lies an intermediate perspective constituted by religious communities, such as churches, sects, and denominations.[8] Such social groups often possess historical continuity and become transmitters of traditions of belief and practice that transcend the individual; while individuals, in turn, may both subscribe to these traditions and also challenge them. The individual's religious identity is thus usually constructed through membership of a specific religious group, and it is to the community that people usually express their allegiance. Thus an individual who belongs to a Methodist chapel will probably relate to the doctrines and

[5] E.g. Snobelen, 'Isaac Newton, heretic'; *idem*, '"God of gods and Lord of lords"'.
[6] Astore, *Observing God*.
[7] Cantor, *Michael Faraday*.
[8] This perspective is shared by several of the essays in Numbers and Stenhouse (eds.), *Disseminating Darwin*.

social norms of Methodism, rather than to some general notion of Christianity. Moreover, from a sociological perspective, religion is generally organized along denominational lines. Religious groups also often leave abundant traces for the historian to study, such as minutes of meetings, sermons, correspondence, theological tracts, and, by the mid-nineteenth century, periodical publications. The availability of such resources allows the historian to pose the primary question addressed by this study: how did specific religious communities engage science?

The present study will concentrate on the history of two religious communities in Britain—England primarily—from the late seventeenth to the late nineteenth centuries. A complex array of 'churches' peppered the British landscape. Some were ephemeral, while others existed continuously over extended periods. As C. Maurice Davies discovered in the early 1870s, the religious life of London was wonderfully diverse, and over a two- or three-year period he attended a different church or chapel each week.[9] As well as visiting a wide range of Anglican churches, reflecting a considerable diversity of belief, he attended Baptist, Congregationalist, Methodist, and Unitarian chapels, and meetings of the Spiritualists, the National Secular Society—and even Faraday's Sandemanians. Although religious belief and practice could take many different forms, the most prominent feature of religious history in England has been the existence of an Established Church which has not only been sanctioned by the state but has also played a major, even controlling, role in the social and political life of the country. Despite the increasing acceptance of religion as a matter of personal conviction, during the period under discussion the influence of the Anglican establishment was pervasive, not only on religious issues but also on politics and education. Much of modern English history until at least the later nineteenth century can be interpreted as the struggle between church and chapel, since this religious divide has been intimately connected with so many aspects of the nation's life.[10] Dissent—or later, Nonconformity, to use its more emollient self-descriptor—was as much a social and political badge as a religious label.

It has often been claimed that religious Dissenters played an unusually large and conspicuous role in the development of science, technology, and medicine when compared with their Anglican contemporaries.[11] While there is some truth in this claim, it is open to a number of objections. For example, it

[9] C. M. Davies, *Unorthodox London*; *idem*, *Orthodox London*; *idem*, *Heterodox London*.

[10] Watts, *Dissenters*; Binfield, *So Down to Prayers*.

[11] In the case of Quakers see, e.g., Hankin, *Common Sense and its Cultivation*, 261–7; Raistrick, *Quakers in Science and Industry*, 222; Mason, 'Religion and the rise of modern science'. More generally, see the literature that has developed in response to Merton, *Science, Technology and Society*, which is reviewed in Paul Wood's introduction to his *Science and Dissent*, 1–18.

is clear that some Dissenting churches do not fit this characterization as well as others; for example, despite the size of Wesley's Methodist connection, science was far less prevalent among Methodists than, for example, among Unitarians or Quakers, and few Methodists made significant contributions to science.[12] As some forms of Dissent were more congenial to science than others, we cannot identify Dissent *per se* as the explanation of scientific achievement. Another set of problems arises when we try to construct an appropriate measure on which to base the comparison between Anglicans and the various Dissenting groups. It is tempting to focus on recognized scientific discoveries or on membership of the Royal Society of London as indicators of scientific success. Apart from a natural scepticism about the validity of such comparisons, there is the more pertinent question of whether we should focus on scientific success, however defined. Such an approach engenders an exclusive interest in innovation, thereby masking many other significant historical questions, including the main ones that motivate this study.[13]

Historians have come to recognize that the analysis of science cannot be restricted to 'great men' or to what we perceive with hindsight to be major innovations. Instead, they have focused increasingly on the place of science within the wider culture, religion included, and shown the extent to which science is a product of its cultural context. We are likely, therefore, to misunderstand the historical significance of science, and especially its relationship to religion, if we disregard context and concentrate on technical discoveries. Thus, while this study does not ignore scientific innovations, it will focus rather on the *ways* in which religious communities have related to science. I have emphasized 'ways' in the plural, because the relationship between science and religion is not simple and singular, but manifold and complex. Moreover, such relationships are highly contingent and subject to change over time and space. Thus, to quote Paul Wood, there is 'no coherent or comprehensive narrative of the shifting relations between Dissent and science from the seventeenth to the twentieth century'.[14]

In light of the preceding discussion it may be helpful to identify the following questions to indicate our primary concerns: Did a particular community feel threatened by science? Was science an acceptable subject to be taught to the community's children? If so, what kind(s) of science were taught? Did members of the community pursue scientific careers or join scientific societies? Were scientific ideas and language deployed in religious

[12] Haas, 'John Wesley's vision of science'; *idem*, 'Reverend Dr William Henry Dallinger'.

[13] In 'How successful were Quakers at science?' I have argued against such claims as: 'Friends have secured something like forty times their due proportion of Fellows of the Royal Society during its long history' (Raistrick, *Quakers in Science and Industry*, 222).

[14] Wood (ed.), *Science and Dissent*, 5.

narratives, such as sermons? How did religious groups (and not just the occasional leading scientist in them) respond to such scientific innovations as Newtonian mechanics and Darwin's theory of evolution? In attempting to answer these questions, some light may be shed on the question of whether Dissenters were particularly successful at science. But that is not our main concern; instead, this book addresses the attitudes to science and involvement in science of two religious communities.

The Dissenting communities studied here are the Religious Society of Friends, generally known as Quakers, and the Anglo-Jewish community. Quakers have been a small but significant element within British Dissent although, as Clyde Binfield notes, they were the 'cats of Protestant Dissent walking perennially by themselves' and separating themselves from the mainstream.[15] By contrast, Jews are not usually considered as Dissenters, a term often applied only to Protestants. However, in the present context there is an important sense in which Anglo-Jewry should be interpreted within a general Dissenting framework. For example, in 1736 one leading voice of the Jewish community argued that Jews should be treated like '*other Dissenters*' in the eyes of the law. He then proceeded to expound the 'great Analogy there is in general between the *Dissenters* and *Jews*, and how easily we are to be mistaken for each other'.[16] Throughout most of the period under consideration, Jews and Protestant Dissenters were subject to almost identical social and political disabilities; they were identified as non-Anglican, and thereby affected by legislation that favoured Anglicans. To give just two examples among many: in the area of education Jews and Protestant Dissenters faced religious tests that prevented them from entering Oxford University and from graduating from Cambridge until the mid-1850s. Jews and Dissenters were likewise prominent in supporting the foundation of University College London, because of its non-denominational agenda. Although Jews and Quakers differed significantly in their relationship to the Established Church, they both suffered from being positioned outside it, and their existence as separate religious communities was defined by their relationship, often their opposition, to Anglicanism.

During the seventeenth and early eighteenth centuries, Quaker opposition to the hegemony of the Anglican-dominated state led to their extensive persecution, with large numbers being imprisoned and their property seized.[17] Although this persecution declined throughout the eighteenth century, the bitter memory of the earlier struggles remained, and engendered a

[15] Binfield, *So Down to Prayers*, 7.
[16] Abrabanel, *Complaint of the Children of Israel*, 239.
[17] Besse, *Collection of the Sufferings of the People Called Quakers*.

range of Quaker beliefs and practices designed to maintain their separate existence. Quakers have often referred to themselves as a 'peculiar people', or a 'people apart'. For example, in arguing that Quakers must accept suffering in order to assert their integrity, the seventeenth-century apologist Robert Barclay reminded Friends that God had 'gathered us into his own power and life, to be a *separate people*'.[18]

The sufferings of Anglo-Jewry were of a lesser order (particularly when compared to the experiences of most Jewish communities on mainland Europe). Yet not only were Jews subject to discrimination under the law, but forms of anti-Semitism remained endemic in English life. Whilst this rarely overflowed into violence, it was manifest in the press, in plays, in anti-Semitic caricatures, and doubtless also in daily street life. The Jewish community was particularly oppressed by the activities of the conversion societies, which were supported by many Christians, both Anglican and Dissenter.[19] Moreover, Jews were often viewed as 'other', historically, socially, and religiously, and this opposition from without was one of the forces that shaped the Jewish community. As we shall see throughout this study, the issues of identity and distinctiveness are crucial in understanding both British Quakers and British Jews, these being factors that affected all their activities, including their engagement with science. However, science not only provides a particularly revealing topic for investigating their interactions with the world outside their communities, but from the responses of Quakers and Jews to science we can make a series of comparisons and contrasts, which reflect the social histories of the two groups. This book therefore offers a comparative study of the ways in which British Quakers and Jews engaged the sciences during the period prior to *c.*1900.

The decision to study the Quaker and Jewish communities was made primarily because they illuminate the central issues raised above. Moreover, while both dissented from the Established Church, they maintained their dissent in different ways—ways that bear directly on their significantly different involvements in science. But the choice was also influenced by pragmatic considerations. Both communities were established during the Cromwellian Commonwealth, and both possess continuous histories over the past three and a half centuries. Despite constant attrition, social pressures, both internal and external, have enabled these communities to remain fairly discrete and identifiable. Continuity has also been maintained by institutions, especially the plethora of Meetings in the case of Quakers and the voluntary

[18] R. Barclay, *Apology*, 339. The phrase 'peculiar people' occurs in Deut. 14: 2 and 26: 18, and 1 Pet. 2: 9.

[19] Felsenstein, *Anti-Semitic Stereotypes*; Endelman, *Jews of Georgian England*, 46–7, 86–117.

communal organizations and synagogues within Anglo-Jewry. This study draws on the records of both communities and on the papers of individual members who participated in science.[20] But one type of source has proved particularly useful. The religious periodical press, which can be traced back to the late seventeenth century, diversified considerably during the early nineteenth century, with almost every religious organization seeking to make its own voice heard in the cacophony of print. Both Jewish and Quaker communities attempted to establish periodicals, but these early attempts were short-lived. However, with the reduction in stamp tax in 1836, other legislative changes, and technological innovations, the price of print fell, producing 'an outburst of new titles in the later 1830s and 1840s'.[21] In 1841 two rival Jewish fortnightlies were founded, the *Voice of Jacob* and the *Jewish Chronicle*, which was subsequently issued weekly. Two years later they were joined by two Quaker monthlies, the *Friend* and the *British Friend*. These and later periodicals provide a window on the Victorian Jewish and Quaker communities, and enable us to appreciate how both communities engaged science, especially such challenges as Darwin's theory of evolution and the materialist worldview with which it was often associated. For the earlier period there are few comparable sources, and I have had to draw on a more limited range of documents.

However, we should not assume that the views expressed in the religious periodical press accurately reflect a community's viewpoint. As we shall see, on a number of occasions both the Society of Friends and the Anglo-Jewish community were divided internally on major issues. For example, the *Jewish Chronicle* was directed to reasonably affluent Anglicized Jews and not to the poor recent immigrants who flooded into Britain during the closing two decades of the nineteenth century. Thus the *Jewish Chronicle* should not be taken as representing the views of the characters who populated Israel Zangwill's *Children of the Ghetto* (1892). Likewise, both the *Friend* and the *British Friend* tended to appeal to different subsections within the Society of Friends, and the foundation of the more liberal *Friends' Quarterly Examiner* (1867) and the radical *Manchester Friend* (1873) illustrate the existence of other, and different, perspectives on Quakerism.

This diversity raises two significant concerns. First, although the periodical press enables us to study a range of views extending well beyond the very few who pursued science, in both communities the majority of members were silent on issues relating to science, technology, and medicine. These silences

[20] Largely owing to George Fox's competence as a bureaucrat, Quaker historical records are very full. The records of Anglo-Jewry are far sparser.

[21] Altholz, *Religious Press in Britain*, 12.

are illustrated by the itinerant Jewish street traders whom Henry Mayhew interviewed *c.*1850, but whose voices were rarely heard in the Jewish press.[22] By contrast, those Jews whose accounts of science have survived were principally editors, rabbis, members of the 'Jewish aristocracy', and an increasing number from the rising middle class. The second, and related, point is that science was not an abiding concern of either religious community. Science was rarely among the most pressing topics of the day, and even among those members whose writings have survived, only a minority addressed issues of contemporary science.[23] This is apparent from the pages of the *Friend* and the *Jewish Chronicle*, where we find occasional articles on science and references to it. In contrast to the number of columns devoted to science—generally far more in Quaker periodicals than in their Jewish counterparts—these periodicals were filled with reports on communal organizations, discussions of biblical topics, articles on contemporary political developments (such as the removal of disabilities), reviews of recently published religious works, correspondence on how to make services more attractive, news of the travels of leading members, and information from abroad, to mention but a few of the many topics included. However, although science was not a particularly prominent topic, it entered into articles on many other subjects. This study aims to identify those aspects of science that each community deployed and to examine how they were utilized.

At the outset it may be useful to identify some of the different roles fulfilled by science within religious communities. Science could form an integral part of a religiously sanctioned education. It could likewise form the basis of an acceptable career. Science was also one of the very few areas in which members of Dissenting communities could engage people from other religious traditions, Anglicans included, on an equal footing. By contrast, science could also be used to accentuate the oppositions between different religious traditions. Most importantly, science was viewed as a harbinger of modernism.

The issues surrounding modernism are complex. Both of the religious communities that we are examining were steeped in their own traditions but, at the same time and to different degrees, pulled towards innovations in science, technology, and modern modes of thought. While reactions to science are of crucial importance in examining how religious communities engaged what they saw as the modern world, the link between science and modernism is not straightforward. For example, those eighteenth-century Quaker botanists who filled their gardens with exotic plants saw themselves

[22] Mayhew, *London Labour and the London Poor*, esp. ii. 115–35.

[23] These and other pertinent historiographical issues are raised by Brooke, 'Science and Dissent'.

as contributing to the evidence for divine design, an activity that was innovative, through the addition of new species, but also traditional, in the sense that they were evoking a time-honoured and religiously sectioned way of viewing the world as God's creation. Yet, particularly during the closing decades of the nineteenth century, both the Quaker and the Jewish communities were divided internally over the question of whether to hold fast to religious tradition (however defined) or to make some accommodation to modernism. Modern thought provided both Quakers and Jews with a major challenge; they had to decide whether and how to address not only developments in the biological and human sciences, but also the higher biblical criticism and radical political ideas. In such contexts science, especially evolution, was centrally implicated, since it betokened modernism and was espoused by the advocates of new religious formations in the closing years of the nineteenth century.

In order to provide an overview of the argument contained in this book, it may be helpful to outline each chapter. Since the primary aim is to examine the role of science within Quakerism and Anglo-Jewry, the next chapter provides the reader with brief histories of both communities, so as to highlight in each case those aspects that have a bearing on our topic.

Throughout the eighteenth and nineteenth centuries education was of major concern to both Quakers and Jews. Not only were they excluded from many educational establishments, which were mainly Anglican-dominated, but they (especially the Quakers) insisted on sending their sons and daughters to schools that taught acceptable doctrines and did not impose untenable views. Thus the place of science in Quaker schools, especially Bootham School in York, is examined in the third chapter, and in schools such as University College School that were acceptable to affluent Victorian Jews. In this chapter we also discuss medical education at the Scottish universities, which did not impose religious tests. The opening of University College London in 1828 was particularly welcomed by the Jewish community. With the repeal of religious tests in the mid-1850s, we follow the first cohorts of Jewish and Quaker students at Cambridge. In this chapter we also look at some of the science-related careers pursued by Jews and Quakers.

In the fourth chapter we examine the Quaker and Jewish Fellows of the Royal Society of London, focusing primarily on the period prior to the 1847 reforms, and also the British Association for the Advancement of Science (founded in 1831). We also review the place of science in several organizations in which Quakers played a major role, and the science holdings of various Quaker libraries. The only Victorian Jewish society directed specifically, but not exclusively, to science was the Jews' and General Literary and Scientific

Institution (1845–59). Another useful comparison is provided by the responses of both communities to the Great Exhibition of 1851, which is discussed in the final section.

Chapter 5 seeks to show how Jews and Quakers participated in various aspects of science. Nine diverse topics have been identified and, in most cases, the work of a Jew and a Quaker is compared. Although discussion of each individual is necessarily brief, this chapter attempts to provide the reader with an appreciation of the active pursuit of science by members of the Quaker and Jewish communities.

The next four chapters contain parallel arguments articulating, first, each community's attitude towards science and how it was pursued, and second, how the community reacted to the most religiously provocative development in science—Darwin's theory of evolution. Since Darwin's theory raised a host of religious and theological issues, and the ensuing controversies gained a high public profile, it is instructive to see how Quakers and Jews responded to this innovative and challenging theory. Much of the material discussed in these four chapters is drawn from nineteenth-century sources. This reflects both the vastly greater amount of source material relating to science published in the nineteenth century, especially in the Quaker and Jewish periodical press, and the increased religious tensions surrounding science in the mid-Victorian period. Throughout these chapters there is a strong emphasis on scientific practice. In particular, the deployment of evolutionary ideas in the research publications of Quaker and Jewish scientists is assessed.

In Chapter 6 Quaker attitudes to science are related to the doctrine of the 'Inner Light', which emphasizes the centrality of personal experience. Thus, it is argued, Quakers encouraged a strongly empiricist view of science, and often deployed design arguments. Notions of scientific method are related to the sociology of Dissent. These themes are reflected in the discussion of Quaker responses to evolution in Chapter 7, especially the emergence of the doctrine of progressive revelation by the modernists who gained ascendance at a conference held in Manchester in 1895. The scientific writings of several Quaker naturalists are discussed, to show that while Quakers were increasingly prepared to use evolutionary ideas in their research, many remained ambivalent towards employing the mechanism of natural selection.

Chapter 8 opens with a section on the deployment of science within the Jewish tradition: in particular, the use of astronomical knowledge and mathematical technique in the construction of Hebrew calendars. We also examine the tension between 'Mosiac science'—the project of reading scientific truth from the Torah—and developments in nineteenth-century science. The following chapter (9), on reactions to the theory of evolution, reflects the social and religious tensions within Victorian Anglo-Jewry and the increasing trend towards modernism by a small but articulate section of the community. A particularly important focus is provided by Raphael Meldola (1849–1915), who was an avid Darwinian.

While Chapters 3–9 provide parallel accounts of how the Quaker and Jewish communities viewed science and participated in its various activities, the concluding chapter draws on these discussions in order to compare and contrast the ways in which these communities engaged science. It also engages the broader question of how science and religion are interrelated, in order to underscore the more innovative aspects of this study.

This study does not attempt to provide a complete history of how Quakers and Jews engaged every aspect of science over a period of some two and a half centuries; nor does it endeavour to name every Quaker and Jew who participated in science. Instead, each chapter focuses on a specific set of issues in which Jews and Quakers can be brought into the same frame, and thereby their activities can be compared and contrasted. Where possible I have sought the activities of groups rather than individuals, since the former are generally more helpful in determining the views of religious communities.[24]

1.1 Scope of this study

1.1.1 *Temporal*

George Fox's preaching in the Yorkshire–Lancashire–Cumbria area in 1652, and particularly his ascent of Pendle Hill that summer, are generally acknowledged as marking the main phase in the creation of the Quaker movement. By contrast, the history of Anglo-Jewry possesses a medieval prelude that ended in 1290 with the expulsion. Although small numbers of Jews settled in England during the intervening period, their readmission in 1656 under Cromwell enabled Jews to live openly as Jews, and thus marks the start of an overt Jewish community. As Cromwell appears to have been motivated by both economic and philo-Semitic beliefs, the establishment of both communities can be interpreted as consequences of the Puritan revolution. Our starting-point will therefore be the 1650s.

The subsequent histories of Jews and Quakers display few points of contact. Although both groups benefited from the same legislative changes (for example, the opening of the ancient English universities to non-Anglicans), no

[24] E.g., we will have little to say about John Dalton's work on atomism, which owed more to his Manchester context than to any specifically Quaker influence. By contrast, as we shall see in sect. 5.5, his early meteorological researches can be located in the tradition of Cumbrian Quaker meteorologists.

single event spanning both histories provides an appropriate termination date for this study. The end of the nineteenth century has been chosen for both historical and pragmatic reasons. In Quaker history the Manchester Conference of 1895 was a crucial moment for the redefining and redirection of Quakerism, and it is generally portrayed as initiating modern Quakerism. As Thomas Kennedy has noted, at Manchester 'liberal theology captured both the rhetorical initiative and the high moral ground', and the dominant theme was 'the compatibility of modern ideas with Quaker tradition'.[25] The reformers who took control at Manchester insisted that Quakers no longer eschew modern thought but engage recent developments in science, including Darwin's theory of evolution. By ending with this reform, we will be omitting the subsequent history of Quakerism, including the role of Arthur Eddington (1882–1944), who reflects the post-1895 ethos.

The year 1895 does not, however, possess special significance for Anglo-Jewry. Yet it falls in the middle of a major upheaval within the community. Although the number of Jews in Britain had been increasing steadily, owing primarily to immigration, the mass immigration of Jews, principally Jews fleeing persecution in Russia, covers the period from 1881 to just before the First World War. In that period the Jewish population leapt from about 55,000 to around 250,000—a nearly fivefold increase. London Jewry, which had been increasing at the rate of about 4 per cent per annum in the period 1851–81, was growing at a phenomenal 10 per cent per annum between 1881 and 1900. This influx changed the face of Anglo-Jewry in many respects.[26] By terminating our study *c.*1900 we will be paying little attention to these immigrants, who were predominantly poor and were initially relatively untouched by the mores of the English middle classes or by secular values, science included. Selig Brodetsky (1888–1954), one of the first of the new wave of immigrants to embark on a scientific career, entered Cambridge only in 1907.[27] Our focus will instead be directed to the established Anglo-Jewish community. The event most closely comparable to the 1895 Manchester Conference was the formation of the Jewish Religious Union in 1902, which marks a significant moment in the development of a progressive, modernist wing within Anglo-Jewry. These two events, which fall close to the start of the new century, provide the termination of our discussion.

In discussing both the Jewish and the Quaker communities' responses to science, we need to combine long-term issues, medium-term periodization (such as the four-period account of Quakerism given in section 2.1), and

[25] Kennedy, *British Quakerism*, 150; Brinton, *Friends for 300 Years*, 196–202.

[26] Alderman, *Modern British Jewry*, 102–51; V. D. Lipman, *History of the Jews in Britain*, 43–66.

[27] Brodetsky, *Memoirs*, 51–63.

short-term factors. Thus, where appropriate, nineteenth-century views will be aligned with medieval or seventeenth-century sources, since both communities located themselves in long-term historical traditions. Elsewhere, however, close attention will be paid to chronology—for example, where responses to Darwin's *Origin of Species* are discussed. In light of the historical material, there is no alternative to employing a variety of different time-scales.

1.1.2 *Geographical*

Although both the Jewish and the Quaker communities were international, the focus will be on Britain, principally England. There are several reasons for this, the most important being that in England both Quakerism and Judaism were crucially fashioned by their relationship to Anglicanism with its alliance to the state and its all-pervasive influence on English social and political life. The specifically English context affected the practice of both religions in important respects, and made English Quakerism and Judaism significantly different from the forms found in other countries. For example, in what was to become the United States, there was no state church to react against, and Quakerism fragmented into three major strands and a number of minor ones. By contrast, English Quakers remained a unified body despite losing members through such schisms as the Beacon controversy of the 1830s. Likewise, in comparison with, say, Germany, Anglo-Jewry did not suffer any major rifts, although divisions were becoming apparent towards the end of the nineteenth century. Moreover, as Todd Endelman has argued, in England Jews were relatively free to integrate into the wider society, a freedom that was denied to most Jewish communities in mainland Europe until the mid- or even late nineteenth century.

While most of the material presented here relates to England, we should not forget that Wales, Scotland, and Ireland were home to communities of both Quakers and Jews. Of these, Irish Quakers constituted the only sizeable group, including a number of botanists and medical men, some of whom are discussed here.[28] Scotland plays a particularly important role in Chapter 3, since prior to the mid-nineteenth century Quakers and Jews embarking on a medical education had to look abroad or to one of the Scottish universities, principally the celebrated medical school at Edinburgh.

Among both Jews and Quakers another important geographical consideration arises from the strong links each maintained with communities of their co-religionists abroad. For example, in the eighteenth century many Sephardi Jews (who were descended from families who had lived in the Iberian

[28] Nelson (ed.), *Quakers in Natural History & Medicine*.

peninsula) were involved in international trade with the Amsterdam Jewish community, while Quakers maintained trading links with Quaker settlements in North America. In both cases scientific specimens and information followed trade routes marked by religious connections. Hence, although our focus is England, we need to appreciate a reciprocal intercourse with co-religionists abroad.

As well as national differences, we should also be aware of local geographical variations. For example, during the eighteenth century the mainly Sephardi Anglo-Jewish community was centred on London, but the increasing number of Ashkenazim (mainly from Germany, Central and Eastern Europe) also founded communities in Manchester, Birmingham, and other cities throughout the nineteenth century. Yet the Jewish community was predominantly metropolitan, compared with Quakers. North-west England was the traditional Quaker heartland, and although Quakerism initially attracted a strong rural following, cities like Bristol, Norwich, York, and Newcastle—together with London—became the main centres of English Quakerism. As historians have noted, Quakerism was not uniform across the country, but differed significantly between, for example, Bristol and Newcastle.[29] It is no coincidence that a substantial proportion of the Quakers discussed in the ensuing chapters hailed from the north of England.

1.1.3 *Which sciences?*

As indicated above, the word 'science' contains a number of ambiguities, not least because it underwent a significant change during the period covered by this study. In the present context we will be using it to refer to a range of subjects including both the physical and the biological sciences, but also geology, anthropology, and mathematics. Moreover, science encompasses aspects of education, the topic of scientific method, and scientific institutions. Thus the ensuing chapters include discussion of what both Quakers and Jews thought about how knowledge of the universe should be gained. Also included are scientific institutions ranging from schools and universities to societies, such as the Royal Society of London.

This study thus focuses on science, broadly defined. However, a broad definition of science necessarily impinges on two other areas, medicine and technology, which are sometimes seen as coextensive with science. Although both medicine and technology have generated problems for science to address, and have in turn drawn on scientific theories, the primary focus here

[29] E.g. Morgan, *Lancashire Quakers*; O'Malley, '"Defying the Powers and Tempering the Spirit"'; S. Wright, *Friends in York*.

will be on science *per se*. Yet certain points of contact are readily acknowledged; for example, medical students at Edinburgh studied several sciences, frequently including chemistry and natural philosophy.

Technology raises a further difficulty, because science is sometimes taken to include technology, whereas in other contexts, they are contrasted. While it would not be appropriate to dwell extensively on Quaker and Jewish contributions to technology, this topic is acknowledged in several places, including section 5.6, which concentrates on railway technologies. While the number of examples could easily be multiplied, the two principal cases discussed there show that both religious communities included entrepreneurs who developed new technologies.[30] Yet, in neither instance did these specific innovations depend greatly on scientific knowledge. The relationship between science, technology, and entrepreneurial activities is further explored in section 5.7 through the case study of Robert Were Fox (1789–1877), a Quaker scientist and proprietor of tin and copper mines in Cornwall.

1.1.4 *Communities*

The issue of who is to be counted as a Jew, or a Quaker, is discussed in Appendix 1. In the case of Quakers the issue is complicated by a number of examples of people who left the movement or were 'disowned' (that is, had their membership terminated because they had infringed Quaker discipline), sometimes at a fairly advanced age. As they cannot be excluded from this study, they must nevertheless be clearly differentiated from practising Quakers who belonged to a formally constituted Meeting. I shall therefore use the term 'ex-Quakers' to refer to them after they severed their connection. Other problems occur with Anglo-Jewry. As the boundaries of the Jewish community were far less clearly specified, where possible I shall distinguish between practising Jews, lapsed Jews, and those who converted to Christianity.

In discussing both communities, we should be careful not to assume too great a uniformity of view about science, or indeed many other issues. Although Quakers do not subscribe to a creed, much of their literature, from Fox's writings to the current edition of *Quaker Faith & Practice* (subtitled *The Book of Christian Discipline of the Yearly Meeting of the Religious Society of Friends (Quakers) in Britain*), emphasizes discipline and prescribes individual behaviour. Thus the social norms of the Society of Friends are highly relevant to this study, particularly those bearing on attitudes to science. However, even the apparent unanimity achieved at Quarterly and Yearly

[30] For Quaker contributions to industry see I. Grubb, *Quakerism and Industry*; Raistrick, *Quakers in Science and Industry*.

Meetings can be deceptive, as the diary of William Lucas (1804–61), a farmer and brewer from Hitchin, indicates. During the 1838 Yearly Meeting he admitted that although 'we may all appear to conform, it is most likely that [the] few who think for themselves do not in some respect differ from the views professed by the Society'.[31] Lucas was troubled by his own shortcomings and also by the many tensions within the Society that threatened its very existence. Yet he rightly identified the importance of individuality, which often prevented those 'who think for themselves' from being in total agreement with the majority. The history of Quakerism has been particularly marked by such free-thinking individuals, and we should therefore be cautious in drawing any generalizations. Quakers also varied in other ways: some were 'gay' and worldly, while others were sombre and quietist; during the middle decades of the nineteenth century some dispensed with the traditional attire and modes of address, while others maintained these peculiarities; some were exceedingly rich, others poor; some were carried by the evangelical fervour that produced the Beacon controversy of the 1830s, but others found evangelicalism inimical to the traditional spirit of Quakerism. An illustration of this diversity occurs in the autobiography of the writer Mary Howitt (1799–1888), who moved in 1836 from Nottingham to Esher, where she was visited by Kingston Friends. She was shocked to find that they

> would not read books [on secular subjects]. They would not go into society. They would not look at a newspaper, nay, even would not admit a newspaper into their houses. Now, is this not a miserable state to be in? Yet these are among the approved and most orthodox members [of the Society of Friends].[32]

Thus, to identify someone as a Quaker does not necessarily imply that he or she holds specific views about either Quakerism or science. Such terms as 'quietist' or 'evangelical' add a first level of precision.

Compared with the highly developed organizational structures operating within the Quaker community, the forces of social and institutional conformity within Anglo-Jewry were weak. Although there might be family and peer pressure, a Jew's decision as to whether and how to practise Judaism was largely a matter of choice. Some belonged to synagogues (whose records are not nearly as complete as those for Quaker Meetings), but many poor Jews could not afford to join, and some more wealthy Jews simply did not join for any of a variety of reasons. The attractions of assimilation into the ranks of British society were opposed by the appeal to tradition and to an individual's need to maintain a separate religious identity.[33] Within the community there

31 Bryant and Baker (eds.), *Quaker Journal*, i. 137.
32 Howitt (ed.), *Mary Howitt*, i. 257.
33 Endelman, *Radical Assimilation in English Jewish History.*

was considerable diversity. Most noticeably—and again in contrast to the Quaker community, which was dominantly middle class by the late eighteenth century—it spanned the very wealthy to the exceedingly poor. It also spanned two traditions, Sephardi and Ashkenazi, that possessed very distinct histories and subscribed to significantly different customs and practices. Other divisions existed. For example, a breakaway Reform synagogue was founded in the early 1840s. Again, late in the nineteenth century the waves of immigrants fleeing the Russian pogroms imported forms of Jewish practice that most Anglicized Jews considered primitive and unacceptable. Thus, within the Jewish community there was great diversity, often greater than among Quakers.

There is one significant section of both communities that is almost entirely absent from the following chapters. The prime examples of women who wrote on science are Priscilla Wakefield, a prolific Quaker whom we encounter in section 5.8, and the little-known Miriam Mendes Belisario (1820–85), author of *Sabbath Evenings at Home*. In places, however, we encounter women among the audience for science; for example, Caroline Fox (1819–71) frequently attended meetings of the British Association, and knew many members of the scientific community. Also girls at the Mount School in York received some education in science. Yet, in general, Quaker and Jewish women had as little involvement in science as their Anglican contemporaries, although (as we shall see in section 3.4.2) a number of late Victorian Quaker women entered Cambridge to study science subjects. However, one nineteenth-century Jewish woman has recently attracted considerable interest, since she pursued an active research career in science, publishing on the electric arc and other topics. Although Hertha Ayrton (1854–1923), née Marks, was Jewish, and her early academic successes were reported in the Jewish press, she espoused agnosticism during her early twenties and wilfully cut herself off from the Jewish community.[34] It is therefore appropriate to include her in the section dealing with Jews at Cambridge (section 3.4.1), but omit her later activities.

[34] Sharp, *Hertha Ayrton.*

2
Two Communities

> [The city of Bath is] a miserable poor place . . . [where] the enemy of Mankind had attempted in various ways to draw attention off from their deepest Interest, by all sorts of temptations, but had lamentably succeeded in that place. Religion of any kind seems to be banished from thence with as much solicitude as Judaism or heresy from Portugal or Spain.
>
> John Fothergill (Quaker, father of Dr John Fothergill), 1744[1]

> [Bath is] a place that I should choose to reside in the last of all others.
>
> Dr John Fothergill (Quaker), 1744[2]

> Bath is at present very full and brilliant, to which the presence of his Royal Highness the Duke of York does not a little contribute.—I am not idle.—We have a good many *b'nai yisrael* [Children of Israel] here.
>
> Dr Ralph Schomberg (lapsed Jew), 1761[3]

> I am delirious as ever, still preferring the coal-pit or stone quarry [where he could pursue his geological investigations] to the Bath Assembly [Rooms], or a Court-Ball.
>
> Emanuel Mendes da Costa (Jew), 1761[4]

The aim of this chapter is to provide very brief overviews of the histories of the Quaker and the Anglo-Jewish communities, in order to introduce the main historical themes encountered in later chapters. As this chapter summarizes selectively the work of many historians, readers requiring fuller accounts of Quaker and Anglo-Jewish history are directed to notes 5 and 31, which contain short bibliographies. Also included are sociological characterizations of the two communities that address their internal dynamics and their relationship to the Anglican establishment.

[1] Quoted in Booth, *Doctors in Science and Society*, 66.

[2] John Fothergill to Robert Key, 6th day, 8th mo., 1744, in Corner and Booth (eds.), *Chain of Friendship*, 94.

[3] Ralph Schomberg to Emanuel Mendes da Costa, 12 Oct. 1761, in Nichols, iv. 768.

[4] Emanuel Mendes da Costa to Ralph Schomberg, 10 Dec. 1761, in Nichols, iv. 768–9.

2.1 The Quaker community

The new movement that developed round George Fox needs to be set in the context of the political and religious upheaval that rent England in the mid-seventeenth century.[5] The turmoil of the Civil War and Interregnum loosened the bonds of uniformity and enabled many people to engage new religious doctrines and social practices. Fox's personal religious quest, which had begun around 1643, soon escalated into a large and vocal populist movement. Fox preached that every person possesses an Inner Light: a divine spark that fosters communication with God and moderates all thought and action; that the religious life demands an unremitting pursuit of truth and the rejection not only of many conventional theological doctrines, but also of those social customs that are contrary to religious purity. Early Quakers were gripped by this vision of a mystical and evangelical Christianity that, independent of the clergy, enables each individual to proclaim his or her own spiritual experience. Converts were attracted from other religious paths, including many who were alienated from traditional sources of social and ecclesiastical authority—women, powerless country labourers, and upwardly mobile tradesmen. Few members of the gentry joined this band of enthusiasts, and those who did tended to be newly created rather than those from the traditional nobility.

Through their extensive travels Fox and other early preachers spread their vision of a pure and undefiled religion. The reputation of Quakers often preceded them, and their arrival in a town or village was attended not only by those curious to hear their message, but often also by an irate magistrate, a fulminating clergyman, and an angry mob. With its emphasis on individual religiosity and its rejection of the clergy and of many social conventions—such as doffing the hat when addressing a 'superior'—Quakerism was widely considered heretical and a threat to both church and state. The Blasphemy Act of 1650 was the first of many legal moves against Quakers. During the next decade Fox was imprisoned in Nottingham, Derby, Carlisle, Leicester, London, Launceston, and Lancaster. Joseph Besse's *Collection of the Sufferings of the People Called Quakers* (1753) lists nearly 21,000 Friends who suffered because of their religious commitments. An estimated 450 died in gaol or as a direct result of imprisonment. Many were fined or had goods confiscated in lieu of a fine. The fortitude with which Quakers bore their sufferings is a

[5] From the vast literature on Quaker history I have drawn principally on the following: Braithwaite, *Beginnings of Quakerism*; *idem*, *Second Period of Quakerism*; Jones, *Later Periods of Quakerism*; Vann, *Social Development of English Quakerism*; Brinton, *Friends for 300 Years*; Isichei, *Victorian Quakers*; Kennedy, *British Quakerism*. Particularly useful for its analysis of key issues and concepts is Bauman, *Let Our Words be Few*.

testimony to their strength of religious feeling. Indeed, imprisonment often increased their resolve. Writing from the Tollbooth at Aberdeen, one prisoner related how the thirty imprisoned Quakers 'have exceeding sweet and comfortable meetings most frequently wherein the power of the Lord doth mightily appear in the midst of us, so that Friends generally are greatly encouraged, to the astonishing and confounding of our adversaries'.[6]

Howard Brinton, who has divided the history of Quakerism into four periods, describes this early phase as the 'heroic or apostolic period',[7] as Quakers asserted their vision of a pure, undefiled form of religion in which each individual is guided by the Inner Light. Through itinerant preaching and a vast range of publications they vigorously spread their subversive religious message, arguing that society must be changed and all forms of evil combated. Like other Puritan visionaries, Quakers directed their energies principally to religious renewal, but they also paid some attention to the physical universe, which they viewed not simply as God's creation but also as infused with religious meaning. For example, in a work published in 1659, Francis Howgill argued that the light of the sun bears a close analogy to the spiritual light.[8] Likewise, many Quakers, Fox included, practised faith healing in the belief that their mission to cure souls also encompassed the cure of bodily ills.[9] Yet most early Quakers took little cognizance of the activities of the newly founded Royal Society, considering that the science it promoted could not assist their religious mission.

Some historians emphasize another important aspect of early Quakerism that is not adequately captured by Brinton's phrase.[10] Fox was not only a religious visionary, with a clear notion of the pure Christian religion, but also a far-sighted pragmatist. In the 1660s he developed an organizational structure that bound Quakers together in a system of self-government that ensured the Society's internal cohesion and its continuation long after his death. Every Quaker was assigned to a local (Preparative) Meeting, which was a constituent of a Monthly Meeting; Monthly Meetings combined to form a Quarterly Meeting, and at the summit of the organization stood the Yearly Meeting. Representatives from each Meeting would attend the Meeting higher in the organizational pyramid; thus Quarterly meetings would send representatives to the Yearly Meeting. Likewise, any problems that deserved weighty

[6] George Keith to Robert Barclay, 12th day, 3rd mo., 1676, in Nicholson and Hutton (eds.), *Conway Letters*, 427.

[7] This fourfold chronology follows closely the four periods in American Quakerism as developed by Brinton, *Friends for 300 Years*, 175–202.

[8] Howgill, *Invisible Things of God*, 136.

[9] Cadbury, *George Fox's 'Book of Miracles'*.

[10] Braithwaite, *Beginnings of Quakerism*, 306–42; *idem*, *Second Period of Quakerism*, 215–350.

consideration could be referred up the chain. The same route was followed for locally collected information, including statistical data. For example, by collecting membership figures from across the movement, the Yearly Meeting acted as a 'centre of calculation', to use Bruno Latour's term, and thus obtained overall statistics for the whole Society.

Conversely, the views and judgements agreed by the Quakers assembled at the Yearly Meeting in London were propagated throughout the Society in an annual epistle. Advice promulgated from the centre included guidelines on such diverse subjects as how to conduct business, how to educate children, how to organize Monthly Meetings, and how Quakers should conduct themselves in a plain and sober manner. This body of evolving guidance on appropriate behaviour was collected in a volume entitled *Extracts from the Minutes and Advices of the Yearly Meeting of Friends* (1783).[11] The epistles promulgated by the Yearly Meeting, and especially the published *Minutes and Advices*, offer the historian helpful insights into the norms of Quaker belief, language, and conduct.

Although Fox constructed a highly democratic movement, abjuring a professional ministry or leadership, he effectively combined consensual decision making with a strong, hierarchical organizational structure. The Society of Friends thus exerted control over many aspects of the individual; for example, if a Quaker moved to a different part of the country, membership had to be transferred to the Monthly Meeting in the area where the member was now domiciled. Meetings performed a wide range of functions, including the care of poor and infirm members, maintenance of meeting-houses, and the imposition of disciplinary procedures. Each Meeting appointed a clerk, who wrote the minutes according to strict rules. When diverse views were expressed, the clerk would have to frame a minute that would maintain both truth and unity. Of the several other types of Meeting instigated early in the Society's history, the Meeting for Sufferings, which dates from 1675, deserves mention. As its name suggests, it monitored the imprisonment, fines, and other distraints to which Quakers were subjected, and where possible it acted to redress such afflictions. It also acted as a pressure group in lobbying parliament to remove such burdens as tithes. Increasingly, however, it became the forum where the sufferings of others, such as slaves, were brought to the notice of the Quaker community, and where social policy and action were instigated.

The stringent organization of the Society of Friends, with its plethora of committees, helped to cement its existence and unity, but it also confronted such mavericks and enthusiasts as James Nayler, John Story, and John Wilk-

[11] A brief history of this evolving body of advice is given in *Quaker Faith & Practice*, 13–17.

inson, who posed a serious threat to the leadership and were marginalized and even separated from the Quaker body.[12] By the end of the seventeenth century, the initial missionary zeal had been largely dissipated, and the movement's itinerant preachers were less concerned with making converts than with maintaining and servicing the existing membership.

The passing of the 1689 Toleration Act was an important moment in Quaker history, although it was neither the start nor the culmination of certain long-term changes. In acknowledging the freedom of religious conscience, the Act allowed Quakers to hold Meetings at legally registered meeting-houses. Although Quakers were no longer so embattled and at the mercy of informers after 1689, many forms of discrimination remained. This profound transformation in Quakerism during the closing years of the seventeenth century also ushered in Brinton's second period: a time of cultural creativeness and mystical inwardness, roughly spanning the eighteenth century. Many Quakers adopted this 'quietist' mode, turning away from the world, calming the soul, and elevating the experience of divine love. As one quietist wrote: 'To be distinguished from the generality of mankind, who are lost among the vanities of the things of Time, by the eye turned towards the heavenly inheritance is an honourable distinction.' Yet this writer was no dreamy mystic, but a pharmacist with an extensive knowledge of the chemical and curative value of plants and minerals. He—William Cookworthy (1705–80) of Plymouth—translated one of Swedenborg's works, but was also an efficient businessman and (along with many other Quakers) invested heavily in the Plymouth Porcelain Company.[13] Quietists were industrious and imbued with a Protestant ethic, viewing time wasting and frivolity as sinful. They included bankers, merchants, and manufacturers, and a number of them pursued science. Yet, in marked contrast to the Society's rapid growth in the third quarter of the seventeenth century, during the course of the eighteenth the total number of Quakers in Britain contracted by nearly 50 per cent, from a peak of about 35,000 to rather less than 20,000.

During the early years of the eighteenth century, Quakers settled down to become a sect, described by Trevelyan as 'a highly respectable and rather exclusive "connection"'.[14] The process of separation from other religious groups has been discussed by Richard T. Vann, who argues that by the early eighteenth century Quakers were living in a separate sectarian world in which the family, with its imposed duties and norms, dominated members' lives. The family unit became embedded within the hierarchy of Meetings. Quakers

[12] Braithwaite, *Beginnings of Quakerism*, 241–78; *idem*, *Second Period of Quakerism*, 290–323.

[13] William Cookworthy to Esther Champion, 8th day, 8th mo., 1773, in Selleck, *Cookworthy*, 126.

[14] Trevelyan, *English Social History*, 267.

were expected to marry within the sect. Children were to be taught by Quaker teachers. Young men from poorer homes were to be apprenticed to a Quaker master, and young women were to serve in Quaker households. Invoking the Protestant notion of the priesthood of all believers, Quakers formed an exclusive connection with its own social norms. Paradoxically, the radical individualism that had so marked the early years of Quakerism was largely replaced by emerging conformity to the norms of the group. They were industrious, upright, honest, and (except when a Quaker belief was at stake) law-abiding. Quakers continued to affirm their differences from non-Quakers by wearing distinctive clothing, by using their own forms of address—'thee', rather than the socially deprecating 'you'—and by sticking resolutely to their own practices and inward contemplation. Such superficial signs of separateness became the badge of Quakerism.[15]

Some writers have claimed that Quakers initially recruited mainly from the poor, but that the membership became more affluent over the ensuing decades. However, Vann rejects this view and postulates the following transition: although early in its history Quakerism had attracted a following from across the social spectrum (excepting the established landed families and the lowest classes), by the early decades of the eighteenth century the social base had narrowed and declined.[16] It is difficult, though, to draw any overall picture from the various studies that have been undertaken, except that local Quaker communities differed significantly in their socio-economic structure. Nevertheless, a sizeable proportion availed themselves of the new business opportunities that appeared in the late seventeenth and early eighteenth centuries. Many were attracted to trading with North America, which proved a risky but often lucrative venture. On the home front, many Quakers became merchants, shopkeepers (including apothecaries), and craftsmen. Others invested in mining and copper smelting. A number of Quaker families moved into banking, an occupation yielding high profits but also subject to significant risk. Thus, although some Quakers could be classed as poor, a high proportion of them were comfortably off, and a number of families were decidedly wealthy. Quakers both participated in the improved economic conditions and were in the vanguard of economic advance.[17]

Since borrowing money from and trading with fellow Quakers reduced the risk of bad debts, Quakers would often loan money to other Friends in order to help them to establish themselves in business. Yet wealth and the doctrine of being *in* the world, but not *of* the world, produced their own problems.

[15] Vann, *Social Development of English Quakerism*, 197–208.

[16] Ibid. 49–87. This view is disputed by other historians, e.g., Reay, 'Social origins of early Quakerism'.

[17] Walvin, *Quakers*, 45–79.

Although Quakers were actively encouraged to prosper financially, from the 1680s on there was also considerable concern that they should pursue religiously acceptable business methods and not forsake their religious practices or principles. In response to these concerns, the Yearly Meeting proposed rules to guard against financial mismanagement and to avoid debt.[18] Moreover, many frivolous and fashionable activities were proscribed, such as gambling and attending the theatre (but not drinking, provided that it was in moderation). In contrast to such proscriptions, many Quakers viewed science as a perfectly acceptable endeavour and one to which they could devote significant sums of money: for example, Quaker scientists constructed astronomical observatories or hothouses for plants. The emergence, then, of Quakers as wealthy and respectable citizens marked their entry into certain forms of science.

In the following chapters Quaker opposition to oath-taking is a recurrent theme. Quakers were not alone in interpreting biblical passages such as Matthew 5: 34–7 ('Swear not at all; neither by heaven . . . Nor by the earth') and Exodus 20: 7 ('Thou shalt not take the name of the Lord thy God in vain') as prohibiting oaths. However, they also supported this position with a variety of powerful arguments. As Richard Bauman has pointed out, the 'strength of the Quaker position on oaths may be accounted for in large part by reference to the centrality of Truth in Quaker doctrine'. Quakers were committed to Truth in every word and action. Not only was oath-taking irrelevant—and positively inappropriate—from this perspective, but the act of taking an oath was predicated on the assumption that the person might otherwise give false testimony. Thus, if a Quaker were to take an oath, it would imply the unacceptable conclusion that he might otherwise be prepared to abandon Truth and therefore act duplicitously. Especially in the seventeenth century many Friends were imprisoned for their refusal to take oaths, particularly the Oath of Allegiance and the Oath of Abjuration, which were directed primarily against suspected Roman Catholics who were thought to pose a threat to the state.[19]

Although the Quaker refusal to take oaths and pay tithes still left them susceptible to fines, even imprisonment, the situation with respect to oaths was somewhat alleviated with the passage in 1722 of the Affirmation Act, which enabled Quakers to make a non-religious affirmation in a court of law instead of swearing an oath. In addition, over an extended period the oaths that were required for entry into various civic positions were slowly removed. However, one of the last remaining pieces of discriminatory legislation, the

[18] *Extracts from the Minutes and Advices*, 2nd edn., 195–200.
[19] Bauman, *Let Our Words be Few*, 95–119.

religious tests that were applied to appointments to academic positions at Oxford and Cambridge, was revoked by parliament only in 1871. While the freedoms enshrined in the Toleration Act and in subsequent pieces of legislation were important in themselves, they also influenced the social structures and psychological outlook of the Society of Friends, and its relation to the Anglican establishment.

The third stage began in the late eighteenth and early nineteenth centuries, when Quakers, like many other religious groups, came increasingly under the influence of evangelicalism, with its emphasis on man's fallen state.[20] Redemption could be achieved only by close attention to the Bible and by the performance of pious deeds. The evangelical impulse cohered well with the traditional Quaker concern for philanthropy, and Friends, together with other evangelicals, were at the forefront of the anti-slavery and similar movements. Some evangelical Quakers embraced science as an appropriate activity, and one that celebrated God through close engagement with his creation. But the evangelical turn created tensions within Quakerism. Partly in response to the rampant Unitarianism which he saw being disseminated by some American Friends, Isaac Crewdson, an eminent Manchester Quaker and wealthy manufacturer, published in 1835 a work entitled *A Beacon to the Society of Friends*, in which he argued the need for Quakers to downplay the doctrine of the Inner Light and instead focus on the Bible as the primary source for their Christianity. The 'Beacon controversy' of the mid-1830s produced a schism resulting in the departure of Crewdson and about 300 other Beaconites, but it also forced many other Quakers to nurture and declare their evangelical commitments.[21]

Many viewed the evangelical thrust as a way of breathing new life into a Society of Friends that had become too conservative, insular, and inward-looking during its quietist phase. As one evangelical lamented in 1832: 'It is a sad loss to our Society of Friends to mix so little with people of other denominations.'[22] In place of long periods of deafening silence, some evangelicals even invigorated Meetings for Worship with Bible readings.[23] Since the Bible provided common religious ground with other evangelical churches, Quakers found less difficulty being *in* the world and making common cause with other evangelicals.

Although evangelicalism did much to revivify what many perceived as the sect's moribund state, the evangelicalism that dominated British Quakerism

[20] Hilton, *Age of Atonement*.
[21] Isichei, *Victorian Quakers*, 45–53; Mingins, *Beacon Controversy*.
[22] W. H. Harvey to W. J. Hooker, 10th day, 9th mo., 1832, in [Harvey], *Memoir of W. H. Harvey*, 27–8.
[23] Kennedy, *British Quakerism*, 75.

during the middle decades of the nineteenth century in its turn became doctrinally rigid and insular. Thus, by the time Darwin published his theory of evolution in 1859, the Society had lost much of its earlier intellectual drive and was declining in both membership and influence. In the early 1860s significant changes were introduced into the movement's rules, in order to redefine its existence as a separate religious body; in particular, the peculiarities of dress and speech were no longer required, and those who married out were able to remain within the Society, provided they did so under the Society's auspices (whereas previously intermarriage led to exclusion). Although these changes halted the decline in membership, the third quarter of the century was marked by further schisms. One was a conservative reaction to these innovations by Quakers who wanted to retain all the minutiae sanctioned by tradition, such as wearing collarless coats and retaining the 'thee' and 'thou' forms of address. Some of these latter-day quietists resigned their membership to form the Fritchley phalanx in 1870.[24] Far more serious was a controversy that erupted in Manchester in the late 1860s around a group of rationalist Quakers with strong Unitarian leanings, who rebelled against what they saw as the restrictive evangelicalism that had enveloped the Society. They sought to reaffirm the traditional doctrine of the Inner Light and to displace the Bible from the movement's epicentre. Moreover, they advanced a form of Quakerism that was more rational and outward-looking, and was prepared to engage the challenging ideas affecting the wider Victorian society, especially science and the theory of evolution. The Yearly Meeting tried to quash these dissidents in a heavy-handed manner, but managed only to exacerbate the situation, thereby causing a painful schism.[25]

The historian Thomas Kennedy has explored the tensions within British Quakerism during the closing decades of the nineteenth century and has documented the gradual emergence of a moderate form of Quakerism that, paradoxically, concurred with many of the views expressed earlier by the Manchester dissidents. Although 'Modernism'—Brinton's term to describe the fourth period—became the dominant voice of Quakerism only at the very end of the nineteenth century, it owed its rise to a cohort of Quakers who, during the previous three decades, questioned the dominant rigid evangelicalism, and sought to reaffirm the traditional doctrine of the Inner Light and to emphasize personal commitment and the idea of progressive revelation. They were also concerned to promote greater intellectual dynamism and to engage modern thought, science included.[26] It is significant that some of the

[24] Isichei, *Victorian Quakers*, 53–60; Kennedy, *British Quakerism*, 40–3.
[25] Isichei, *Victorian Quakers*, 60–5; Kennedy, *British Quakerism*, 47–85.
[26] Kennedy, *British Quakerism*, 86–210; Bronner, 'Moderates in London Yearly Meeting'.

most prominent reformers were fully aware of developments in science, had studied science, and even held scientific posts in universities and colleges. As Brinton's period of 'Modernism' falls largely outside the scope of this study, the focus here is on the three earlier periods of Quaker history, the second and third in particular, which covered approximately the eighteenth and nineteenth centuries. The closing decades of the nineteenth century are emphasized, being the period when Quakerism principally confronted the modernist tendencies arising from science, especially the theory of evolution.

Although Brinton's four-stage account is helpful in characterizing the different phases of Quaker history, this periodization may undervalue some long-term commitments. In particular, the Quaker Truth Testimony has been a constant theme throughout Quaker history, the pursuit of Truth providing not only a distinctive aspect of Quaker belief but one that underpinned attitudes to religion, science, history, and all other activities. Thus, as we shall discuss in section 6.2, science was particularly acceptable because it was a means of seeking Truth. For Quakers, no doctrine, theory, or belief can be taken as manifestly true, and even the assumptions of Quakerism have repeatedly been challenged in order to advance the search for Truth. As Silvanus Phillips Thompson noted in his 1915 Swarthmore Lecture, aptly entitled *The Quest for Truth*, the main countervailing force has been the 'over-respect for venerated authority; the excessive deference to those whom we rightly revere, and to the sanctions of long-established custom'.[27] Although this self-questioning attitude has been more evident at some periods than others, Quakers have repeatedly invoked the Truth Testimony in their opposition to social and intellectual conventions. The plain style of speech and of dress should likewise be understood as strategies for dissociating Quakers from the fashions of the day. In one of the most perceptive analyses of early Quakerism, Bauman has argued that the plain style 'challenged the [existing] social structure and the structure of social relations in very fundamental ways'.[28] Such challenges make Quakers not just paradigmatic Dissenters, but also very confident in their dissent. Quakers have therefore felt secure in criticizing those aspects of the social and religious establishment that they consider antipathetic to their own values, and they have also actively opposed discriminatory practices and legislation.

We must also reflect further on the relationship between Quakerism and the Anglican Church. Despite a certain convergence of interest during the mid-nineteenth-century evangelical period, the dominant mode of interaction was very different. This relationship can best be explored using a

[27] S. P. Thompson, *Quest for Truth*, 35.
[28] Bauman, *Let Your Words be Few*, 55.

standard sociological model of religious sectarianism. According to this model, sects are characterized primarily by their separation from other religious bodies, but particularly from such institutions as the established churches. Thus, as the early Quaker literature shows unequivocally, the Society of Friends portrayed itself—and was likewise portrayed by its opponents—as being in opposition to the Anglican Church. In creating this separation, members of a sect constitute a priesthood of believers, and thereby encourage the full participation of all members and, as in the case of Quakers, reject a professional ministry. They also seek to convert others to their distinctive brand of Truth. Moreover, while strong ties are established between members—most evident in the Quaker practice of endogamy—they also remove themselves from certain aspects and practices of secular society.[29]

The above model applies well to the 'heroic or apostolic period' of Quakerism. However, by the end of the seventeenth century, the more radical aspects of Quakerism had been tempered, some forms of discrimination removed, and Quakers had become more prosperous economically. Although the level of antipathy towards them also declined, and the movement became less insular, it still retained its separate identity and separated itself from other religious bodies. Although some eighteenth-century Quakers complained about laxity of discipline, the organization created by Fox was sufficiently resilient to ensure its continued separation and identity. Some distinguishing features of Quakerism came to assume greater symbolic importance, such as the simple black clothing and insistence on using 'thee' and 'thou' that immediately marked out the Quaker from his neighbours. Although much of the radicalism that characterized early Quakerism had become muted, the sectarian outlook remained largely intact. Until the early 1860s, exclusion as a result of marriage to a non-Quaker was strictly enforced, although marriage before a priest was sometimes treated more leniently. Perhaps the main departure from the church–sect model was that Quakerism had largely abandoned the active search for converts by the end of the seventeenth century. But, as Elizabeth Isichei has noted, although English Quakers adopted some of the characteristics usually associated with religious denominations, they 'remained profoundly sectarian until [at least] the middle of the nineteenth century'.[30]

In the ensuing discussion Quakers will therefore be portrayed as a Dissenting religious sect that in crucial respects defined its existence in opposition to the Established Church and its associated institutions, such as the unreformed

[29] On sects see especially Isichei, 'From sect to denomination'. Also Wilson, *Sects and Society*; Hill, *Sociology of Religion*, 47–70.

[30] Isichei, 'From sect to denomination', 208–9.

universities of Oxford and Cambridge. Likewise, when it came to science, the fields pursued by Quakers differed significantly from those cultivated at the two ancient Anglican institutions.

2.2 The Anglo-Jewish community

Although a few Jews appear to have settled in England over the preceding decades, significant Jewish immigration only recommenced under Cromwell in 1655.[31] Cromwell was keen to readmit Jews into England, and in response to his encouragement, small numbers of Sephardim began to arrive in London, together with a few Ashkenazim. The legal status of these immigrants was not clearly defined, and this lack of prescription proved advantageous by allowing Jews considerable freedom. It is also important to recognize that while some of these Sephardim had previously practised their religion openly, many were, or were descended from, New Christians (who had outwardly converted under coercion but often retained some semblance of Judaism), and possessed only a hazy understanding of Judaism. Among the early arrivals were wealthy merchants involved in international trade with other Sephardim, often family members, in Amsterdam and other commercial centres. Trading in such diverse commodities as precious stones, silver, wine, and linen, they found London an attractive base for their economic activities, which stretched from the New World in the west, to India in the east. Other Jews were successful in such related areas as diamond dealing and commodity brokerage, and a few Jewish physicians—including several trained in Portugal—also settled in London. In contrast to the successful and prosperous leading Sephardi families, Jewish peddlers, street traders, servants, and beggars also arrived.

During the early 1660s the Sephardim formed a properly constituted community, governed by a *mahamad* (governing council), with a written constitution modelled on the synagogue in Amsterdam. The first rabbi (or *haham*) was hired, and by the century's end three others had held the post. In most of these cases the rabbi's tenure was terminated after a few years, owing to conflict with the congregation. Moreover, there were many other disagreements within the community, some of which led to legal proceedings before the English civil courts. Several factors combine to explain the instabilities within the Spanish and Portuguese community. As the earliest rabbi soon

[31] The main sources I have used are Alderman, *Modern British Jewry*; Endelman, 'Communal solidarity'; *idem*, *Radical Assimilation in English Jewish History*; *idem*, *Jews of Georgian England*; *idem*, *Jews of Britain*; Englander, 'Anglicized not Anglican'; Felsenstein, *Anti-Semitic Stereotypes*; Katz, *Jews in the History of England*; Kershen and Romain, *Tradition and Change*; Pollins, *Economic History of the Jews of England*; Ruderman, *Jewish Thought*; *idem*, *Jewish Enlightenment*.

discovered, the community, and especially its entrepreneurial wealthy members, being far removed from established centres of Jewish life and often with little experience of Jewish tradition, cared little about religion, and were unwilling to submit to his religious authority. Another source of volatility was the community's composition, comprising immigrants who had arrived from many different countries and including not only those who had been brought up as practising Jews but also religiously ambiguous New Christians, some of whom reverted to Christianity after a short flirtation with Judaism. Moreover, there was considerable social diversity within the community, the more affluent families contributing most of the funds required not only for the upkeep of the synagogue and payment of the *haham*'s salary, but also to assist financially its many poor and destitute members. Finally, members of the community had to confront the problem of how to negotiate their lives within a country which, while allowing Jews considerably more freedom than in most countries in mainland Europe, was nevertheless indubitably Christian. As candidates for positions in most civic institutions were presupposed to be Christian, often specifically Anglican, Jews found themselves barred from public office. Even in pursing their business interests, Jews were often at a marked disadvantage; for example, City merchants sought on several occasions to restrict the activities of Jews, and when the Stock Exchange was reorganized in 1697, the number of Jewish brokers was limited to twelve. Thus, despite the relative freedom enjoyed by Jews in England, there were also many constraints.

Although the Spanish and Portuguese community had previously held services in converted premises, in 1701 it moved into its own impressive purpose-built synagogue, located on Bevis Marks in the City of London. The community also hired a new rabbi, David Nieto, a scholar who had studied medicine at Padua and become one of the rare Anglo-Jewish intellectuals (*maskilim*) able to span Jewish tradition and modern forms of learning, science included. Sephardi communal organizations developed, including a school and a medical charity. Yet, during the course of the eighteenth and early nineteenth centuries, tensions existed within the community, leading to a loss of members—most famously the departure of Isaac Disraeli's family over an apparently minor incident. Although there remained a few significant Sephardi families in the nineteenth century, most prominently the Montefiores, the Sephardim were being eclipsed by the Ashkenazim in both size and influence.

While the size of the Sephardi community remained fairly static, Ashkenazi immigration, especially from Germany and Poland, proceeded apace from late in the seventeenth century, the majority of arrivals being poor peddlers and street traders, supplemented by more affluent artisans and shopkeepers and a few wealthy families. England offered them greater freedoms and financial opportunities. Some settled in provincial towns, including major ports, market towns, and spas. The majority, however, sought their fortunes in the metropolis, forming a sizeable immigrant community in the east part of the City and the neighbouring wards to the east. A few wealthy Ashkenazi families, such as the Harts and the Goldsmids, swelled the number of Jewish brokers and international traders. Although early Ashkenazi arrivals had joined the Sephardi synagogue, their numbers increased sufficiently to enable them to form their own congregation in 1690 in nearby Duke's Place, the synagogue subsequently known as the Great Synagogue. A schism led to the formation of a second synagogue, the Hambro, in 1707. Again, in 1761, a breakaway group founded the New Synagogue, while another synagogue was opened to serve the increasing number of more affluent Jews who moved westwards from the City. Meanwhile, poor Jewish immigrants from Poland also established their own *minyanim* (prayer groups) in the East End.

By the end of the eighteenth century, the Anglo-Jewish community numbered 22,000–25,000, about two-thirds of whom lived in London. While some Christians took the presence of Jews in their stride as indicative of Britain's enlightened inclusiveness, others positively welcomed their arrival, which they interpreted as a sign that, with the dispersion of the Jews, the Second Coming was imminent. For others still, Jews were a mixed blessing, since while some members of the community helped generate wealth, the existence of this alien group threatened the *status quo*. Still others were quick to associate the Jews with immorality, vice, and avarice. In cartoons and popular theatre, the figure of the Jew was mocked and often associated with the dishonest acquisition of wealth.[32] Although the issue of conversion was frequently discussed during the eighteenth century, the rise in evangelicalism at the century's end led to the formation of several well-funded organizations dedicated to saving Jewish souls and to publishing periodicals and pamphlets aimed at Jews. During the first decade of the nineteenth century, the London Society for Promoting Christianity among the Jews was founded, and the already existing London Missionary Society increasingly turned its attention to the poorer Jewish population of London. Although few converts were made, over the ensuing decades the conversion societies were a constant source of harassment to the Jewish community.[33]

A few Jewish families, principally Sephardim, entered the British upper classes during the eighteenth century, often purchasing country seats and mixing freely with their non-Jewish neighbours. Likewise, we find a number

[32] Felsenstein, *Anti-Semitic Stereotypes*.
[33] Binfield, 'Jews in evangelical dissent'.

of wealthy Jews engaged in upper-class pursuits, such as taking the spa waters at Bath, where they rubbed shoulders with members of the gentry, aristocracy, and even royalty.[34] While some of these upwardly mobile Jews assimilated, a clearly defined social elite emerged in the Jewish community. This group, amounting to a hundred or more families, was wealthy, and many of its members were financiers in the City of London or involved in international trade. While the Montefiores and the Rothschilds are among the better known, élite families bore such names as Goldsmid, Salomon, Henriques, Mocatta, Cohen, Montagu, and Samuel. They constituted the 'Jewish aristocracy'. Despite a few defections to Christianity, these dynasties tended to intermarry, and they remained remarkably stable throughout most of the nineteenth century. Moreover, although they produced few scholars, they were deeply attached both to their religion and its traditions, most being regular attenders at the wealthier synagogues. Most importantly, as Endelman and Englander have emphasized, these families adopted a strongly paternalistic role, and assumed responsibility for running most of the communal organizations, such as the Board of Guardians and the Jews' Hospital. Whenever need arose in the community—for example, if during the rigours of winter, poor Jews were in need of medical care, food, and shelter—the élite families usually rallied round with donations to charity and practical support. In Albert Hyamson's outline biographical dictionary of Anglo-Jewry a surprisingly high proportion of entries are designated as 'com[unal]. worker[s]'.[35] As well as their central role in Jewish communal life, members of these families moved fairly easily in the upper echelons of English society, and many accepted public office once Jews became eligible. Yet these élite families, whose wealth depended on commerce, expected their sons to enter the family business. Having successfully established themselves in England, both economically and socially, these families were largely content to consolidate their social and economic standing. Education—both secular and Jewish—was respected, but not often pursued extensively. Likewise very few practised science or medicine. Only after the mid-1850s, when non-Anglicans were allowed to take degrees at the two ancient English universities, did the sons of the Jewish aristocracy enter Cambridge, but their numbers were small, and some left without a degree and subsequently worked in their family businesses.

Despite the existence of a number of wealthy families at the beginning of the nineteenth century, most London Jews were afflicted by poverty and lived

[34] See nn. 3 and 4.

[35] Hyamson, 'Plan of a dictionary'. The copy in the Roth Collection at the University of Leeds contains a number of additions and corrections, presumably by Roth.

in crowded and insanitary conditions in the East End. The poor Jews whom Henry Mayhew encountered around the mid-century included street sellers peddling oranges, spectacles, sponges, and metal objects. However, he was informed that by far the largest number, some 500 or 600, traded in old clothes.[36] In the public mind, Jews were associated not only with the old clothes trade, but also with criminality and dishonesty. For example, in 1827 the popular periodical press carried an anti-Semitic satire entitled the 'Jewish Slopseller'—a Jewish dealer in cheap, poor-quality or used clothing often worn by sailors. Here the Jew was portrayed in pseudo-scientific terms, as if he constituted a natural, biological species. His most prominent quality, and the one from which all his other defects flowed, was greed. Every situation he exploited for financial profit. He was dishonest and thoroughly unscrupulous; indeed, the narrative is centred on the bargain that the Jew struck with a sailor, giving him complete power over the unfortunate mariner. In this story the Jew was stereotyped as uneducated and lacking in finer feelings: 'If he can give a second-cloth the passing freshness of a superfine, he is, in his own esteem, a second Descartes; if he can replace copper for gold, another Newton.' Most interesting from the point of view of the present study is the assertion that the slopseller lacked any appreciation of nature and of beauty in the natural world; the brightly coloured bullfinch, the mysterious veins on a pebble, and even the powerful eruption of Vesuvius were not treasured by him, but became degraded and exploited for personal gain. Thus, the anonymous author of this scurrilous piece portrayed the Jew as the antithesis of the cultured Englishman who, among other attributes, appreciated the natural world.[37]

Throughout the nineteenth century the Jewish poor were a continual problem and an embarrassment to the leaders of Anglo-Jewry. Various philanthropic and educational schemes were devised to try to turn the poor into respectable English men and women. It is unclear to what extent these schemes were responsible, but during the first three quarters of the century a significant proportion of Jews was upwardly mobile. Although a Jewish underclass remained, many families were able to escape poverty and enter the middle class. In a celebrated statistical analysis, Joseph Jacobs estimated that some 57 per cent of the Jewish population in London in 1882 were upper or middle class, and the remainder divided roughly equally between 'lower' class and 'paupers'.[38] Moreover, by the 1830s a sizeable proportion of immigrants,

[36] Mayhew, *London Labour and the London Poor*, ii. 119–21.

[37] [Anon.], 'Jewish slopseller'. This piece also appeared in the *Monthly Magazine*. A later example is the spoof article in *Punch* (6 (1844), 44), entitled 'Insects and their habitation', in which the moth is described as 'an insect of Hebrew origin, from its attachment to old clothes'.

[38] *JC*, 2 Feb. 1883, 10–11.

especially from Germany, constituted skilled workmen. Their number was supplemented by some manufacturing and banking families that were attracted to Britain because of its industrial and trading might. However, the majority of immigrants were poor, especially those from Eastern Europe who moved into London's East End and into the most decayed districts of many provincial cities.

But the increase in wealth and the significant expansion of the Jewish middle class also enabled many upwardly mobile Jewish families to send their sons to schools, where they obtained a good secular education, often including science, and where they mixed with the children of upper-middle-class Anglican and Dissenting families. These schools, which also attracted sons from a number of élite families, were increasingly geared to preparing students for university. The goal initially was University College London, but later, with the progressive removal of religious tests, also Cambridge and Oxford. Many of these better-educated young Jewish men subsequently entered the professions. Thus, by the closing decades of the century, a sizeable group of professional Jews existed in England, drawn from upwardly mobile middle-class families, but supplemented by the sons of some of the traditional Jewish aristocracy. The growth of this new professional élite can be tracked through the reports of examination successes published in the Jewish periodical press. However, its existence was publicly proclaimed in 1891 with the formation of the Maccabæans, an evocative name conjuring a proud and successful band of ancient Jewish warriors. The Maccabæans were 'An Association of Jewish Professional men and others to promote the higher interests of the Jewish race', which sought to bring together Jews who were 'interested in literary, scientific, artistic or professional pursuits'.[39] The early Maccabæans included literary figures (such as Israel Zangwill), lawyers (including Arthur Cohen, QC, and Rufus Isaacs), scholars (Lucien Wolf and Joseph Jacobs), artists (Solomon J. Solomon and Frank Emanuel), musicians (Frederic Cowen and Charles Salaman), politicians (Sir Julian Goldsmid, MP), rabbis, physicians, and scientists. In seeking to attract professionals, the society wanted to exclude those who were 'merely moneyed men', but it did not object 'to a man of culture merely because he has money'.[40] By the century's end, the ranks of the Maccabæans had swelled to nearly 200, including a number of scientists.

We need to consider one further group. With the increase in anti-Semitism in many countries during the 1870s, and especially following the assassination

[39] *JC*, 27 Nov. 1891, 6; Jacobs (ed.), *Jewish Year Book . . . 5658*, 60–1.
[40] H. J. Cohen to Philip Hartog, 10 Nov. 1891, MS 126 AJ17/17, Papers of the Ancient Order of Maccabæans, Hartley Library, University of Southampton.

of Tsar Alexander II in 1881, a rising tide of Jewish immigrants arrived in Britain. Ships arriving from Europe were crammed with Jews, some of whom stayed only a short time in Britain before sailing to the USA. Those who stayed, either intentionally or because they could not afford the onward fare, were not only numerous, amounting to some 150,000 prior to the First World War, but predominantly destitute, ill-educated (in secular subjects), and non-English-speaking. Many were also deeply religious, but the beliefs and practices they maintained threatened the comfortable position that Anglo-Jewry had created for itself in English society. Anglo-Jewry was ambivalent about these new arrivals: they were fellow Jews fleeing hardship and persecution, but they could not easily be integrated into the established community, and, it was widely thought, they were likely to provoke an anti-Semitic backlash. As indicated in the previous chapter, these new immigrants do not fall within the scope of this study, although their impact on the established Anglo-Jewish community will receive comment.

The preceding discussion indicates the main social groups within Anglo-Jewry and the ways in which the rising middle class and some members of the social élite, being economically and socially secure, expanded into new educational and professional roles during the closing decades of the nineteenth century. Moreover, they became increasingly involved in the wider British culture, contributing to art, science, and music. Also highly relevant to understanding the community's engagement with science are the religious divisions within Anglo-Jewry. Different sections of the community adopted different attitudes to both Jewish tradition and modern forms of knowledge, including innovations in science.

One potentially significant development was the establishment of a Reform Synagogue in London. By the early decades of the nineteenth century, the Sephardi community was suffering from low attendance and a high level of apathy, while few of its members possessed a good understanding of either Hebrew or Portuguese (the language in which a number of prayers were written). Moreover, the location of the synagogue, Bevis Marks, was proving inconvenient. Many of the more affluent Jews had moved westward to more salubrious neighbourhoods and wanted a branch synagogue in their area. When they presented this request to the *mahamad*, it was refused. Similar discontent and disillusionment were apparent in the main Ashkenazi synagogue, the Great Synagogue in Duke's Place. In both communities the leadership feared any innovation that might undermine its position, and was unwilling to acknowledge the need for change. Dissent found its first expression in April 1840 with a declaration signed by twenty-four leading members of the Anglo-Jewish community. After complaining about the poor attendance at services, the signatories, from some of the wealthiest families, identified their grievances, the first being 'the distance of the existing Synagogues from the places of our residence'. Concern with convenience was also reflected in their complaint that services were too long and were held at inconvenient times. Yet inconvenience was not their only grievance, since they also identified the 'imperfections of the Order of Service; . . . the unimpressive manner in which it is performed, and . . . the absence of religious Instruction'. The reformers intended not only to establish a synagogue in the West End, but to ensure that services were conducted 'in a manner more calculated to inspire feelings of devotion' and that appropriate religious instruction was offered.[41]

Such sweeping criticisms struck at the core of the religious establishment, and especially the position of the rabbis and synagogue officials who maintained the *status quo*, thus provoking a violent reaction. The Chief Rabbi, Solomon Hirschell, and David Meldola, the *haham* at Bevis Marks, tried to stop the breakaway synagogue. In January 1842 the Sephardi Elders even propounded a *cherem*—a declaration threatening the excommunication of those who formed the new synagogue. Undeterred, the reformers proceeded to form their own synagogue—the West London Synagogue—and appointed a young, dynamic minister, David Woolf Marks (1811–1909), who played a significant role in defining its philosophy, liturgy, and ritual. In particular, he abolished the second day of festivals (Orthodoxy requiring a second day in order to allow for the uncertainty arising from the time difference between the Promised Land and England), and shortened services to a mere two and a half hours. However, in many other respects he shunned innovation; for example, although the new prayer-book contained English translations of Hebrew prayers, the service was still conducted in Hebrew. English reform was pragmatic and intellectually conservative.

The reforms instigated by Marks should be compared with the far more innovative types of Judaism introduced particularly in Germany. The *Wissenschaft des Judentums* movement (anachronistically translated as 'the Science of Judaism') found potent expression in the manifesto written by a group of Berlin students in 1819. These secularized Jews sought to respond to the challenge posed by anti-Semites by showing that Judaism was not traditional, separatist, and opposed to modern values, but that Jews were willing and able to merge with forward-looking elements within the non-Jewish world. Thus they proposed that Jews should assimilate. Another, somewhat less radical, response was the formulation of a reformed Judaism that sought to maintain only those beliefs and rituals that could be sanctioned by reason. Again, this

[41] The documents are reproduced in Kershen and Romain, *Tradition and Change*, between pp. 48 and 49.

movement was initially centred on Germany, where a number of newly founded synagogues rejected traditional aspects of Judaism and sought to align themselves with modern, rational norms. In so doing, they were seen by traditionalists as challenging the foundation of Judaism in *halachah*, the oral law. Thus, for example, acknowledging that many Jews were not familiar with Hebrew, the reformers adopted the vernacular in their sermons and in at least some of their prayers. The service was often changed and shortened, and new prayer-books were written. Likewise—in emulation of Christian practices—some synagogues introduced an organ and a choir, and dispensed with the dietary laws or changed them to make them more relevant. In both size and radical zeal the reform movement become a major force in Germany and later in the USA.

By contrast, the changes introduced by the English reformers were very limited. Moreover, they took little cognizance of the major intellectual innovations that inspired the *Wissenschaft des Judentums* movement and exerted a major impact on both Christian and Jewish thinkers especially in Germany. Foremost among these was the 'higher criticism'—the application of rational, scientific methods to the critical analysis of the Bible and of history—which challenged many traditional religious beliefs and practices and ignited religious controversy.[42] Although the impact of the higher criticism was less intense among Christians in Britain than in Germany, it resulted in the publication of such controversial works as *Essays and Reviews* (1860), in which several Anglican clergymen rejected the traditional view that the Bible was divinely inspired.[43] A few Anglo-Jewish writers were influenced by these challenging ideas, which had little impact on the West London Synagogue. Moreover, as the century progressed, a fair degree of *rapprochement* was achieved with the mainstream Orthodox synagogues. Although Marks remained its senior rabbi until 1909, one of his assistants was Philip Magnus (1842–1933), an influential advocate of technical education, for which he was later knighted. After serving in this position from 1866 to 1880, Magnus resigned, complaining that the synagogue had stagnated. This view coheres with Israel Zangwill's brutal assessment (of 1892) that the synagogue had 'stood still for fifty years admiring its past self'.[44] Rather than being at the forefront of progressive thought, the West London Synagogue was marked by complacency and apathy. It also proved far less dynamic than its two sister communities in Manchester (founded in 1856) and

[42] Kershen and Romain, *Tradition and Change*, 9–28.

[43] [Temple *et al.*], *Essays and Reviews*.

[44] Foden, *Philip Magnus*, 23–58; Kershen and Romain, *Tradition and Change*, 31, 110.

Bradford (founded in 1881), the latter being founded by skilled textile workers from Germany, who imported German reformist innovations.

During the closing years of the century, a small but increasingly vocal section of Anglo-Jewry was pressing for change and emphasizing the need for Jews to engage with important recent developments in the religious and secular world. These later progressive Jews were not only reacting against the lethargy within Anglo-Jewry; they also wanted to distance themselves from the growing influx of Orthodox Jews. Embarrassed by these poor immigrants, with their traditional religious practices and their decidedly un-English habits, these reformers sought to align Judaism with modernism. At the centre of this expanding vortex was Claude Goldsmid Montefiore (1858–1936), who had studied at Oxford, where he imbibed the higher criticism from his tutor Benjamin Jowett. In line with the *Wissenschaft des Judentums* movement, he saw the need for Judaism to be reinvigorated by drawing on rational, historical analysis. In 1888 he co-founded the *Jewish Quarterly Review* with Israel Abrahams, the Reader in Rabbinics at Cambridge, and during the next few years he championed a new vision of Anglo-Jewry in his writings and lectures. Among his kindred spirits were Sir Julian Goldsmid, a scion of one of the founding families who became President of the West London Synagogue, and Lily Montagu (1873–1963), the talented daughter of Samuel Montagu. Ironically, her banker-father had played a major role in the Federation of Synagogues, an umbrella organization for the mainly small synagogues attended by the new immigrants.

The founding of the Jewish Religious Union (JRU) in 1902 marked an important development. Aware that many Jews did not attend Sabbath morning services, Montefiore and Montagu sought to attract these non-attenders by offering popular services on Saturday afternoons. Such services would be largely in English and—equally contrary to tradition—men and women would be permitted to sit together. The sermon would be on a theme of contemporary relevance. Although some Orthodox Jews participated, such as the open-minded and ever receptive Rabbi Simeon Singer of the New West End Synagogue, the JRU became increasingly associated with Montefiore's mission, and was even viewed with disfavour by the West London Synagogue, which refused to offer the JRU use of its premises unless a number of patently untenable conditions were met.[45] A subsequent outgrowth of the JRU was the Liberal Synagogue, which appointed its first minister in 1912. Only then did London possess a near counterpart to the well-established progressive synagogues that had for many decades flourished in Germany and North America.

[45] Kirshen and Romain, *Tradition and Change*, 102–6; Bayme, 'Claude Montefiore'.

As well as internal developments within the Jewish community, we must also consider further its relationship with the Christian majority. Jews, like Quakers, were subject to a number of legal disabilities that affected principally the wealthier members of the community. One of the first obstacles to be challenged was the restriction on trade imposed on foreign-born Jews, who were debarred from owning land or ships and from participating in colonial trade, but were required to pay an excessive levy. The Jewish Naturalization Bill introduced in parliament in 1753 sought to allow Jews to be naturalized without having to receive the Anglican sacrament. But the Bill evoked a bitter outcry, and was quickly rescinded. However, the main push for emancipation occurred during the middle decades of the nineteenth century, and was directed against the Christianized oaths that prevented Jews from entering a number of civic institutions and corporations. For example, from 1830 Jews were permitted to become freemen of the City of London, and in 1833 Lincoln's Inn introduced an acceptable form of words that enabled Jews to become barristers. Jews were allowed to hold municipal office in 1845, and the Religious Opinions Relief Bill of the following year removed further minor disabilities suffered by Jews and Dissenters. The most prominent remaining hurdle, which possessed great symbolic significance, was admission to parliament. In 1847 Lionel de Rothschild (1808–79) was elected Member of Parliament for the City of London, but the House of Lords intervened to prevent him from taking his seat. The formal stumbling-block was the traditional, if outmoded, Oath of Abjuration that he was required to swear, which contained the unacceptable phrase 'on the true faith of a Christian'. During the next ten years Rothschild was re-elected four more times, before he was finally admitted in 1858. Particularly relevant to the next chapter are a series of legal changes that enabled Jews to attend and hold positions in the ancient English universities. Although Jews had benefited from the 1854 and 1856 Universities Acts, that enabled them to take degrees, in the late 1860s and early 1870s they played a more prominent role in removing the final religious tests that prevented non-Anglicans holding university posts.

The path to emancipation can be read as part of the natural, liberalizing trend in history, often called 'Whig history'. However, it should be understood in the context provided by the central thesis in Anglo-Jewish historiography: the 'disintegration of the autonomous corporate structure of traditional Jewry and the movement to participate in [the British] state and society' (to quote David Englander). More generally, as Todd Endelman has argued, the high degree of toleration in England resulted in 'the acculturation and integration of Anglo-Jewry . . . at a pace unmatched by any other Jewish community in the West'. In numerous respects, ranging from forms of dress to the design of synagogues, Jews sought to emulate their Christian neighbours.

The community was strongly attracted to the norms of respectable Englishness, and many of its members saw themselves as English men and women who just happened to be Jewish by some quirk of birth. Likewise, in his study of the English *maskilim* (enlightened Jews), David Ruderman has noted their willingness to adopt English—even Christianized—patterns of thought.[46] As we shall see on a number of occasions in the following chapters, the Jewish engagement with science formed part of this wider pattern of acculturation.

Yet acculturation was not the only force affecting Anglo-Jewry, which sometimes exhibited a decidedly ambivalent attitude towards the wider Christian society, the two countervailing pressures being tradition and discrimination. Committed Jews saw themselves as the gatekeepers of Torah, that great font of religious knowledge for both Jews and Christians, but also as possessing a long and honourable religious and cultural tradition. Thus Jews were continually being torn between tradition and the behavioural norms of the host society. Upwardly mobile Jews might model themselves on their Christian neighbours, while retaining a degree—sometimes a very small degree—of Judaism.

The Jewish community also encountered anti-Jewish sentiments in society at large, as manifested by such obstacles as unacceptable oaths and the prevalence of anti-Semitic stereotyping in contemporary literature. The machinations of the Christian conversion societies were a continual thorn in the community's side. Repeatedly under attack from anti-Semites and conversionists, Jews were made to feel inferior, intellectually, culturally, and socially. This was particularly apparent in the area of education, where, until the closing years of the nineteenth century, there existed what might be called a 'cultural deficit'. According to their detractors—like the author of the 'Jewish Slopseller', discussed above—Jews had not contributed to such cultural activities as music, art, and science, but were dishonest and drawn inexorably to money-making. Indeed, Jews were marked out as an underclass that could neither progress in society, nor advance English culture. Conversion, said some critics, offered the only route whereby Jews could progress both spiritually and socially. By implication, the Jew was less able and less intelligent than the Christian.

To respond to these charges, the Victorian Jewish press, with its commitment to Enlightenment values, repeatedly sought to demonstrate that, given an equal opportunity, Jews could acquire as much culture as Christians. Hence, whenever a Jew passed an examination, gave a concert, published an article or a book, or received any other mark of recognition, the achievement

[46] Englander, 'Anglicized not Anglican', 238; Endelman, *Jews of Georgian England*, 9; Ruderman, *Jewish Enlightenment*.

was noted in the *Jewish Chronicle* and other periodicals. For example, it reported Nathan Defries's lecture on coal gas at the British School Reading Room, and the success of Sir Francis Henry Goldsmid's gardener in winning two prizes at Regent's Park Botanical Gardens. These and numerous other celebrations of Jewish achievements may appear rather naive, but they should be understood as providing evidence that refuted the pervasive view that Jews were inferior. This message was often made explicit, as in the report on John Zackariah Laurence's success in obtaining a first class honours' degree in medicine, when the *Jewish Chronicle* called on Charles Dickens, who portrayed Jews as lowly and ignorant, to note that Laurence's achievement demonstrated that Jews possess minds and can engage ideas.[47]

Yet this cultural deficit was not simply an invention of the anti-Semite. Despite Jewish writers' attempts to refute such charges, they often acknowledged that English Jews had excelled neither in specifically Jewish studies nor in most areas of English culture. Jews may have made their mark in the boxing ring, but they had not advanced literature, music, art, or science. John Mills, a Christian clergyman who wrote sympathetically on Anglo-Jewry, stated in 1853 that, notwithstanding some recent evidence of change, 'the community seems very inert in its internal movements—so entirely are they absorbed by business or pleasure as rarely to find either leisure or means for the promotion of literature'.[48] The novelist Grace Aguilar (1816–47) was one of the very few counter-examples. The Jewish press not only tried to combat the external threat of conversion societies and to advance the cause of political emancipation; it also repeatedly urged the community to address the issue of anti-intellectualism. The Jewish periodicals of the time repeatedly pointed to the lack of literary contributions by the Anglo-Jewish community: but 'you cannot expect literary productions, as long as the education of our youth remains in the present condition', bemoaned the editor of the *Jewish Chronicle* in his retrospect for the year 5606 (i.e. 1845–6).[49] The answer lay in improving education, and the Jewish press enthusiastically supported such innovations as the Jews' and General Literary and Scientific Institution. Jews had to participate in Brougham's 'march of the intellect'.

Throughout the period covered by this study, most Jews in mainland Europe were governed by 'the autonomous corporate structure of traditional Jewry', and they were unable to participate in the wider civic society.[50] By contrast, Jews in England not only possessed considerable freedom to assimilate, but religion was a voluntary matter. English Jews were relatively free to

[47] *JC*, 10 Dec. 1852, 76; 9 May 1862, 5; 27 Aug. 1852, 371.
[48] Mills, *British Jews*, 324.
[49] *JC*, 16 Oct. 1846, 1–2.
[50] Englander, 'Anglicized not Anglican', 238.

join the synagogue of their choice (provided they could afford the fees) or to distance themselves from the Jewish community. Rabbis were poorly paid, rarely held in high esteem, and were unable to exert much influence on their congregations. The organizational structure of Anglo-Jewry was therefore weak, providing individuals with little guidance on how to respond to events in the wider English society. Instead, Jews were subject to the often opposing forces of acculturation, religious tradition, and discrimination, when framing a response to developments in science and other contemporary issues. Nor could the Anglo-Jewish community look to an existing scientific tradition, except in the distant past, since even by the end of the nineteenth century, few English Jews had entered science. Yet the success in removing political disabilities, and especially Montefiore's admission to parliament in 1858, played a major role in changing the self-image of the Jewish community. During the concluding decades of the century, Anglo-Jewry manifested a rising self-confidence, and the cultural deficit was largely erased. Significant numbers of Jews were beginning to enter the professions and to make their mark on science, music, scholarship, and literature.

3
Education and Careers

Throughout the eighteenth century, the opportunities for even fairly rudimentary education in science were limited. Reading provided the major source of scientific information, and the book trade recognized that a substantial audience existed for science texts, ranging from introductions to Newton's philosophy to books on plant classification, and from 'research monographs' to works on natural theology that highlighted the providential design displayed in the creation. Peripatetic lecturers, who were often accomplished showmen, also brought science to paying audiences, and various local societies organized science lectures. By contrast, the two ancient English universities, which were closely associated with the Established Church, accepted small numbers of students predominantly from a restricted social élite. Non-Anglicans, some of whom form the subject of this book, were among those excluded, although a few entered Cambridge under disadvantageous conditions. Yet, since instruction in scientific subjects offered by Oxford and Cambridge was limited, non-Anglicans were not as greatly disadvantaged with respect to science education as one might initially suppose. The situation in Scotland was significantly different, owing to what George Elder Davie has called the 'democratic intellect' that operated north of the Border, enabling many from less wealthy backgrounds to attend their local university.[1] Moreover, in contrast to Oxford and Cambridge, students at the Scottish universities were not required to conform on religious matters. During the eighteenth and early nineteenth centuries, many English Dissenters therefore attended the Scottish medical schools, especially Edinburgh, where they often received a firm grounding in several sciences.

During the early decades of the nineteenth century, science education underwent many changes. New institutions of higher education were founded, such as the non-denominational University College London (founded in 1828) and a number of local colleges and universities, many of which possessed a strong science base and did not impose religious tests. By the 1820s Cambridge too had gained a stronger reputation in science,

[1] Davie, *Democratic Intellect.*

especially in mathematical physics. The establishment of science degrees at Oxford in 1849 and the instigation of the Natural Sciences Tripos at Cambridge in 1851 marked important innovations in science education at these traditional institutions, although they attracted few students in the early years. Some public schools likewise offered instruction in science, often natural history, but, as the Devonshire Commission of the early 1870s noted, the provision was generally slight, and varied considerably between schools. In addition to this plethora of educational institutions, there was a rapid growth in the market for books, encyclopaedias, and especially periodicals that carried the new and exciting developments in science to a variety of reading audiences.

Although the main developments in science education during the eighteenth and nineteenth centuries are well known, we need to identify those that were pertinent to non-Anglicans. Not only were Oxford and Cambridge under ecclesiastical control, but so too were the majority of schools. Moreover, both Jews and Quakers possessed their own educational agendas. Thus, although Jewish parents may have wanted their children to be trained in secular subjects, most non-Jewish schools would inevitably expose pupils to Christianity, and often to the influence of teachers who were committed Christians. Also, children from more Orthodox Jewish families would not attend school on Sabbath or during religious festivals. Quakers possessed an even stronger antipathy towards Anglican educational establishments, and many leading Friends insisted that only Quaker schoolteachers could offer their children a truly Quaker education, in which even the sciences would be taught from a Quaker perspective. Education thus remained a highly contentious issue for members of these religious groups.

This chapter focuses on several specific institutions in which Jews and Quakers encountered science. We start with schools, primarily Quaker schools, some of which offered an extensive introduction to science. By contrast, Jewish schools placed far less emphasis on science, although some non-Jewish schools attended by Jewish children—such as University College School—were noted for their science provision. From schools we move to universities: first, the Scottish universities and especially their medical schools which attracted Jewish and Quaker students. Next we turn to London University, principally the non-denominational University College London (hereafter UCL), and then to Cambridge and Oxford once they opened their doors to non-Anglicans in the 1850s. Closely associated with education is the issue of careers. Throughout this chapter, but especially in the final section, we shall examine the scientific and scientifically related careers pursued by Jews and Quakers.

3.1 Schools

3.1.1 *Science in Quaker schools, especially Bootham*

One of Fox's earliest recorded insights, allegedly prompted by a divine communication, was that the education offered at Oxford and Cambridge universities did not provide an adequate preparation for the true Christian ministry.[2] As he clearly perceived, the two ancient English universities were inimical to Quakerism. The feeling was mutual, and from the early 1650s Quakers visiting Oxford and Cambridge were abused and imprisoned, undergraduates frequently interrupting Quaker meetings and even threatening to kill those who attended.[3] Although Quakers suffered ill-treatment in many other towns, the confrontations in Oxford and Cambridge were particularly vicious, and symbolize the antipathy between the religiously conservative universities and the new populist movement. Quakers viewed these institutions as the main training grounds for Anglican clergy, who would then be dispatched throughout the kingdom to defend their church, to wage war on Dissenters, and to disseminate their moribund and false version of Christianity. Opposition to the Established Church implied opposition to the educational system that trained and maintained its clergy. Hence, from early in their history, Quakers were vocal critics of the values and curricula underpinning education at these Anglican institutions. As one contemporary noted, Quakers preached 'publicly in the streets [of Cambridge] against Universities, learning, tythes, and the clergy'.[4] The emphasis at the English universities and schools on classical authors, and particularly on Aristotelian learning, provided more specific targets.[5]

Quakers responded by setting up their own schools, in order to ensure that Friends' children could learn appropriate religious values and also be equipped with a means of earning a living in a manner that was both socially useful and 'innocent'—that is, not conflicting with Quaker mores which forbade, for example, Quaker iron-founders to manufacture armaments. However, the provision of schools was a slow process, and during the move-

[2] Nickalls (ed.), *Journal of George Fox*, 7–8.

[3] Ibid. 218, 278, 408; Braithwaite, *Beginnings of Quakerism*, 297–8; Brown and Peckover, 'Brief history'.

[4] C. H. Cooper, *Annals of Cambridge*, iii. 475.

[5] One controversial issue was the teaching of Latin. Some dismissed it as a barbarous language that was unnecessary for a true Christian, since the Inner Light was the only touchstone of religious understanding. Others accepted Latin into the curriculum on utilitarian grounds, but wanted inspirational Christian texts substituted in place of heathen authors, who often extolled the virtues of war and other unacceptable activities. Quakers even published their own Latin primers, such as the *Institutiones Pietatis* (1676). See Braithwaite, *Second Period of Quakerism*, 525–53.

ment's early years schooling was not high on the agenda. Moreover, the 1662 Act of Uniformity denied Dissenters the freedom to form their own schools. In defiance, Fox and other Quakers encouraged the founding of schools, and willingly advised on the curriculum. By 1691 at least fifteen such schools existed under the auspices of Quarterly Meetings.[6]

The Yearly Meeting, which commenced in 1668, did not engage the subject of children's education until 1688, after which date it was frequently discussed, and the resulting advice was issued in epistles distributed throughout the movement. For example, the 1692 epistle specifically identified the education of the young as the most pressing issue and offered the following advice:

> It is earnestly requested that all Parents among Friends take all Godly & Christian care in the Education of their Children, and be good examples to them, and not to allow them in any thing that may gratifie a vain mind in Immodest Apparell or Foolish Garbs, or other Extravagancies tending to their Hurt . . . But sincerely to use their best Indeavours to Train them up in the Nurture and Admonition of the Lord in Sobriety, Modesty & Plainness in Apparel, Language & Conversation, as becometh our Holy Profession & Christian Religion.[7]

Parents were also urged not to expose their children to the corrupting influence of non-Quaker schoolteachers, who would impose 'Heathen Authors and the Names of their Gods'.[8] The *Extracts from the Minutes and Advices of the Yearly Meeting of Friends* also reprinted an epistle from 1703 which advised

> friends of all degrees [to] take care to breed up their children in some useful and necessary employments, that they may not spend their precious time in idleness; which is of evil and tends much to their hurt.[9]

While this and many other early examples of educational advice were addressed to parents, the 1695 Yearly Meeting confirmed the need for a system of schools under the auspices of Monthly and Quarterly Meetings.[10]

Thomas Lawson's *A Mite into the Treasury* (1680) provides a useful source for examining Quaker criticisms of the education offered at church schools and at the two ancient universities. Lawson (1630–91) dismissed the 'Insatiable itch after Titles' (such as degrees), caps, and gowns as part of the heathen

[6] A. Lloyd (*Quaker Social History*, 168) gives this number of schools for 1671. Stroud ('The history of Quaker education in England (1647–1903)' (M.Ed. dissertation, University of Leeds, 1944) lists some fifty schools that existed before 1695, some of which were very short-lived. See also O'Brien, 'Educational establishments'.

[7] Minutes of London Yearly Meeting, i (1668–93), 316–17, LSF.

[8] Ibid. 231; advice dated 1690.

[9] *Extracts from the Minutes and Advices*, 2nd edn., 122.

[10] Stroud, 'History of Quaker education', 46.

paraphernalia that had come to dominate British universities. The primitive church eschewed such self-serving artifices, as did Lawson himself, who had attended Cambridge in the early 1650s but did not graduate. He perceived that, beginning in the third or fourth century, heathen learning, based on Aristotelianism, had come to dominate education. Yet this was 'Earthly, Sensual and Devilish' knowledge that the Christian must reject. Turning to the seven liberal arts—grammar, logic, rhetoric, music, arithmetic, geometry, and astronomy—he detailed how each had become heathenized. Logic was totally based on scholastic premisses and should be completely ignored. Grammar, which had arisen with the proliferation of languages at the Tower of Babel, was responsible for creating misunderstandings between nations. Subsequently, 'many Prophane, Obscene, Lascivious, Corrupting and Depraving Authors' had been introduced into British schools. Pagan rhetoric, heathen astronomy (which he equated with astrology), and musical instruments had no place in Christian worship. By contrast, he argued, Christian education should inculcate the virtue of divine wisdom. In place of grammar, children should be taught 'the Lord's Language' manifested in the Holy Bible. In place of pagan astrology, children should appreciate Abraham's understanding of God's wisdom and power in producing 'the Wonderful Fabrick of the Creation'. Education should inculcate a religious world-view, and not propagate heathen learning.

Lawson's comments on geometry and arithmetic were considerably less severe. Unlike logic, rhetoric, and grammar, these subjects were not the prerogative of education under the Established Church. Instead, both subjects were of wide utility, and were applicable to the concerns of life. However, he insisted that they could play no role in opening the sealed book of divine wisdom. The theme of utility reappeared when he recommended that young people should

> read the Nature, Use and Service of Trees, Birds, Beasts, Fish, Serpents, Insects, Earths, Metals, Salts, Stones Vulgar and Precious; as also Rules of Gardening, Agriculture, Grassing of cattle, Building, Navigation, Arithmetick, Geography, Chronology, Sound History, Medicine, Knowledg in Law, Improvement in Lands, Chyrurgery, Traffick, Govrnment, Ordering of Bees, Propagation of Plants, by Roots, Seeds, Slips, Layers, Suckers, by Grafting, Inoculating, Imping; of Geometry, of Useful and Necessary things, whereby they might be qualified for the Concerns of this Life, for the Help, Benefit and Advantage of others in their respective Generations . . . [11]

This extensive list of acceptable activities was contrasted with the heathen subjects that dominated traditional learning at Anglican schools and

[11] Lawson, *Mite into the Treasury*, 5, 34, 39, 41, 42. On Lawson see Whittaker, *Thomas Lawson*. 'Inoculating' and 'Imping' are forms of grafting.

universities. In emphasizing education, which prepared the student for 'the Concerns of this Life', Lawson recommended several branches of natural knowledge. He followed his own advice by becoming an able botanist, and travelled widely collecting botanical specimens.

Fox was equally free in offering educational advice. In 1668 he described a visit to Waltham, where he established a boys' school. He then 'ordered a women's school be set up at Shacklewell [Hackney] to instruct young lasses and maidens in whatsoever things were civil and useful in the creation'.[12] Far more explicit were his instructions to a Friend that he should establish a school for teaching languages, 'together with the nature of herbs, roots, plants and trees'.[13] In his *Some Fruits of Solitude* (1693), William Penn (1644–1718) provided 300 aphorisms, several of which encouraged the reader, particularly the young reader, to appreciate nature. 'The World', he wrote, 'is certainly a great and stately Volume of natural Things . . . This ought to be the Subject of the Education of our Youth.'[14] Although the appreciation of nature and its uses received positive sanctions from Lawson, Fox, Penn, and several other leading Quakers, it is not clear whether and to what extent such views were implemented by early Quaker schoolteachers.

The foregoing examples indicate that by the late seventeenth century leading Quakers recognized both the need to provide schools and the importance of nature study as a legitimate activity for Friends, and especially for their children. This positive sanction is all the more significant in the light of the many activities deemed unacceptable by strict Quakers, such as gambling and dancing. Nature study was applauded not only for its intrinsic value and its coherence with Quaker beliefs and practices, but also because it taught practical skills that would enable Friends to support themselves financially, and thereby maintain their communities.

Although a number of Quaker schools were founded in the late seventeenth and early eighteenth centuries, this impetus did not continue during the middle decades of the century, when quietism was at its peak. In 1760 a committee was appointed to investigate the issue of schooling, since it was realized that about half the children of Quaker parents failed to attend Quaker schools. With the foundation of Ackworth School, near Pontefract, Yorkshire, in 1779, this issue was finally resolved. The new school's main proponents included Dr John Fothergill (1712–80), David Barclay (a banker), and William Tuke (a grocer and merchant from York), whose proposals soon gained

[12] Nickalls (ed.), *Journal of George Fox*, 520.

[13] Minute of Six Weeks' Meeting, 11th day, 5th mo., 1675, quoted in Braithwaite, *Second Period of Quakerism*, 528.

[14] W. Penn, *Some Fruits of Solitude*, 2. See also 3–4, 49–50. This work was first published in 1693.

extensive support throughout the Quaker community. As Fothergill asserted, the school sought to attract less affluent Quaker families—those 'below middling circumstances'—that had often previously failed to provide their children with a Quaker education. Ackworth was conceived in pragmatic terms, with an emphasis on teaching 'reading, writing and accounts' to prospective tradesmen and merchants. Girls were likewise taught basic subjects to equip them for service or marriage. Fothergill also stressed the importance of teaching Quaker history and the 'general doctrines of religion and morality'. A garden was soon established at Ackworth, enabling boy pupils to practise horticulture, but other aspects of science were largely ignored during the school's early history (Fig. 3.1).[15]

During the late eighteenth century and opening decades of the nineteenth, some Quaker schools obtained scientific equipment, and a number of young

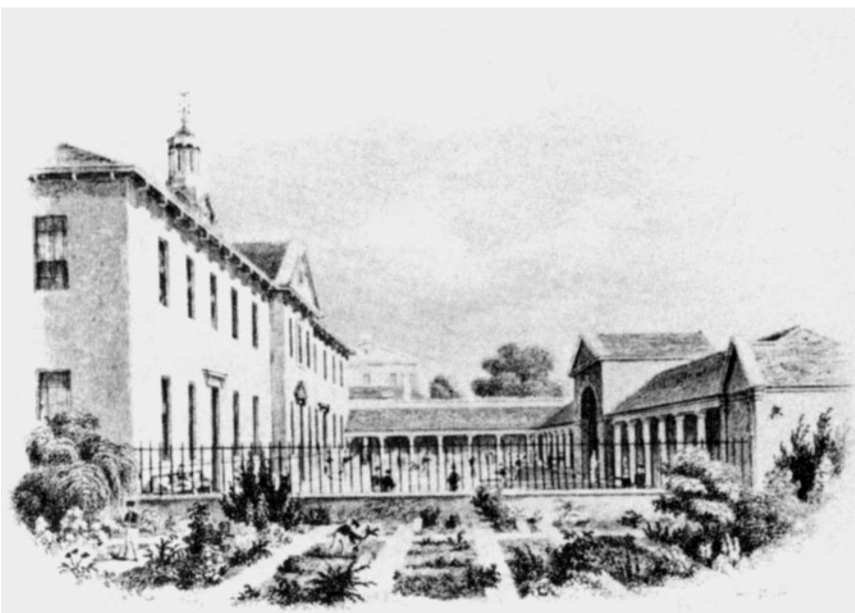


Fig. 3.1. Garden at Ackworth School (1853), where many generations of Quaker boys gained horticultural experience tending the garden (front). From Elfrida Vipont, *Ackworth School: From its Foundation in 1779 to the Introduction of Co-Education in 1946* (Ackworth: Lutterworth, 1991), facing p. 96.

[15] W. A. C. Stewart, *Quakers and Education*; Vipont, *Ackworth School*; Fothergill, *Letter from J. Fothergill to a Friend*.

Friends studied science, either at school—sometimes from visiting lecturers—or through self-education. Thus in the mid-1780s 14-year-old William Allen (1770–1843) constructed his first telescope from components costing a few pennies. Likewise Charles Tylor, who attended a boarding-school in Rochester in the 1820s, was introduced to chemistry and possibly astronomy, and participated in field trips to collect natural history specimens.[16] Science education also received strong support from Jonathan Dymond, who argued in his influential *Essays on the Principles of Morality* (1829) that 'Science is preferable to Literature,—the knowledge of things to the knowledge of words. It is not by literature nor by literary men that the business of human society is *now* carried on.' Adopting a religious and anti-utilitarian conception of morality, Dymond nevertheless urged his fellow Quakers to recognize the social progress that was occurring, for which their children needed to be equipped with a knowledge of science, rather than of Latin.[17]

We shall focus on John Ford (1801–75), who taught at Rochester but was subsequently responsible for making Bootham School in York 'that great nursery of Quaker naturalists', on account of the many eminent botanists, zoologists, entomologists, and ornithologists who studied there. The education offered at Bootham was also endorsed by J. G. Fitch, the Assistant Commissioner for Schools for the York area, who reported in the late 1860s that the school's science provision was 'more ample than in any school I ever visited'.[18]

Unlike Ackworth, which recruited mainly the sons and daughters of less affluent Quakers, Bootham (known previously as the York Friends' Boys' School) attracted the sons of wealthier families. Although a tradition of high-quality science teaching soon developed at the school, Bootham's reputation in the sciences arose primarily from an extra-curricular innovation, its Natural History Society. Founded in 1834, the Society was one of the earliest to be established in a British school. It became the focus of scientific activity within the school, and over many generations its student members participated in field trips, astronomical observations, and the collection of specimens. Frequently this interest continued into adulthood, and many cases can be cited of members who subsequently pursued scientific careers.[19]

The origins of the Society long pre-date the school's move to Bootham (one of the main thoroughfares in York) in 1845, its previous premises being in

[16] [W. Allen], *Life of William Allen*, i. 2; Tylor, 'Schooldays in the twenties'.

[17] Dymond, *Essays*, 245–58; part repr. in *Irish Friend*, 1 (1837–8), 46–8.

[18] *Extracts Relative to the Friends' Schools at York*, 5; D. E. Allen, *Botanists*, 69–76.

[19] C. J. Smith (ed.), 'In celebration of natural history at Bootham School, York, 1834–1984'. This mimeographed volume contains contributions from some forty-five alumni, the earliest among whom were at Bootham in 1903–6. Fifteen ex-pupils were elected to the Royal Society.

Lawrence Street. When the school opened there in 1829, John Ford was appointed Head Teacher. He soon became acquainted with members of the Yorkshire Philosophical Society, which in 1831 hosted the inaugural meeting of the British Association for the Advancement of Science. In his diary for May 1833, Ford recorded a meeting over breakfast with John Phillips, the Curator of the Yorkshire Philosophical Society's museum and subsequently Professor of Geology at Oxford. During this early morning social call Phillips displayed to Ford his instruments, including barometers, a needle for measuring the angle of magnetic dip, a rain gauge, and several telescopes. This instructive visit prompted Ford to 'stimulate myself to more diligence in science'.[20] He therefore joined the Yorkshire Philosophical Society, half of his subscription being paid by the York Quarterly Meeting so as 'to enable him to introduce Boys [from the school] to the [Society's] Museum'.[21]

Ford, whose own teaching had included a range of scientific topics, actively encouraged his pupils to found their own journal, entitled 'The Naturalist', in 1833 (Fig. 3.2). The first issue extended to sixteen manuscript pages, containing articles on the insects and plants found in the neighbourhood of York, a meteorological record, and a paper on the crocus (complete with carefully pressed specimens). There was also news from James Backhouse, on a Quaker mission to Australia, who forwarded to the school extracts from his journal.[22] Judging by the number of subscribers and the amount of work that was involved in producing 'The Naturalist' and 'The Ornithologist' (another manuscript production dating from 1834), Ford soon generated a zest for natural history among his pupils.

Shortly after the school reconvened following the 1834 summer vacation, the York School Natural History Society was established, its aim being 'to promote the study of Natural History, in its various departments'. According to the annual reports, many of which were printed, the Society soon amassed sizeable collections of plants, insects, shells, eggs, fossils, and minerals. Various eminent Quakers donated specimens, even collections, to swell the items accumulated by the student members. Thus one ex-pupil contributed several dozen varieties of plant, and another donated a copy of Charles Lyell's *Principles of Geology*. By 1837 the herbarium contained 379 flowering plants. Enthusiasm was further stimulated by the award of prizes—for example, for the best collection of flowering plants gathered over a six-month period.

20 S. Thompson (ed.), *Memorials of John Ford*, 30–1, 174–6.

21 Minutes of the School Committee of the York Quarterly Meeting, quoted in Stroud, 'John Ford (1801–1875): The life, work and influence of a Quaker schoolmaster' (unpublished Ph.D. dissertation, University of London, 1947), 150. In 1836 the Quarterly Meeting took over the full cost of Ford's subscription.

22 'The Naturalist', Box 19.1, Bootham School Archives. For Backhouse, see sect. 5.3.

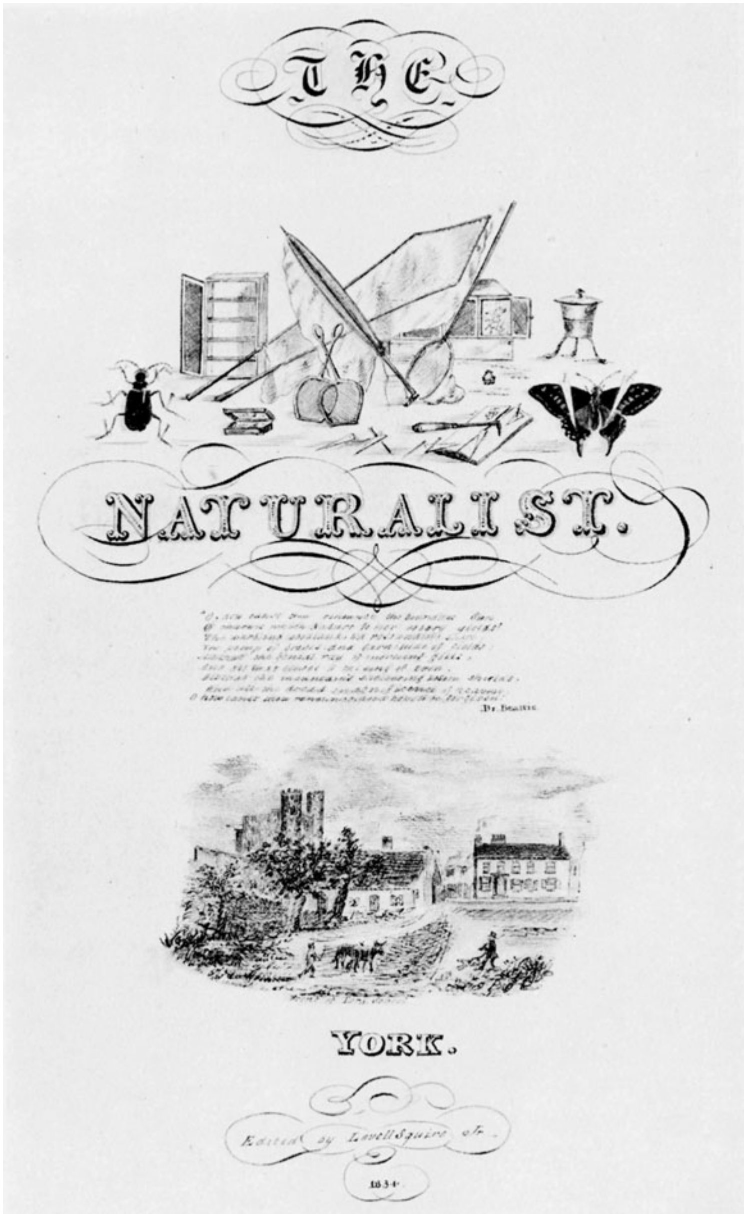


Fig. 3.2. Title-page of an early issue of 'The Naturalist' produced by pupils at the York Friends' Boys' School, 1834. From F. E. Pollard *et al.*, *Bootham School 1823–1923* (London: Dent, 1926), facing p. 47.

Some Quakers were evidently concerned that the award of prizes might give rise to 'a mercenary spirit', and Ford had to defend this practice, arguing that if any student displayed such a tendency, a teacher would tactfully caution the student.[23] Yet the award of prizes proved an effective means of encouraging pupils to collect and arrange specimens.

The Society occasionally purchased scientific books and periodicals, such as the *Zoologist* and the *Naturalist*, both of which were conducted by Edward Newman (1801–76), a Quaker who was later disowned but subsequently reinstated. The boys frequently participated in field trips, especially to nearby Askham Bog, and reported on the flora and fauna encountered during vacation travels. Some meetings were devoted to reading papers on natural history, but pupils also contributed essays and poems on classical and literary themes. Beginning in 1850, these student papers were copied into a series of manuscript volumes under the title 'The Observer'.[24] The Society also included astronomy, which received a considerable boost after the school's well-equipped observatory was completed in 1853.

Although there are few references to astronomy during the early years of the school, interest in the subject increased during the 1840s. Joseph Pease (1799–1872), a Quaker banker, therefore loaned the school a transit instrument, which was used by the older pupils. The school's move to more spacious premises in 1845 extended the possibilities for observation. By chance, Thomas Cooke, the foremost manufacturer of high-quality achromatic lenses, was located in nearby Stonegate, later moving to Coney Street. Cooke supplied the Yorkshire Philosophical Society with a powerful transit instrument in 1844, and pupils at Bootham purchased small achromatic lenses from his shop in order to construct their own telescopes. These lenses, one boasted, were 'good enough to see the rings of Saturn and the moons of Jupiter'.[25]

In 1849 the school was asked to relinquish its transit instrument after Pease requested its transfer to the newly founded Flounders Institute for training Quaker teachers.[26] Ford then began soliciting contributions towards the purchase of a replacement telescope. Serendipity intervened in 1851, in the

[23] *Report on the Employment of Leisure Time at School*, 8.

[24] Annual Reports of the York School Natural History (and Polytechnic) Society, Box 21, Bootham School Archives. In 1869 the Natural History Society was not flourishing, and a decision was made to rename it the Natural History, Literary and Polytechnic Society.

[25] [J. W. Richardson], *Memoirs of John Wigham Richardson*, 46.

[26] Isaac Brown, the Principal of the Flounders Institute, possessed a 'richly stored mind [that] was a well furnished laboratory of all the departments of natural science'. Astronomy was, however, his forte and he, like several other Quakers, purchased a medium-sized refractor from Cooke and Sons. See obituary notices in *AM*, 1897, 4–27; *MNRAS*, 56 (1895–6), 188–9. In his election to the Royal Astronomical Society in 1851, his first proposer was Isaac Fletcher.

Fig. 3.3. The observatory at Bootham School, completed in 1853. From Bootham School Archive, with the kind permission of Bootham School.

form of Samuel Gurney (1786–1856), the affluent banker. After inspecting the school with other weighty Quakers, Gurney expressed his satisfaction, and proffered a donation of £100. Ford proposed that Gurney's donation be directed to purchasing 'a good telescope, mounted equatorially, and placed in a suitable building', in order to enhance the school's science provision. Subsequently, during a visit to the school, the astronomer Charles Piazzi Smyth advised Ford and Cooke on the construction and contents of the observatory, which was completed by the end of 1852 (Fig. 3.3). The observatory was equipped with a 4¼ inch Cooke instrument, costing £120, and a clock, with a compensating mercury pendulum. In a later minute the committee that managed the school on behalf of the York Quarterly Meeting was informed that the new facilities provided 'much enjoyment to many of the boys and also to their teachers'.[27]

Subsequent annual reports of the Natural History Society contain information about astronomical activity at the school. In 1854 the new telescope, which 'proved a thoroughly good instrument', was used to observe several planets, especially Saturn, and also the moon. In the following year observations were made of sunspots and binary stars, and photographs were taken of

[27] *Extracts Relative to the Friends' Schools at York*, 5.

the moon in its various phases. Good-quality photographs of star clusters were produced a few years later. A pupil who had attended Bootham in the late 1860s subsequently recalled that he had learned to use the telescope and devoted much of his time to making observations and recording them in a diary. This immersion in astronomy had, he claimed, contributed considerably to his personal development, since 'it wakened in me a real enthusiasm'.[28] Although interest in astronomy has waxed and waned over the years, the Bootham observatory has been, and continues to be, a locus for serious scientific endeavour.[29]

Why did Ford place so much emphasis on practical science? One recurrent theme in his writings is the role of science in diverting schoolboys from evil activities. Schoolteachers have traditionally been responsible for the moral welfare of their charges, and a nineteenth-century Quaker schoolmaster's lot must have been particularly difficult in the light of the Society of Friends' many proscriptions. With long silent meetings and a ban on many amusements, such as music and card-games, the more mischievous schoolboys posed a serious threat to discipline. As Ford's diary makes clear, when he taught in Rochester, he experienced considerable discomfort from witnessing the unruly and unpleasant behaviour of some of the boys, whom he was forced to reprimand. This experience may have encouraged Ford to found the Natural History Society in the hope that it would be morally beneficial. Moreover, the Friends' Education Society received reports in 1838 and 1845 on how to occupy gainfully the leisure time of male pupils. Indeed, one report argued that participation in natural history channelled the boys' energies away from 'idle, frivolous, or pernicious pursuits . . . [and] from the society of the gay and trifling'. Moreover, as an early set of minutes makes clear, natural history was 'not only a means of present employment', but provided a way of preventing 'men after leaving school from falling into idle or vicious ways'.[30]

In another early half-yearly report the author—again probably Ford—drew attention to the civilizing effects produced by science. Members of the Natural History Society worked together as a community 'in the naming or arranging

[28] Dudley, *Life of Edward Grubb*, 31. Grubb attended Bootham from 1868 to 1871.

[29] My discussion of astronomy at Bootham is based on Stroud, 'John Ford (1801–1875)'; Robinson, '150 years'; the annual reports of the York School Natural History [and Polytechnic] Society, Box 21, Bootham School Archives. My thanks to David Robinson for permitting me to read his unpublished papers relating to astronomy at the school and to the archivist, Margaret Ainscough. On Cooke see Matthew, 'Science and technology in York'; McConnell, *Instrument Makers to the World*; Chapman, *Victorian Amateur Astronomer*, 234–7.

[30] 'Twelfth half-yearly report of the York School Natural History Society', 1840, kindly transcribed by David Robinson; minute of 6th day, 12th mo., 1842, quoted in Stroud, 'John Ford (1801–1875)', 151. See also *Report on the Employment of Leisure Time*, 22.

of specimens' and in sharing specimens with other members. Furthermore, added the author, 'arrangement, classification, and order, without which no sound progress can be made in any department of Natural History, will be found to be excellent aids towards the right fulfilment of the multifarious duties of future life'.[31] Likewise, in a paper presented to the Friends' Educational Society, Ford described how teachers could imbue appropriate, Quakerly behaviour in their pupils, yet without resorting to bullying or corporal punishment. Rather than presenting themselves as figures of authority, Ford urged teachers to treat their charges with sympathy and understanding. 'How shall we obtain this influence . . . ?', he asked. 'Watch your opportunities; help your pupils in their little difficulties, answer every request so as to invite another, aid them in their pursuits of science, or natural history, in prosecuting their inquiries, in determining and naming their plants, their fossils, and their shells.'[32] Natural history was therefore a communal activity in which pupils could co-operate with each other and with the teacher. Such serious, directed, communal interactions could instil the desired moral tone in a Quaker school. Moreover, the study of natural history possessed the additional religious attraction of making manifest God's providence.[33] As one pupil asserted, the study of nature 'would keep us from idleness; form an agreeable amusement and is calculated to expound the ideas of the wisdom, power and goodness of our Heavenly Father'.[34] Yet, not all forms of nature study were acceptable to Quakers, and in 1800 the committee governing Ackworth School banned J. F. Martinet's *Catechism of Nature, for the Use of Children*, because it might encourage pantheism.[35]

Societies similar to the Bootham Natural History Society existed at many of the other Quaker boys' schools.[36] Moreover, although the educational provision for girls was not as extensive as for boys, many Quaker girls received a firm grounding in literature, arithmetic, and even science. The York Quarterly Meeting, which controlled Bootham, also founded the Mount School, which opened as Castlegate School in 1831. Evidence from letters written by early pupils indicates that they learned botany during nature walks and attended

[31] 'Third half-yearly report of the York School Natural History Society', 1837, kindly transcribed by David Robinson.

[32] Ford, *Influence and Authority*, 12. Ford's paper at the Friends' Educational Society is reported in the *Irish Friend*, 1 (1837–8), 84.

[33] E.g. the study of infusoria introduced members of the Society to 'this most minute and complicated, and not least wonderful part of the Great Creator's works': 'Annual report of the York School Natural History Society', 1846, Box 21, Bootham School Archives.

[34] F. A. Knight, *History of Sidcot School*, 90.

[35] Howitt (ed.), *Mary Howitt*, i. 76.

[36] E.g. at Ackworth, Croydon, Wigton (Lancashire), and Sidcot. *Report on the Employment of Leisure Time*, 8–25; F. A. Knight, *History of Sidcot School*, 89–95; Bolam, *Unbroken Community*, 133–6. See also W. A. Stewart, *Quakers and Education*, 147–56.

lectures at the Yorkshire Geological Society. The school even hired a lecturer to deliver lectures on chemistry and other subjects, illustrated by experiments. On at least one occasion John Ford invited the girls to Bootham, where, after tea, he demonstrated a series of chemical experiments, including some exciting displays illustrating the combustion of sulphur, phosphorus, and potassium. 'I like John Ford very much and his manner of explaining', commented one pupil, who also reported that the school's superintendent and 'older girls are very much interested about Chemistry and Natural Philosophy'. Between 1842 and 1858 there existed a school society that tended mineralogical, botanical, and conchological collections, accumulated specimens, and submitted reports. At this time the school may also have owned a Cooke telescope. In contrast to the very limited education offered to most contemporary girls, even from wealthy families, these pupils at the Mount received an unusually extensive introduction to scientific subjects.[37]

Another impressive innovation occurred in 1877 with the founding of the *Natural History Journal*. Despite its title, it was not controlled by the scientific community like, say, the *Natural History Review*. Instead, it was a school magazine published by a consortium of Friends' schools. Soon, however, it changed its title to *The Natural History Journal and School Reporter* in order to extend its scope and to include regular reports on sporting events (Fig. 3.4). Except for this 'games' section, the pages of the *Journal* were filled with information on botany, zoology, entomology, meteorology, and astronomy, often garnered by the pupils themselves, although ex-pupils also frequently contributed. The constituent schools submitted regular reports on the activities of their scientific societies, especially the Natural History Society at Bootham. This ambitious journal is an exemplar of practical involvement in science by Quakers, and particularly by the older pupils at Quaker schools. Since subscriptions soon reached 600–700, the *Journal* must have found its way into a significant proportion of Quaker homes.

As a sect committed to providing a religiously and morally appropriate education for its children, the Society of Friends constantly encountered the problem of recruiting teachers. Prior to the mid-nineteenth century, Meetings sought to obtain the services of Friends who were prepared to teach, but the system was rather haphazard, and Quakers with higher prospects rarely wanted to enter such a poorly paid occupation. After the opening of Ackworth, a form of apprenticeship operated which aimed at recruiting older boys by requiring them to teach classes of younger pupils. In 1836 the Mount School began a similar scheme to recruit women teachers, which proved more successful than the Ackworth system. The problem was directly addressed,

[37] Sturge and Clark, *Mount School*, 44, 47, 53, 64–5.

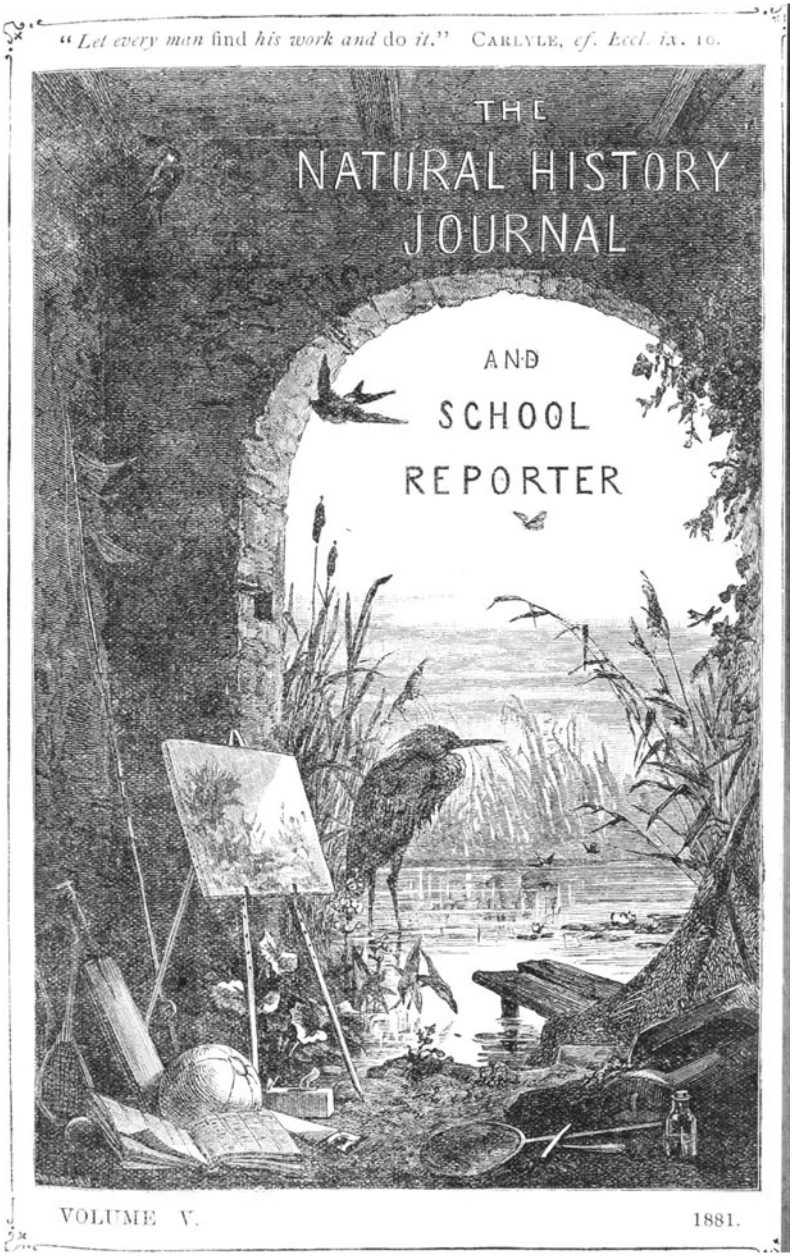


Fig. 3.4. Title-page of *The Natural History Journal and School Reporter*, 5 (1881). Plainer frontispieces were used in earlier volumes, which were entitled *The Natural History Journal*. Reproduced with the kind permission of Leeds University Library.

however, only in 1848 with the founding of the Flounders Institute and made possible by a substantial bequest of £40,000 from the estate of the late Benjamin Flounders of Yarm, whose fortune had been made in banking and railways. The Institute sought to attract 'the sons of poorer members', with a view to training them to become teachers in order to staff Quaker schools. Attracting an average of six students a year, it was moderately successful in this.[38] Although the first principal, Isaac Brown (1803–95), was a keen astronomer and a Fellow of the Royal Astronomical Society, the teachers trained at the Flounders Institute did not generally emphasize science in their teaching. In 1879 an independent report (which did not cover the York schools, which recruited from wealthy Quaker families) was highly critical of the standard and quantity of mathematics and science education at Quaker schools. It appears that the impetus towards science teaching so evident earlier in the century had largely dissipated. In response to this critical report, an educational conference was convened, which *inter alia* recommended an increase in the amount of applied science taught in Quaker schools.[39]

One response to this demand, and also to the perceived need to send more Quakers to the two ancient English universities, was the decision by the Friends' Public School Company in 1890 to establish Leighton Park School in Reading. This school provided advanced training to enable boys to 'go to Oxford or Cambridge without further coaching'. Science was positively encouraged, and in 1893 a Natural History Society was instituted. One of the school's early pupils was Leonard Doncaster (1877–1920), who proceeded to Cambridge, a Chair at Liverpool University, a Fellowship of the Royal Society, and a short but successful career as a zoologist and geneticist.[40]

3.1.2 *Jews, schools, and science*

In 1664, a decade after the readmission of the Jews, the Sephardi community founded a school at which boys received religious education and were also taught arithmetic and how to read and write English. A Sephardi girls' school was later added. By contrast, the Ashkenazi community was slow to establish schools, and only in 1732 was a *Talmud Torah* (a religious school) founded to provide a basic education to boys from poor homes. Funded by wealthy members of the community, the *Talmud Torah* subsequently expanded its teaching to include secular subjects, while the proportion of Hebrew teaching was reduced. Partly in response to the success of Anglican schools, especially

[38] W. A. Stewart, *Quakers and Education*, 95–104.

[39] *Report of the Educational Conference*, 19–23, 79–97, 170–2.

[40] S. W. Brown, *Leighton Park*, 34; Allen and Mackinnon, '"Allowed and expected to be educated and intelligent"'.

those founded by the evangelical National Society, in attracting Jewish children, the Jewish community accepted the need for a community-maintained school in London, catering for the large numbers of poor children. After gaining the support of several philanthropists, both Christian and Jewish, the *Talmud Torah* was extended in 1822 to include both a boys' and a girls' school. The new school, subsequently known as the Jews' Free School (JFS), offered religious education, but also concentrated on providing a basic level of schooling in reading, writing, and arithmetic. This curriculum was intended to impart those skills necessary to enable pupils subsequently to earn an honest living. It was argued that, once provided with an adequate education, they would not only reject a life of crime, but also be less likely to become prey to conversion societies. However, some members of the community considered the school too secular and too intent on Anglicizing Jewish children.[41]

Although a number of other schools for the children of poorer members of the community, such as the Westminster Jews' Free School and the Stepney Jewish School, were founded in the nineteenth century, the JFS came to dominate Jewish education in London. This was partly owing to the school's size—well in excess of 2,000 pupils in the late nineteenth century—but also because the school and its teachers gained the community's respect. Yet, apart from some mathematics, science does not appear to have attracted much attention until the 1890s, when, under the impetus of central and local government directives, a new wing was added to the boys' school, containing laboratories for scientific and technical instruction. The school's published history includes a 1908 photograph showing an airy and well-equipped chemistry laboratory with about thirty boys at work.[42]

By contrast, some of the more affluent families hired private tutors. For example, Herbert Samuel (1870–1963) claimed that, like many other late Victorian Orthodox Jews, he did not attend school 'on account of the difficulty of providing religious teaching and maintaining the special observances'. Instead, he received his early education at home, and was later sent to University College School.[43] Indeed, University College School, which had been founded in 1830, was particularly attractive to wealthy and professional Jewish families. Like University College London (UCL), its elder sibling, it was non-denominational and, in contrast to most public schools of the period, was not subject to clerical control. One headmaster thus summarized the school's attitude towards religion: 'we propose no tests; we teach no dogmas, we merely provide an opportunity for a boy to get some adequate

[41] Black, *J.F.S.*
[42] Ibid. 113 and fig. 32, facing p. 162.
[43] H. L. Samuel, *Memoirs*, 4.

knowledge of the documents on which the different forms of religion in England are based'.[44] The school was viewed as progressive, and catered mainly for the commercial and professional classes, especially Jews and Dissenters. While Latin and Greek were taught, mathematics and the sciences were strongly represented. Thomas Hewlett Key, the highly respected Headmaster, who served from 1832 to 1875, was himself elected to the Royal Society in 1860 on the strength of his philological researches. He greatly encouraged the science professors at UCL to participate in the school's teaching and to advance its scientific ethos. His son-in-law, Alexander Williamson, the Professor of Practical Chemistry, therefore arranged for his assistant, George Carey Foster (later Professor of Natural Philosophy at the College) to offer pupils a practical chemistry class in a basement room at the school. As the Devonshire Commission noted in the 1870s, this was one of the few school laboratories in the country. Many students at University College School went on to study science subjects either at UCL or at Cambridge, including a number of Jews such as Arthur Cohen, Numa Hartog, Philip Magnus, and Marcus Adler.[45]

While University College School was non-sectarian and offered a modernist academic training, some Jews were prepared to send their sons to more traditional public schools of higher social standing despite their manifestly clerical ethos, such as St Paul's School, which gained a good reputation for mathematics teaching but introduced science only in the late 1870s. The City of London School likewise attracted a number of Jewish pupils, and in the 1860s enthusiastically embraced the teaching of science. This school was also unusual, in that the Headmaster had facilitated the entry of Jews in the 1840s by permitting them to be absent from prayers and from Scripture lessons.[46]

While such schools as University College School, the City of London School, and St Paul's School were able to attract pupils from reasonably affluent Jewish families, one small Jewish school proved particularly appealing, because it offered a 'liberal and solid education' that included Hebrew, biblical studies, classics, and mathematics. This institution was run by a respected Jewish teacher, Leopold Neumegen (1787–1875), with the assistance of his wife and, later, his daughter. As the *Jewish Chronicle* remarked in 1875 in its obituary of Neumegen: 'There is scarcely a family of any position amongst us whose members have not received a portion of their education at the school which he conducted for many years so successfully.' Among those who attended Neumegen's boarding-school in Highgate, and later Kew, were the

[44] Quoted in Felkin, *From Gower Street to Frognal*, 8.
[45] Ibid. 14–15; Usher, Black-Hawkins, *et al.*, *An Angel Without Wings*, 19.
[46] Gardiner and Lupton (eds.), *Res Paulinae*; Douglas-Smith, *City of London School*, 95.

mathematician J. J. Sylvester, Raphael Meldola, the legal writer Jacob Waley, and George Jessell, later Master of the Rolls. Mathematics was taught—Jessell is said to have shone in it—and probably taught very effectively, since several pupils subsequently studied mathematics at UCL. However, there is no evidence that Neumegen provided instruction in other branches of science.[47]

As various Victorian commissions reported, the science provision in schools was generally unsatisfactory, although a minority of schools enthusiastically embraced science. While Bootham was among this minority, the science provision at other Quaker schools was less impressive, although Leighton Park School at the end of the century was a notable exception. Although a few Quaker children were sent to public schools at which an Anglican ideology was paramount—several members of the Barclay family attended Eton—Quakers generally maintained firm control over their children's education. By contrast, with the principal exception of Neumegen's school, which was strong in mathematics, the Jewish élite and upper middle classes sent their sons to non-Jewish schools some of which offered a moderately good introduction to science and mathematics. However, prior to the closing years of the century, only a small proportion of the children of either community received much science at school.

3.2 Medical education

3.2.1 *Quakers at Edinburgh Medical School*

In the late seventeenth and early eighteenth centuries, several English Quakers travelled to the Continent specifically to gain a medical education. The University of Leiden proved particularly attractive, since it boasted a first-class medical school and did not operate religious tests. However, this was an expensive route to a medical career, and the opening of the Medical School in Edinburgh in 1726, which was modelled on Leiden, where its principal founders had studied, provided a far cheaper and more accessible option.[48] With impressive teachers, a hospital, an anatomical lecture theatre, and a botanical garden, Edinburgh offered a high-quality medical education, combining both medical theory and clinical experience. Moreover, an education at Edinburgh enabled students to pursue a broad curriculum, including chemistry, botany, and natural philosophy. Edinburgh was also increasingly viewed as a city of learning, culture, and intellectual vitality. As the fame of

[47] *JC*, 16 Apr. 1875, 885; Finestein, *Jewish Society in Victorian Britain*, 257; Marchant (ed.), *Raphael Meldola*, 12–14.

[48] Goslings, 'Leiden and Edinburgh'; Rosner, *Medical Education.*

Edinburgh and its Medical School spread, students flocked from Scotland, Ireland, England, and North America, and the number of medical graduates rose from twenty in the 1730s to more than 1,100 in the 1830s.

There were several educational paths open to the prospective medical practitioner. Surgeons and apothecaries often spent a year or two at Edinburgh studying, in order to round off their medical education and gain some of the social veneer that an apprenticeship might not confer. For a prospective physician to obtain an Edinburgh MD (throughout most of the period under discussion), a student had to submit evidence that he had pursued relevant studies for at least three years—either three years at Edinburgh, or a shorter period at another university and the remainder at Edinburgh. Although the degree of MD could be obtained from Aberdeen and St Andrews, which required only certificates of competence signed by two physicians, an Edinburgh degree was valued by the medical profession and was widely recognized by patients. Thus one Edinburgh professor claimed that 'the title of doctor [of medicine] acquired here, more certainly than in several other Universities, proves its possessor to be both learned and skilfull'.[49]

By the middle of the eighteenth century, Edinburgh was firmly established as the preferred venue for Quaker medical students. The quality of its education, the relatively low financial outlay required, and the cultural attractions of the city were all strong inducements, but there were three additional reasons why Edinburgh proved particularly attractive to Quakers. First, like Leiden, the Medical School was under secular, not ecclesiastical, control. Edinburgh Town Council possessed overall responsibility for supervising the University, their remit including the appointment of professors.[50] Second, Scotland had its own Act Rescinding the Laws of Conformity (1689), which was more inclusive than the Toleration Act that operated in England. Moreover, the Test Acts of 1673, which were only fully abolished in 1871, did not apply to the Scottish universities.[51]

Finally, although Quakerism made relatively little impact north of the Border, from the 1660s a Meeting had existed in Edinburgh. Throughout most of the eighteenth century, membership of the Edinburgh Meeting remained small.[52]

Nevertheless, it provided a point of religious contact for Quaker students away from home. Parents and their local Meetings were happy to send their

[49] Rosner, *Medical Education*, 66, quoting William Cullen.

[50] Morrell, 'Edinburgh Town Council'.

[51] Burnet, *Story of Quakerism in Scotland*, 114, 147–50.

[52] A visitor in 1767 numbered the attendance at eight to ten men and approximately the same number of women (Bell, 'Philadelphia medical students', 13). During the ensuing decades numbers increased to approximately 110 in the second quarter of the nineteenth century (Miller, 'Reminiscences', 1).

sons to Edinburgh in the knowledge that they would be cared for by Edinburgh Friends, especially by the Miller family.[53] On arrival in Edinburgh, prospective students often called first on a Friend to whom they carried a letter of introduction. Introductions sometimes preceded arrival. Thus William Miller III (1722–1801), a member of the Miller clan who had moved from Edinburgh to Tottenham, wrote on behalf of one of his neighbours named Hall Overend, a Quaker surgeon who had recently completed his apprenticeship. Miller specifically requested an Edinburgh relative to

> show him [Overend] so much Friendship, in the first place, [and] to recommend him to a sober family, where he may Lodge and Board properly with Frugality, and after a few days, to go with him to such of the professor's houses as he chooses to attend this year, as he has in his hands good three Guineas and a Crown to give each of them, which I believe is their Fee, that alone will be an Ample introduction to them.[54]

Many Quaker medical students were invited to visit, take tea, or dine at the Millers—'a very agreeable Asylum by way of change', as one Philadelphian put it—or one of the other Quaker families.[55] A number of medical graduates subsequently recalled with pleasure the hospitality extended by the Millers.[56] For their part, members of the Miller family developed close relationships with some of the students who visited them at Hope Park, their impressive residence with its extensive ornamental gardens. Thus, shortly after he arrived in Edinburgh in 1820, the religiously austere Thomas Hodgkin (I) (1798–1866) visited Hope Park on several occasions, prompting the comment: 'we think him a very agreeable and intelligent young man, and we are quite disposed to show him all attention and kindness'. His hosts nevertheless found him rather stiff, 'which nettles us sometimes, in spite of our admiration'.[57]

Almost a century earlier John Fothergill had inaugurated the Quaker connection with Edinburgh medicine. In 1734 he travelled to Edinburgh with the intention of spending just one year completing his training as an apothecary, having previously been apprenticed to Benjamin Bartlett, a Quaker apothecary in Bradford. Instead, he was urged by Alexander Munro, *primus*, who held the Chair of Anatomy and Surgery, to continue his training in order to 'occupy a higher station' than that of an apothecary.[58] Having been

[53] W. F. Miller, *Memorials of Hope Park*. The Miller family built up a flourishing business as seedsmen and nurserymen, later diversifying into linen manufacture.

[54] W. Miller III to G. Miller IV, 18th day, 10th mo., 1795, in W. F. Miller, *Memorials of Hope Park*, 16.

[55] Bell, 'Thomas Parke's student life', 252.

[56] W. Miller V to G. Miller IV, 25th day, 2nd mo., 1820, in W. F. Miller, *Memorials of Hope Park*, 90. See also [Anon.], 'Memoir of the late Martin Barry', 82.

[57] W. Miller V to G. Miller IV, 8th day, 12th mo., 1820, in W. F. Miller, *Memorials of Hope Park*, 100.

[58] Lettsom (ed.), *Memoirs of John Fothergill*, 5.

awarded his MD in 1736, he moved to London, where he became a highly successful doctor and a respected Quaker. In this exalted position he was often approached by young men, both Quaker and non-Quaker, for advice on how to pursue a medical career. Thus he recommended one enquirer 'to get into some Shop in Edinburgh, to attend the Materia Medica and Anatomy [courses] the first winter, and to go through a course on Experimental Philosophy'.[59] Visiting Americans often headed straight for Fothergill's house in London, and were directed to spend time in Edinburgh, which they did bearing letters of introduction from Fothergill and other Quaker doctors. For example, as George Logan (1753–1821) from Philadelphia remarked in a letter to his father, Fothergill had received him 'in such a manner as had more the appearance of a tender Father than a transcient Friend'.[60]

Before setting out for Edinburgh, a Quaker student would normally have been issued with a certificate of transfer from his local Meeting. This document certified that the student was moving to Edinburgh, and 'upon enquiry being made relative to his conduct and respecting debts, nothing appearing to prevent the issuing of a certificate on his behalf, we accordingly recommend him to your Christian care'. Although the wording of certificates appears to have become standardized by about 1820, earlier certificates sometimes supplied the reason for moving, such as 'for the Purpose of studying physic' or 'in view of Medical improvement'. Also, some earlier certificates contain such phrases as 'he is of sober life & conversation' and 'free from debts & marriage engagements'.[61] As such terminology makes clear, in issuing a student with a certificate, the Meeting was vouching for his probity. Issuing a certificate was not automatic. For example, Caspar Wistar (1761–1818), who later became Professor of Anatomy at the University of Pennsylvania, proved a particularly difficult case for the Philadelphia Monthly Meeting, because he had fallen 'into the Scandalous & alarming temptation of being engaged in a dual'.[62] However, after much discussion, he was eventually issued with a certificate which took him first to London and then to Edinburgh, where he completed his medical studies, gaining his MD in 1786.

Certification also fulfilled other functions. In accepting a certificate, the recipient Meeting assumed responsibility for ensuring the medical student's welfare. Likewise, when a student had completed his studies in Edinburgh, enquiries were made as to his continuing fitness: whether his behaviour was

[59] Fothergill to Alston, 14 Sept. 1743, in Corner and Booth (eds.), *Chain of Friendship*, 79–80. This student may not have been a Quaker.

[60] George Logan to Charles Logan, 10 July 1775, in Bell, 'Philadelphia medical students', 5.

[61] CH10/1/96, SRO.

[62] Bell, 'Philadelphia medical students', 6. The Wisteria plant bears his name.

sufficiently Quakerly, and whether he was clear of financial and matrimonial commitments. If he proved acceptable, his certificate would be forwarded to the Meeting covering the district in which he intended to reside.

The majority of Quaker medical students at Edinburgh were English, with significant numbers from Ireland and North America, but very few Scots. With rare exceptions, the English students were drawn from Quaker families of moderate means. The big banking and manufacturing families, such as the Lloyds, Gurneys, Hoares, and Barclays, rarely sent their sons to study medicine at Edinburgh, but expected them to join the family business. Quakers at the other end of the financial spectrum could not afford to pursue a costly medical education. The example of John Dalton (1766–1844) offers an interesting insight into why one Quaker of great scientific ability, but limited means, did not enter medicine. In 1790 Dalton was earning about £40 a year teaching at a Quaker school in Kendal, but he sought the advice of his patron, Elihu Robinson, and also of a London-based uncle, about how to pursue a more lucrative career. He was attracted to medicine, and felt sure that he could finance himself at Edinburgh for three years. Somewhat optimistically he estimated the cost of board as £10 to £15 for each winter and college fees costing 12 guineas each session. Thus he envisaged spending between £70 and £80 over the three-year period. He thought he might achieve this by living frugally and earning money during the intervening summers. Although Robinson's response was mildly encouraging, Dalton's uncle considered that medicine was 'out of the reach of a person in thy circumstances'. Instead, he suggested that his nephew might 'move in the humbler sphere of apothecary or attorney, thou mightest, perhaps be able, with a little capital and great industry, to establish thyself in one of these'.[63]

To send a son away to Edinburgh for three years would cost at least £150—probably considerably more—to cover travel, board, lodging, and the fees paid both to the professors and to the University. Fothergill's background was not atypical. His father was a yeoman, as were the fathers of several other Quaker physicians; other parental occupations include clogmaker, combmaker, woolcomber, woollen draper, wool stapler, tallow chandler, tanner, and wheelwright. Some hailed from rather more wealthy backgrounds, such as worsted manufacturer, cotton-broker, and shipbuilder. Although such occupational descriptions are not precise indicators of wealth, they nevertheless suggest that most Quaker medical students were the sons of richer artisans and moderately prosperous traders. A significant proportion of Quaker students on the MD track at Edinburgh were intending to pursue a

[63] Lonsdale, *Worthies of Cumberland*, 74–7; Thackray, *John Dalton*, 18.

career of higher status and greater earning power than those pursued by their fathers.

Yet, living away from home, probably for the first time, also proved a test of religious commitment. Quaker students were conspicuous in dress and in their use of language—for example, using 'thee/thine', instead of the conventional 'you/your'. Quakerism could also be socially restrictive, as Quakers could not join their fellow students in singing, dancing, and playing card-games; even drinking had to be in moderation. They were expected to refuse invitations to concerts and the theatre. Although he attended a non-Quaker funeral—'all ceremony is excluded by the Scotch on these occasions'—the unbending Hodgkin even refused to attend a formal dinner in honour of the Professor of Geology.[64]

Although the Edinburgh Meeting offered a home away from home, not all students welcomed the prospect of having their lives scrutinized by Edinburgh Friends. Many took advantage of the situation to loosen their links with their parents' religion. Living in cosmopolitan Edinburgh and surrounded by non-Quakers, they took the opportunity to deviate from Quaker ways, casting off their sombre cloaks and hats in order to merge with the student body. The attraction of the theatre, the concert-hall, and the public house proved too strong for some. Concerned for the moral welfare of the students under their care, the Edinburgh Monthly Meeting initiated the procedure of visiting new arrivals. Edinburgh Friends were shocked to find that one student, Charles Lloyd, held beliefs 'entirely opposite to the principles we profess'.[65] Likewise, John Pennington from Philadelphia was found to know little about Quaker principles and to be living a thoroughly un-Quakerly existence.[66]

In most other respects the educational experiences of Quaker students did not differ significantly from those of their non-Quaker peers. Together they matriculated, and attended lectures and clinical rounds. Many Quakers also availed themselves of membership of the various student societies that greatly augmented the intellectual vitality of Edinburgh. If their university experience was similar to that of other medical students, at graduation they encountered formal procedures that set Quakers apart and required them to assert their religious distinctiveness in public. Three months before a student was due to graduate, he was required to present the Dean of the Faculty with a fee—of

64 Thomas Hodgkin to John Hodgkin jun., 3rd day, 4th mo., 1821, HO/D/A521, HFP; Kass and Kass, *Perfecting the World*, 76.

65 The only course of action open to the Edinburgh Monthly Meeting was to return his certificate to the issuing Meeting; Lloyd then became its responsibility, not Edinburgh's (CH10/1/4, fols. 26–7, SRO; H. Lloyd, *Quaker Lloyds*, 222–4, 279–80).

66 CH10/1/4, fols. 133–44, 153, SRO.

£10, later £23—and certificates confirming that he had attended the appropriate courses. He was then examined in Latin on Hippocrates' aphorisms and on a series of medical case histories. The next stage was to write a dissertation on a medical subject, again in Latin. Although many dissertations consisted of little more than a compilation of existing views on the chosen subject, some students pursued original investigations and produced dissertations that embodied significant research.

The first religious hurdle, which was ignored by many practising Quakers, concerned the rubric on the title-page of the printed dissertation. The dissertation was accepted 'annuente summo numine, et auctoritate reverendi admodum viri, D. Georgii Baird, S. S. T. P. [Sancti Scripturi et Theologiae Professor] Academiæ Edinburgenæ Præfecti'—with the agreement of the highest power and the authority of a very respected man, George Baird, Professor of Holy Scripture and Theology, and Principal of the University of Edinburgh. The first problem was the evocation of 'the highest power'. In a letter to his father, Thomas Hodgkin considered adding a footnote in Latin: 'Let not God be present, unless there occurs a difficult problem worthy of a defender.'[67] Second, the title attached to the Principal implied that he possessed divine knowledge that other Christians could not access. The alternative formulation, employed by some Quakers, was 'ex Auctoritate ornati viri, D. Georgii Baird, Academiæ Edinburgenæ Præfecti'—on the authority of a learned man, George Baird, Principal of the University of Edinburgh.[68] The Principal's imprimatur was thereby stripped of all theological connotations.

When Hodgkin had nearly completed his dissertation, he was informed that the college insisted on graduates using the standard form of title-page: a 'foolish form', he told his father. Evidently in the previous year another Quaker, Thomas Fisher, had created controversy by using the alternative form, which 'gave offence'. Hodgkin had therefore to petition Senate for permission to use an acceptable form of words. Progress was slow, and was further hampered by his undertaking a tour of the Highlands. While away from Edinburgh, a friend reported that one of the medical professors had told him that 'he was not very sanguine' that the matter would be resolved in Hodgkin's favour, and if it were, there would be 'a good deal of cavil'. On his return, Hodgkin visited the Principal, George Baird, who expressed his approval, but referred Hodgkin to the Faculty of Medicine, which granted him permission.[69]

[67] Thomas Hodgkin to John Hodgkin sen., 27th day, 5th mo., 1823, HO/D/A590, HFP.

[68] See, e.g., Hodgkin, *De Absorbendi Functione*.

[69] Unidentified to Thomas Hodgkin, 12 June 1823, HO/D/A1053, HFP; Thomas Hodgkin to John Hodgkin jun., 12th day, 7th mo., 1823, HO/D/A594, HFP; Thomas Hodgkin to John Hodgkin sen., 27th day, 5th mo., 1823, and 29th day, 7th mo., 1823, HO/D/A590 and 596, HFP; Kass and Kass, *Perfecting the World*, 113–14.

The third, and more serious, religious hurdle was the oath taken at the graduation ceremony. The procedure followed at the formal medical graduation was recorded in a diary entry of 1775 by a non-Quaker, Sylas Neville, who, with the other candidates,

> Met the Principal, the Professors . . . in the Guard-Hall, and after hearing *the Oath to be subscribed by each Candidate*, and *the Sponsio to be subscribed by those who are Quakers* read over by the Secretary, proceeded to the Common or Public Hall of the University, where the different candidates were examined by the Professors upon their Dissertations . . . When the examinations were over, the Candidates were required to retire, while the Principal asked the Professors if it was their pleasure that he should confer the Degree of Doctor on them, to which they having assented, we (the Candidates) were called in, having first put on Doctor's gowns, and after subscribing the Oath [or the Sponsio] above mentioned received the reward of all our labours—the Degree of Doctor of Medicine, which was conferred by the Principal in the name & by the authority of the University.[70]

The wording of this oath, which was based on sections of the Hippocratic oath, required the graduate to 'persevere in every duty of a worthy mind towards the University of Edinburgh'; second, he would 'exercise the Art of Medicine cautiously, purely and honourably'; third, he would, as far as possible, 'take care faithfully that all [his actions] are conducive to [effecting] health in sick bodies'; fourth, he would maintain confidentiality. While Quakers would not disagree with these sentiments, two aspects of this formula infringed upon their sensibilities. The graduate was expected to make his pledge 'serio et sanctè coram Deo cordium scrutatore' ('seriously and sacredly before God who sees into men's hearts'). Secondly, the declamation ended with the explicit oath: 'Ita præsens spondente adsit Numen' ('Thus may the divine presence be favourable to me as I make this pledge'). In both instances God was being invoked, and thus his name was being taken in vain—contrary to Exodus 20: 7. Moreover, both phrases implied a double standard of Truth: If one's word is a sufficient guarantee of truth, then the oath is not only redundant but objectionable, since it casts doubt on the person's initial assertion.

As Neville indicated, Quakers were exempt from the oath and instead signed a *sponsio* (affirmation) that entirely omitted the sentence 'Ita praesens spondente adsit Numen'. Moreover, the pledge 'serio et sanctè coram Deo cordium scrutatore' was replaced by an unobjectionable phrase: 'serio et solennito coram Senatu Academio' ('seriously and solemnly before the

70 Cozens-Hardy (ed.), *Diary of Sylas Neville*, 225; emphasis added. William Woodville signed the Quaker *Sponsio* in 1775. I am grateful to John Christie for drawing Neville's diary to my attention.

Academic Senate'). The text of both versions is reproduced in Appendix 2.[71] Between 1772 and 1867 sixty-eight graduands, the vast majority Quakers, signed the affirmation in preference to the traditional oath.[72] Thus Edinburgh University, which imposed no religious tests on entry, was prepared to remove this final barrier, thus enabling even the strictest Quaker to graduate.

3.2.2 *Jewish medical students in Scotland*

The links between the Anglo-Jewish community and the medical profession date from soon after the readmission under Cromwell. Among the early Sephardim who settled in London were a handful of medical men, including Fernandez (Moses) Mendes (1647–1724), a *converso* who was appointed court physician to Catherine, the Portuguese wife of Charles II. As early as 1687 a burial society (*Hebrá*) was founded, employing a doctor and a surgeon to attend the community's indigent members. In 1747 the Sephardi community also founded a hospital (*Bet Holim*), which employed nurses, a surgeon, and a physician.[73] These latter positions were filled by, among others, Jacob de Castro Sarmento, whom we will encounter below, and Joseph Hart Myers, the first Jewish graduate from Edinburgh Medical School. Later, communal organizations also employed medical men in pursuit of their philanthropic activities. For example, the Board of Guardians, which became the main Anglo-Jewish charity caring for the poor, appointed two medical officers in 1862.

Most of the small number of Jewish medical men who practised in London in the early eighteenth century had been trained abroad. In order to enhance their standing in society and to attract patients, some of these foreign-trained doctors also obtained a medical degree from one of the Scottish universities, such as Aberdeen, where an MD could be purchased with the support of at least two patrons attesting the candidate's medical reputation. Thus the first Jew to obtain an MD from a Scottish university was the *converso* Jacob de Castro Sarmento (1692–1762), who had previously graduated in medicine at the University of Coimbra, but subsequently left Portugal. With letters of support from powerful patrons in the medical establishment, he received his MD degree from Marischal College Aberdeen in 1739. During the ensuing century a further fifteen Jews followed him to Aberdeen—usually to Marischal

[71] The manuscript list of medical graduates casts interesting light on the use of this affirmation. Rather surprisingly, the first eight Quakers to graduate from Edinburgh signed their names to the standard oath. In subscribing to the oath, these graduates, who included John Fothergill, appear to have ignored the traditional Quaker prohibition against oath-taking. The first Quaker known to have signed the alternative formulation was Jonathan Binns, who graduated in 1772.

[72] 'University of Edinburgh Lauriations and Degrees', University of Edinburgh Library.

[73] Gaster, *History of the Ancient Synagogue*; R. Barnett, 'Dr Jacob de Castro'.

College, less often to King's College. Among these were Ralph Schomberg, who had studied at the University of Rotterdam, and Gumperz Levison, who had been a student at the medical school in London conducted by John and William Hunter. As medical degrees could be purchased from Aberdeen and St Andrews and required no residence qualification, they were appropriate for men like Sarmento, Schomberg, and Levison who, with a medical training and some practical experience behind them, wished to enhance their standing with a degree and a title. A rather less illustrious example is provided by Samuel Solomon (MD Aberdeen, 1796), whose fame and not inconsiderable fortune arose from the sale of a potion called, appropriately, 'The Cordial Balm of Gilead', which his acquired qualification helped to endorse. In contrast to those Jews who 'purchased' degrees from Aberdeen or St Andrews, very few Quakers followed this route, a rare exceptions being John Coakley Lettsom, who received an MD from Aberdeen in 1788, but had already been awarded an MD from the University of Leiden and had attended Edinburgh for two years.

As with Quakers in the late eighteenth and early nineteenth centuries, Edinburgh attracted many Jews who sought training in medicine, as opposed to those who merely wished to obtain a degree. Yet, unlike Quakers, those Jews who studied in Edinburgh or Glasgow would have encountered few co-religionists with whom to stay or pray. Although occasional references exist to Jews in eighteenth-century Edinburgh, the first synagogue was opened only in 1816, seven years before the synagogue in Glasgow.[74] Yet, when Abraham Raphael Mendes da Costa attended Edinburgh Medical School in 1767–8—more than thirty years after Fothergill had opened this route to Quakers—he was the first Jew to do so. Following da Costa, a further twenty-six Jews studied at Edinburgh prior to 1880, and another six studied at and graduated from Glasgow. Many of the early students were Sephardim, with Ashkenazim becoming more prominent by the early decades of the nineteenth century. Several of the students were drawn from the small Jewish communities in Glasgow and Edinburgh, and some subsequently practised in Scotland. One prominent example is Asher Asher (1837–89), a native of Glasgow, who gained his medical degree at his local university in 1855, and subsequently practised for a few years in Scotland before moving to London, where he became medical officer to the Board of Guardians. A major figure in Anglo-Jewry and Secretary of the United Synagogue after its foundation in 1870, Asher was a tireless campaigner for improving the conditions of the poor. Like several other Jewish medical men, he was licensed by the Royal College of Surgeons of Edinburgh.[75]

[74] Arnold Levy, *Origins of Glasgow Jewry*, 12.

[75] [Asher], *Some Notes and Articles*; K. Collins, *Go and Learn*.

Little is known about the experience of Jewish medical students at Edinburgh and Glasgow. Unlike Quakers, they appear to have found nothing objectionable in the wording of the oath taken at graduation, as no specifically Christian sentiments were expressed. Although a few Jews studied medicine in Scotland, they did not establish the strong link with the Scottish universities that Quakers possessed from the time of John Fothergill onwards. By contrast, Jewish medical students followed a number of different trajectories. Maurice Davis (1822–98), for example, studied medicine at the Anglican-dominated King's College London, before gaining his membership of the Royal College of Surgeons and a medical degree from St Andrews (1852). His close contemporary Henry Behrend from Liverpool, trained in London, Liverpool, and Germany, before being elected medical officer to Liverpool North Dispensary in 1851.[76]

Like Quakers, the Jewish medical students at Edinburgh exhibited strong transatlantic connections. Several were from the Caribbean, most of whom returned home to practise. The Edinburgh-born and Edinburgh-trained Louis Aschenheim (1817–58) emigrated to Jamaica in 1843, where he practised, contributed to the improvement of public health, and founded the Kingston branch of the Jews' and General Literary and Scientific Institution.[77] The link with America is further illustrated by Joseph Hart Myers (1758–1823) from New York, who, after studying at Edinburgh, graduated there in 1779, and, after continuing his studies on the Continent, returned to London to practise. Myers is noteworthy because of his close connection with Lettsom, who came from the Virgin Islands. They worked together, serving the poor at the Aldersgate Street Dispensary, and were members of the Medical Society of London, founded in 1773, which sought to provide a forum for discussion of medical issues and provided a counterblast to the slothful Royal College of Physicians, which licensed medical practice in London.[78]

During the eighteenth and early nineteenth centuries, neither Jews nor Quakers could be elected to the Royal College of Physicians, since a degree from either Oxford or Cambridge was required. Although Jews and Quakers were excluded from fellowship of the College, they could apply for licenses allowing them to practise. Thus, prior to 1860 we find approximately a dozen Quaker licentiates and several Jews.[79] Only after reforms prompted by the 1858 Medical Act did the College dispense with this restrictive practice and allow those with alternative qualifications to become Fellows, in certain cases

[76] *JC*, 16 May 1851, 254.
[77] K. Collins, *Go and Learn*, 163–4; *JC*, 30 Oct. 1846, 18; 20 Aug. 1847, 227.
[78] T. Hunt (ed.), *Medical Society of London.*
[79] Munk, *Roll of the Royal College of Physicians.*

subject to passing an examination. By contrast, the Royal College of Surgeons, which was founded in 1800, imposed no religious tests (although an oath was required on admission to Council). It therefore attracted a number of Quakers and Jews.

While some of the Jewish medical men went into private practice or worked in hospitals and dispensaries, others entered the foreign civil and military service. Thus Jacob Adolphus (MD Aberdeen, 1816) served as Inspector-General of Army Hospitals and Physician-General to the Militia Forces on Jamaica, while Joseph Marcus Joseph (MD Aberdeen, 1831) joined the India Medical Service, rising to become Deputy Surgeon-General in the Bengal Army. Except for Quakers, who eschewed connections with the military, these career patterns were not atypical for Scottish-trained medical men, who filled the ranks of the military and colonial medical service.

In contrast to the rise in numbers of Quaker medical men from early in the eighteenth century onwards, few members of the Anglo-Jewish community turned to medicine. If we omit those like Sarmento and Meyer Schomberg who were born abroad, the number is smaller still. Indeed, of the fifty-eight Jewish medical students and graduates at the Scottish universities listed by Kenneth Collins in the period to 1880, fewer than half were born in the British Isles. Approximately the same proportion practised medicine in Britain. Thus, despite the presence of a few Jewish medical men, some of whom maintained the community's philanthropic institutions, medicine was not a career that attracted many British Jews until quite late in the nineteenth century. This stemmed largely from the overriding need for Jewish families to gain economic security and social status before embarking on a secular educational training and entering the professions. Those few British Jews who did enter medicine were mainly from rising middle-class families. It was rare for a member of the Jewish aristocracy to pursue medicine, a notable exception being Nathaniel Montefiore (1818–83), a nephew of Sir Moses, who trained in surgery. However, he did not earn a living from his medical skills, but dedicated himself to the family business and to charitable works. Writing to one of his sons, he recounted his activities: 'Yesterday I had a good day[']s work at the [Jewish?] schools—an hour at Bevis Marks,—an hour at the Branch [= finance-house] and an hour at the Orphan Asylum[. S]o that was pretty good was it not.'[80] Montefiore's activities were circumscribed by his membership of the Jewish élite, and he therefore practised medicine only within the context of his philanthropy.

[80] N. Montefiore to 'Whimsey', 9 Mar., n.y., Nathaniel Montefiore letters, vol. 1, Archives of University College, London.

3.3 The University of London

3.3.1 *Mathematics at University College under Augustus de Morgan*

University College London (UCL) was founded in 1828 in direct response to the religious tests operated at Oxford and Cambridge, which acted as a deterrent to Dissenters, Jews, and others who would not subscribe. By contrast, the founders of UCL insisted that it should be non-denominational, allowing entry to members of any religious body or none. Among these founders were several Dissenters and Jews, the most prominent being Isaac Lyon Goldsmid (1778–1859), a member of the Stock Exchange and a partner in Mocatta and Goldsmid, bullion brokers. Not only did he work indefatigably to establish the College, but he also shouldered a significant share of the financial burden. The first professors, who spanned a wide range of religious positions, included Hyman Hurwitz, as Professor of Hebrew.[81] It soon became the principal institution of higher education for Jewish students, many of whom lived in London and were recruited from the College's junior department, University College School. In this subsection we focus primarily on the Jewish students at UCL during the middle years of the century, and especially those who studied mathematics under the charismatic Augustus de Morgan (1806–71), who had been appointed to the Chair of Mathematics in 1828.

The Jewish community appreciated de Morgan as the fiercest defender of the College's non-denominational stance. Indeed, his resignation in 1866 was precipitated by a controversy over the appointment to the recently vacated Chair of Moral Philosophy and Logic. De Morgan was among those who considered that James Martineau, the Unitarian minister, was the outstanding condidate, since he possessed an impressive reputation as an innovative thinker and an effective teacher. Even the College Council, in the report issued after a review of the applications, designated him 'the most eligible candidate'. Yet there had been misgivings on the part of certain Anglicans about appointing a Unitarian, whose religious outlook might influence young, impressionable minds, by challenging their safe religious principles with radical Unitarian heresies, even drawing them away from Christianity. Council, divided over whether to appoint Martineau, eventually offered the position to a less able candidate who posed no such threat. De Morgan, horrified that Council had forsaken the venerable principle of religious neutrality, resigned immediately.[82]

During his long tenure of the Chair of Mathematics, de Morgan attracted a number of Jewish students, including Jacob Waley (1819–73), who headed the

[81] Bellot, *University College*.
[82] De Morgan, *Memoir of Augustus De Morgan*, 336–58.

first, 1839, list of Bachelors of Arts at London University. Indeed, of the five who graduated that year, Waley alone graduated in both mathematics and classics, the other four graduating solely in classics. Waley was subsequently called to the Bar, and became not only an eminent lawyer but also, from 1853, Professor of Political Economy at the College. Impressed by de Morgan's stand over the issue of religious neutrality in 1866, Waley organized a letter which expressed support for his friend's action and proposed some more tangible and public form of testimonial. The nine signatories—all former pupils of de Morgan—included three Jews: Waley, George Jessel, and Joseph Solomon (another lawyer).

De Morgan was lionized by many of his students, with whom he often established close and long-lasting friendships. He was very approachable, and as Philip Magnus remembered, he 'was always in his lecture room some time before the lecture' in order to 'answer any questions, or to assist the students in solving difficulties'.[83] He also inspired a love of mathematics that his students often pursued as a pastime while following other careers, most often in law. Thus George Jessel (1824–83), the Master of the Rolls who was subsequently elected to the Royal Society, not only obtained a Gold Medal in mathematics when he graduated in 1843, but also retained a lifelong interest in the subject. Arthur Cohen (1829–1914), who also followed a high-profile legal career, likewise became an enthusiastic mathematician under de Morgan. His lectures made 'a great impression' on Cohen, who 'thought of nothing but mathematics'; indeed, he is supposed to have missed one of his examinations because he was so engrossed in contemplating a mathematical problem! 'Time and space were very indifferent to him', remarked his daughter, who recounted:

> For him there was real poetry in the combinations of pure mathematics. They were to him a kind of art, taking him out of the turmoil of politics and the grind of law. We have found scores of copy-books [among his papers] full of figures in geometry, some very elaborate and neatly drawn, others with pages of algebraic formulae, some even written within a few months of his death.[84]

UCL gained a reputation as the zenith of mathematical education in London, and it also fostered a student mathematical society, the brain-child of de Morgan's son, George, and another student, Arthur Ranyard. In the autumn of 1864 they publicized their proposal, and by the time of the first meeting had attracted twenty-seven members. At that stage the majority of members were de Morgan's students, both past and present. Recognizing the lack of a society in London for the study of mathematics, this group called themselves the London Mathematical Society (LMS) rather than the origin-

[83] Foden, *Philip Magnus*, 19.
[84] Lucy Cohen, *Arthur Cohen*, 12, 48–9, 71.

ally suggested name, the University College Mathematical Society. That the original membership included six Jews—22 per cent of the total—is of particular interest, given both the small size of the Anglo-Jewish community and the lack of an existing mathematical tradition. Five of the six—Philip Magnus, Benjamin Kisch, Marcus Nathan Adler, Numa Edward Hartog, and Lewis Solomon—had followed the route from University College School to the College itself, where they had studied mathematics, usually in conjunction with another subject. The sixth—David Lindo Alexander—had followed a less usual path. Alexander, who appears to have had no previous connection with UCL, had recently concluded his studies at Cambridge University, where he had graduated thirtieth Wrangler in the Mathematics Tripos.

The subsequent presence of many older and more experienced mathematicians among its membership indicates that the LMS quickly cast off the stigma of a student society; indeed, it was soon recognized as the main mathematical society in London.[85] The first mature recruit was Benjamin Gompertz (1779–1865), the eminent mathematician and actuary, then in his mid-eighties. By the middle of 1866 five more Jews had joined—Arthur Cohen, Michael Friedländer, Joseph Solomon, J. J. Sylvester, and Jacob Waley. With the exception of Friedländer, who later became Principal of Jews' College, they had all been students of de Morgan. In mid-1866 the LMS was undergoing significant expansion, attracting more former UCL students and also an increasing number from beyond the orbit of UCL. At that time Jews represented some 14 per cent of the membership, a proportion that declined over the ensuing decade with the deaths of some of the early members, while others resigned their membership as the Society became increasingly the domain of innovative researchers. No more Jews joined until 1875, when Charles Leudesdorf was recruited. Hence the strong Jewish presence was confined to the Society's early years.

De Morgan's Jewish students published very little mathematical research, the one notable exception being Arthur Cohen, who proceeded to Magdalene College, Cambridge. Four papers of his were published, including one in the Royal Society's *Philosophical Transactions*, which set out to generate the principal theorems of dynamics using a geometrical method.[86] Despite his enthusiasm for mathematics, Cohen embarked on a legal career, as did George Jessell and David Lindo Alexander. All three were from élite Jewish families. Although the study of mathematics at UCL held out no career prospects for

[85] Rice, 'Mathematics in the metropolis'; Rice and Wilson, 'From national to international society'; Rice *et al.*, 'From student club to national society'.

[86] A. Cohen, 'Solutions of two problems'; *idem*, 'Proof of the parallelogram of forces'; *idem*, 'On linear equations in finite differences'; *idem*, 'On the differential coefficients and determinants of lines'.

these students, it provided a gentlemanly, secular, and intellectually stimulating interval before proceeding to the Bar.

However, several other Jewish mathematics students at UCL proceeded to actuarial careers, which combined mathematics and commerce. For example, in the period between his short tenure of the Chair of Mathematics at the University of Virginia and gaining his position at UCL, Sylvester worked for the Equity and Law Life Assurance Company. Gompertz, who made significant contributions to actuarial science, gained employment with the Alliance British and Foreign Assurance Company (through the good offices of his Jewish and Quaker friends), and frequently advised various Friendly Societies.[87] Marcus Nathan Adler, one of the Chief Rabbi's sons, likewise followed the route from University College School to UCL (whence he graduated in mathematics in 1857), and then entered the actuarial profession. All three were highly respected actuaries, often holding positions in the Institute of Actuaries or the Statistical Society, to which several other Jewish contemporaries belonged. Yet, with the exception of Gompertz, who married the sister of Moses Montefiore, these Jewish actuaries were from less affluent families, and therefore required a salaried profession. Actuaries were of distinctly lower standing than barristers.

A number of Quakers also attended UCL in the middle decades of the nineteenth century, although not many of them pursued scientific subjects. Thomas William Backhouse (1842–1919), later a banker in Sunderland actively engaged in astronomical and meteorological research, is one of the few exceptions. After attending Bootham, he studied under de Morgan. Unfortunately, he does not appear to have left an account of his time in London. However, Edward Fry, who subsequently pursued a successful legal career, described de Morgan as 'very witty, and his exposition of the simple concepts of arithmetic and geometry were highly enlightening'. By contrast, John Wigham Richardson (1837–1908), who became a successful shipbuilder, recorded in his autobiography his criticisms of both Bootham and UCL. He remarked that he did not consider de Morgan to be 'very good as a teacher. He was full of his ideals [*sic*] as to the square root of −1 and we spent time over that which would have been better devoted to other branches.... But we all loved him. I seem to see him before me now with his one eye and his boots not a pair!' Yet the pragmatic Richardson clearly experienced some difficulty keeping abreast of de Morgan's lectures, and failed to find in them the intellectual challenge that inspired de Morgan's Jewish students.[88]

[87] M. N. Adler, 'Memoir of the late Benjamin Gompertz', 16.

[88] A. Fry, *Memoir of the Right Honorable Sir Edward Fry*, 43; [J. W. Richardson], *Memoirs of John Wigham Richardson*, 98.

3.3.2 *King's College*

While most of the Jews who sought a university education in the mid-nineteenth century attended the non-denominational UCL, Henry (de) Worms (1840–1903) provides an interesting exception. He was unusual not only because he attended the Anglican-dominated King's College London (KCL),[89] but also because he actively pursued studies in science and engineering, even publishing a research monograph. Born in 1840 into a respected banking family connected with the Rothschilds, and possessing strong trading links with Ceylon, he was a Privy Councillor, served as Under-Secretary of State for the Colonies (1888–92), and was raised to the peerage in 1895, taking the title of Lord Pirbright. Hitherto overshadowed by these later achievements, his early scientific education and research interests now merit greater attention. Worms entered KCL in October 1856, and spent the next four years studying in the Department of Applied Science.[90] Clearly a very able student, he obtained certificates in both Geology and Practical Chemistry, the award of the Workshop Prize for proficiency in constructing a piece of machinery, and a Certificate of Honour in the General Examination.[91] He was subsequently elected to the Royal Astronomical Society (1861) and the Geological Society, and became a Fellow of both the Statistical Society (1877) and the Royal Society (1889), this last as 'a Candidate of the privileged class'.[92]

Given the College's strong Anglican roots and orientation, King's may appear an unlikely choice for a practising Jew. Why, then, did Worms forsake the well-trodden path to UCL and instead register as a student at King's? The most plausible reason is that during the mid-1850s the engineering training at King's was far superior to that offered by UCL. The teaching staff at UCL included Eaton Hodgkinson, the Professor of the Mechanical Principles of Engineering, whose lectures have been described as 'unsuccessful', 'partly on account of a nervous hesitancy of speech', and the incompetent Richard Potter, who taught Natural Philosophy.[93] Although most other departments at King's were in the doldrums, engineering and science attracted significant numbers of students, many of whom became military or railway engineers. Among the lecturers in this area were Thomas Minchin Goodeve, who held the Chairs of Natural Philosophy and of Manufacturing Art and Machinery,

[89] Maurice Davis (1822–98), who studied medicine, also attended KCL.

[90] I have not found evidence to substantiate the claim that he 'originally intended to devote himself to medicine'; 'De Worms, Henry, first Baron Pirbright', *DNB*; M. Williams, *Leaves of a Life*, 37.

[91] Hearnshaw, *Centenary History of King's College*, 273; information kindly supplied by Elizabeth Selby, archive assistant at King's College London.

[92] Certificate EC/1889/01, RSL.

[93] Bellot, *University College*, 267.

Charles Wheatstone (Experimental Philosophy), James Tennant (Geology), and William Allen Miller—the ex-Quaker Professor of Chemistry. Goodeve, who was described as a 'highly successful' lecturer and departmental head, was largely responsible for the flourishing state of the applied sciences at King's.[94]

In addition to attending a wide range of courses in both pure and applied subjects, Worms was active in the College Engineering Society, which he joined when it was re-established in November 1857. The Society's minute-book records that at an early meeting he 'made some remarks, promising to assist the Society as much as possible, although they objected to have him as an officer or committee man'. The nature of their objection is not clear, but Worms was obviously keen to make his mark on the Society, and a few months later he achieved election to the Society's committee and was appointed one of its auditors. In June 1858 he was elected president, a position he held until April 1862. That he was re-elected on a number of occasions, and the warmth of the vote of thanks that was offered on his retirement, indicate the high esteem in which he was held.

The strength of Worms's commitment to the Engineering Society—which was known temporarily as the Engineering and Scientific Society—is evident from his contributions. He presented a number of papers, on topics ranging from the history of science to the manufacture of iron. On one occasion, in the presence of the College Principal, the Revd Dr Richard Jelf, he discoursed on the need to combine both the practical and the theoretical aspects of engineering. But the minute-books also show that he made substantial contributions to the discussion of papers presented by his fellow students. Being mature and well educated, he possessed the knowledge and confidence that enabled him to contribute effectively on a wide range of subjects. While he may have appeared intimidating to his peers, he also inspired their respect. In light of his Judaism, two of his contributions to the Society's proceedings are particularly relevant. A paper on Ferdinand de Lesseps's widely discussed proposal to build the Suez Canal created much interest: 'Mr Worms then laid before the meeting the different arguments against and for this undertaking[,] both in an Engineering, a commercial and a political point of view.' He then proposed that the canal 'would neither be feasible in an engineering point of view nor desirable for political reasons'—a proposal that was endorsed by the Society. At another meeting, a paper was read on 'English ecclesiastical architecture', following which Worms made some rather caustic remarks on the 'Anti-Christian Architecture of this country'.[95]

94 Skeat, *King's College*, 15–18; Hearnshaw, *Centenary History of King's College*, 258–61.

95 The previous two paragraphs are based on 'Minutes of King's College Engineering Society', MS KSE/M3, Archives of KCL. See also Skeat, *King's College*.

At the end of November 1859 the Engineering Society held a soirée to which many leading scientists were invited. The principal exhibit was 'a new machine illustrative of the motion of the earth'. This machine was subsequently discussed in Worms's book, *The Earth and its Mechanism*, published in 1862 and dedicated to his mentor, Charles Wheatstone. In pursuing this investigation, he examined the experimental evidence for the earth's rotation and added various related theorems. Claiming that he intended 'to promulgate a knowledge of the more recent discoveries and experiments relating to this branch of science', he divided the book into two parts, the first being 'popular and adapted to the comprehension of the general reader', while the second was for the mathematician. This second part, which occupies a 150 formula-packed pages, demonstrates Worms's commitment to mathematical analysis. He also appears to have executed the printed engravings that appeared in the book—another indicator of his practical competence.[96]

Several issues which arise principally in the first part deserve attention. The first is that Worms was clearly well-read in the current scientific literature and drew not only on Wheatstone's work but also on the writings and innovations of Jean Foucault, Giovanni Plana, Heinrich Magnus, Auguste Bravais, Peter Hansen, and Johann Bohnenberger, among others. Moreover, the two opening chapters engaged the history of astronomy through analysis of ancient and early modern texts. Worms was particularly keen to demonstrate that, contrary to the claims made by certain other writers, the ancients did not espouse the heliocentric system. Instead, he argued, the Copernican system was the product of early modern rationalism. He also chastised those superstitious bigots who, in supporting Aristotelianism, had criticized Galileo's science. The Bible, he argued, was not intended to teach science, and such passages as Joshua's command that the sun stand still possessed no relevance for science. Worms was attracted to the problem of experimentally justifying the earth's motion, because it demonstrated the triumph of science over superstition. Yet, despite his advocacy of reason, it is clear that he viewed science within a generalized religious framework, since he referred to 'the Almighty hand' that had created the earth and 'the Creator [who] had covered this earth with animal and vegetable life'.[97]

In his book Worms discussed several experiments that demonstrated the earth's motion. His exposition was clear, but essentially derivative. However, his use of the pendulum to determine the earth's rotation—and thus his rationale for writing the book—should be interpreted in the context of an

[96] Worms, *Earth and its Mechanism.* This was reviewed in the *JC*, 21 Nov. 1862, 7, and by Augustus de Morgan (*Athenaeum*, 3 Jan. 1863, 16–17), who criticized Worms's judgement on a couple of issues relating to both physics and the history of astronomy.

[97] Worms, *Earth and its Mechanism*, 28.

important problem in contemporary science. In 1851 Foucault had reported on his famous experiment using a lengthy pendulum; he observed that the plane of oscillation was not constant, but changed continually in a manner reflecting the daily rotation of the earth. Several other investigators, Worms included, subsequently repeated Foucault's experiment with minor modifications. The main hall at KCL was the site of Worms's experiment, performed before 'a large number of spectators' on an unspecified date in 1859, but probably at the Engineering Society's soirée on 30 November. A spherical brass bob weighing 40 pounds was suspended from a thick steel wire, the length of the pendulum being 17 feet, 9 inches. He made a number of minor improvements to earlier performances of the experiment, his most ingenious innovation being the construction of three devices that made small changes in the plane of oscillation visible to the assembled spectators. One was the positioning of small wooden cones that were violently ejected when struck by the heavy brass bob. A second was a visual method that enabled the audience to see the progress of the bob at the extremity of its oscillations. Finally, and most dramatically, Worms arranged an electrical circuit that fired a cannon when the bob reached a particular position. These methods of demonstration illustrate Worms's practical ingenuity and showmanship.

It is not clear why Worms chose to study a combination of the pure and applied sciences in preference to mathematics, which attracted a number of contemporary Jewish students to UCL and to Augustus de Morgan. Despite following a different educational path from these co-religionists, he too soon turned to law. He entered the Inner Temple, and was called to the Bar in 1863.

3.4 Cambridge and Oxford

Prior to the mid-nineteenth century, both of the ancient English universities operated religious tests, but in different ways. At Oxford a student had to subscribe to the Thirty-Nine Articles of Faith at the time of admission, whereas Cambridge allowed non-Anglicans to enter, but not to graduate. Thus non-Anglicans could enjoy a Cambridge education, but very few did so. Committed Friends, for example, would not have sent their sons to such an un-Christian institution. Yet, to effect their escape from the Quaker community, a few birthright Quakers were willing to cross this manifest religious divide. For example, the upwardly mobile Thomas Young (1773–1829) entered Emmanuel College, Cambridge, early in 1797, with the intention of gaining a Cambridge MD that would enable him to proceed to the much-coveted fellowship of the Royal College of Physicians. At that time he was still formally a Quaker. However, early in 1798 he was disowned, and he soon converted to Anglicanism, which enabled him to proceed with his intended career in medicine.[98] Another example is James Cowles Prichard (1786–1848) who, after being apprenticed to a Quaker pharmacist, studied in Edinburgh and was awarded his degree in 1806. He then entered Trinity College, Cambridge, where, according to his biographer, 'he must have spent a portion of his time on theology; for it was at this period of his life that, on the ground of conviction, he separated himself from the Society of Friends' and became an Anglican. He subsequently moved to Oxford, first joining St John's College, later transferring to Trinity College as a gentleman commoner. 'Knowledge, not title, was his object', added his biographer, since he did not seek a degree from Oxford.[99]

In contrast to practising Quakers, a few Jews were drawn to the two ancient English universities, principally because they offered employment. Since both universities trained the clergy, teachers of Hebrew were in demand. As early as 1540, a Regius Chair of Hebrew had been founded in Cambridge, and in Oxford six years later. Although Jews could not hold these positions, Jews proficient in Hebrew might find employment as private teachers or college lecturers. Among teachers of Hebrew were several practising Jews, including Isaac Abendana (in the seventeenth century) and Israel Lyons sen. (in the eighteenth), and also converts to Christianity such as Judah Morris.[100] The ancient universities also occasionally provided less formal opportunities for Jews, despite debarring them from official positions. Israel Lyons the younger (1739–75), who may not have been a practising Jew, was patronized by Robert Smith, Master of Trinity, who encouraged him in his mathematical and botanical studies. The influential naturalist Joseph Banks also arranged for Lyons to deliver a course of lectures at Oxford in 1764.[101] A few years later Emanuel Mendes da Costa, who was desperately seeking lecturing engagements, petitioned the Vice-Chancellor at Oxford to be allowed to lecture on fossils. His approach was via Thomas Hornsby, the Savilian Professor of Astronomy, who subsequently informed da Costa that although the Vice-Chancellor had initially expressed interest, after discussing the matter with others he had decided that 'the course of Lectures proposed to be read by Mr Da Costa could not be read here with propriety'—whether the lack of propriety arose from da Costa being a Jew or from some other cause is not clear. Later still, in 1784, a correspondent of da Costa's investigated on his behalf the possibility of a lecture course in Oxford. However, replied his

[98] Minute of the Westminster Monthly Meeting, 15 Feb. 1798, LSF; A. Wood, *Thomas Young*.

[99] Hodgkin, 'Obituary of Dr Pritchard', 187; Symonds, *Some Account of... James Cowles Prichard*.

[100] Roth, 'Jews in the English universities'; Frankel and Miller (eds.), *Gown & Tallith*.

[101] Glyn, 'Israel Lyons'.

correspondent, he had been informed that 'the study of Natural History is very little pursued in Oxford'.[102]

The repeal of parts of the Test and Corporation Acts in 1828, followed by the Catholic Emancipation Bill of 1829, encouraged reformers that non-Anglicans would soon be able to enter Oxford and take degrees at both of the ancient universities. Owing to concerted opposition, these reforms were defeated initially, but over the ensuing quarter-century the pressure increased to reform many aspects of university organization and education. In the mid-1850s parliament passed legislation requiring both universities to undertake extensive changes, including the removal of religious tests at matriculation and graduation: Oxford removed the requirement for subscription to the Articles in 1854, and Cambridge followed two years later. Thus in principle the universities were now open to non-Anglicans, who could both matriculate and graduate.

However, even after these reforms, colleges still exerted considerable discretionary powers. As Cecil Roth has argued, 'the removal of restrictions on the admission of Jews to the University did not immediately do away with all obstacles so far as the individual colleges were concerned'.[103] As largely independent, self-governing bodies, colleges could determine whom to admit. Moreover, even after admission, non-Anglicans often faced difficulties. For example, since attendance at chapel was considered the norm, anyone wishing to be excused had to obtain permission from the Master. As William Whewell, the long-serving Master of Trinity, asserted, it was totally at the Master's discretion whether a grace would be granted allowing a non-Anglican student exemption. Yet Trinity had no consistent policy; one member of the Rothschild family, who was admitted in 1859, was exempted from chapel attendance only after his father and his tutor petitioned Whewell. Whewell's response showed little understanding of the student's situation: 'I have taken into consideration your wish that your pupil, Mr Rothschild, should be excused attendance at chapel on the ground, I presume, that he has no sympathy with Christian prayers, and that Christian worshippers might prefer his absence.'[104]

Non-Anglicans were also likely to encounter prejudiced attitudes among both staff and students. Sylvester, for example, was taunted over being a Jew during one dinnertime at Hall, 'lost his temper and threw a plate or dish at the

[102] Thomas Hornsby to Da Costa, 29 Mar. 1774, and John Ibbotson to Hornsby, 5 Apr. 1774, in Nichols, iv. 516–18; W. van Mildert to Da Costa, 10 June 1784, ibid. 787–8.

[103] Roth, 'Jews in the English universities', 112.

[104] Cited in Winstanley, *Early Victorian Cambridge*, 83. Winstanley identifies the student as Alfred de Rothschild, who was admitted in 1861, whereas his brother Nathaniel Mayer de Rothschild was admitted in 1859.

offending person's head'.[105] A not unrepresentative example of institutional conservatism is the view expressed by Edward Henry Perowne, a committed evangelical and Fellow at Corpus Christi, Cambridge. Speaking in 1870 before the Select Committee on Religious Tests, he reminded the committee that 'my own college and many other colleges are essentially religious houses'. Hence, he argued, the Head and Fellows of the college must be members of the Church of England. Although he was prepared to admit Dissenters to the student body, this was no concession. For admission to the College the Master required a certificate of baptism and, if signed by a Dissenting minister, Perowne pointed out that the student was excommunicated from the Church of England and was therefore ineligible to receive Communion. In his experience all students who had entered Corpus as Dissenters left as Anglicans. He therefore favoured retaining the *status quo*, since graduates wishing to proceed to college fellowships would simply conform, 'for political purposes'.[106] For their part, committed Dissenters avoided inflexibly Anglican colleges, while Jews steered clear of some of the devoutly evangelical ones. Evangelicals were keen to avail themselves of the numerous pulpits in both university towns, in order to spread their message. As one Cambridge Anglican recorded in his diary in 1841: 'A great deal in the Jew-converting line today:—3 sermons!'[107]

James Joseph Sylvester (1814–97) was among the very few Jews to study at Cambridge before 1856. He entered St John's College as a sizar (being in receipt of a scholarship) in 1831, but was forced to leave in 1833 owing to illness, and was subsequently placed second in the 1837 Mathematics Tripos. This examination had become the primary intellectual competition at Cambridge, and each year the most able students vied for the highest places. (The top rank consisted of Wranglers, followed by the Senior Optimes, and then the Junior Optimes.) Since the religious tests prevented Sylvester from graduating at Cambridge, he left without a degree, but was awarded one by Trinity College, Dublin.[108]

Following the reforms of 1856, one of the first Jews to pursue the Mathematics Tripos was Numa Hartog (1846–71), who obtained the coveted position of Senior Wrangler in 1869. The *Jewish Chronicle* acknowledged Hartog's success: he had 'achieved the highest academical distinction known in this country—viz., that of the Senior Wranglership—and . . . is the first Jew that has ever gained this distinction'. Hartog possessed the sang-froid to press his claim to graduate, in order to be considered for the Smith's Prizes—another

[105] A. T. Brown, *Some Account of the Royal Institution School Liverpool*, 51.
[106] Bury, *College of Corpus Christi*, 56–8.
[107] *Romilly's Cambridge Diary*, 222.
[108] On Sylvester see A. T. Brown, *Some Account of the Royal Institution School Liverpool.*

highly coveted award among mathematicians. Moreover, he was prepared to graduate only on terms that would not compromise his religion, and therefore petitioned for an acceptable form of words. The Vice-Chancellor and Senate agreed simply to confer on him the title of Bachelor of Arts. 'The significancy [*sic*] of this event', argued the *Jewish Chronicle*, 'lies in the concession so nobly and so gracefully made by the University authorities that be to religious liberty, the BENJAMIN of modern civilisation, and the demands of an enlightened age.'[109] Although Hartog obtained the second Smith's Prize, he could not proceed to a college fellowship, as expected after such an impressive display of mathematical ability, because he would have to profess himself a member of the Church of England. '[H]is Senior Wranglership is likely to be a barren honour so far as college preferments are concerned', complained one newspaper.[110]

Although the Protestant Dissenting Deputies (who lobbied for the repeal of discriminatory legislation) and the Dissenting press had long urged the need for change, Hartog's well-publicized case fuelled the argument.[111] Such an apparent injustice attracted much sympathetic comment. Two interesting issues emerged in the *Jewish Chronicle*'s coverage. First, the editor, Michael Henry (1830–75), pointed out that many non-Anglicans took the easy route and subscribed to the Thirty-nine Articles out of convenience rather than conviction. This was not, he claimed, the way to build a strong Anglican Church but rather to encourage moral laxity.[112] His other argument bore directly on science:

> Science is surely not held to be purely a Christian patrimony. If it has any connection with religion at all, it is first Pagan, and next Jewish. The Church, with all her might, and through all her history, strove to keep down science as long as she could. Nor are there even now wanting consistent prelates who, imbued by the spirit of the Mediæval Church, hold science in contempt, decry it whenever opportunity occurs, and, if they could, crush it out of the curriculum of education.[113]

Although this is certainly not a balanced historical view, it interestingly aligned Hartog's struggle with Galileo's defence of the Copernican system against his clerical opponents. It also associated science with both paganism and Judaism. From this perspective, it is pertinent that the challenge to the *status quo* should come from a Jew and a scientist.

[109] *JC*, 29 Jan. 1869, 5; 5 Feb. 1869, 2, 4.
[110] Quoted in *JC*, 12 Feb. 1869, 5.
[111] Manning and Greenwood, *Protestant Dissenting Deputies*, 372–9.
[112] *JC*, 2 Apr. 1869, 9.
[113] *JC*, 26 Feb. 1869, 2.

Within a few weeks John Coleridge, the Solicitor-General in Gladstone's new administration, introduced a bill to remove the tests. Although successful in the House of Commons, it was defeated in the Lords. Throughout the ensuing months, the pressure increased, with public meetings, ballots among university dons, and articles in the press. Revocation of the tests was raised in parliament on several subsequent occasions, but was again defeated by the Lords in 1870. Believing that the tide was turning, Gladstone brought the bill back to parliament in February 1871. There followed months of intense debate in both Houses. The Marquis of Salisbury, a staunch opponent, urged the House of Lords to appoint a select committee to determine whether there were sufficient safeguards to ensure 'the maintenance of religious instruction and worship and for the religious character of [university] education'.[114] Hartog was among those called to give evidence. Despite concern within the Jewish community that the Lords would again torpedo the bill, the Commons firmly rejected the committee's proposed amendments, which included the proposal that professors should not teach anything contrary to Holy Scriptures. When the legislation returned to the Lords, Salisbury was outvoted, and in June 1871 the university tests were finally repealed, and Jews, Dissenters, and even atheists could compete with Anglicans for posts at Oxford and Cambridge.

3.4.1 *Jews at Cambridge*

Todd Endelman has argued that the sons of élite Jewish families saw no advantage in pursuing a university education. These London-based families had achieved their considerable wealth principally in the City of London, in such areas as banking, insurance, and the stock market. Sons usually followed fathers into the family business, and although they were often moderately well educated, neither university attendance nor a university degree would advance their careers. Moreover, since these families already moved easily in the upper echelons of English society, education was not important to them as a means for social advancement.[115] Yet, while acknowledging their commitment to business and to the community, I shall argue that the patterns of education among the Jewish élite were more complex.

Prior to the mid-1850s, a small number of Jewish students entered Oxford and Cambridge. Some were converts or in the process of converting. For example, one of Meyer Schomberg's sons, Isaac, was admitted to Cambridge in 1746/7, a year before he was baptized. Again, in the 1830s Thomas Bailey

[114] *Times*, 14 Feb. 1871, 4.
[115] Endelman, 'Communal solidarity'.

Levy and his brother George Levy studied at Oxford, and both were later appointed Anglican clergymen.[116] Yet other Jewish students, like Sylvester and Arthur Cohen, entered Cambridge with no intention of converting and in the knowledge that they could not graduate. Cohen, who was from a wealthy, élite family and had studied at UCL, was encouraged to enter Cambridge by his family and by Baron Lionel de Rothschild. However, 'there were great difficulties on account of his religion. He could not be admitted to Trinity, but Sir Moses Montefiore, his uncle, at last approached the Prince Consort [Albert], through whose influence as Chancellor of the University he entered [Magdalene] as a fellow commoner.'[117] Despite this unconventional beginning, the 'handsome Jew' was clearly popular among the student body, and thrived on his mathematical studies and on sport. He also became Secretary to the Cambridge Student Union in 1852, and its President in the following year.[118] As a fellow commoner, Cohen had no intention of taking a degree—indeed, the religious tests prevented him from graduating—but he had the right to dine with the Fellows at Magdalene. In 1853 he sat the Mathematical Tripos, achieving the position of fifth Wrangler. Cohen had aimed at the ultimate position of Senior Wrangler, but slipped down the list, having 'given too much time to light literature and rowing'.[119] Andrew Warwick has likened the competition to become Senior Wrangler to the whole-hearted pursuit of manly sports at Cambridge (cf. Harold Abrahams in the film *Chariots of Fire*). Students, who often hired mathematics coaches, required superhuman dedication, and had to abandon other activities, such as reading literature and rowing. However, critics of the competition considered it detrimental to a rounded education.[120]

Following the 1856 Act that enabled non-Anglicans to graduate, several Jewish students from the social élite entered Cambridge but did not graduate, presumably for the reasons suggested by Endelman. For example, of the five Rothschilds who matriculated between 1859 and 1895, three did not graduate. One of the two who did was (Nathaniel) Charles (1877–1923), who attended Trinity (his father's college) in 1895. However, he gained a poor third class degree in the Natural Sciences Tripos, despite earning high praise from the Professor of Zoology, and subsequently entered the family's banking business. While pursuing a conventional commercial career, he became a respected

[116] Roth, 'Jews in the English universities'; Frankel and Miller (eds.), *Gown & Tallith*.

[117] Lucy Cohen, *Arthur Cohen*, 13. It is unclear why he was rejected by Trinity College.

[118] The first Jewish President of the Cambridge Union was Alfred Hyman Louis from Birmingham, who matriculated at Trinity College in 1847. He was forced to withdraw from Cambridge in 1850 owing to ill health.

[119] Lucy Cohen, *Arthur Cohen*, 16.

[120] Warwick, 'Exercising the student body'.

conservationist, amateur entomologist, and an expert on fleas.[121] His older brother (Lionel) Walter (1868–1937) had entered Magdalene College in 1887 with the intention of pursuing the Natural Sciences Tripos. But he did not thrive academically at Cambridge, far preferring amateur dramatics, ornithology, and lepidoptery. After two years he turned his back on Cambridge and returned to the family home at Tring, where he obsessively built up one of the most extensive natural history collections in the country, while neglecting the family business.[122] Cambridge also attracted Jewish students from less affluent families. In the pre-1856 period, the paradigm example is Sylvester, who, unlike Cohen, entered Cambridge as a sizar and subsequently had to create a career and earn a living from mathematics. Among the post-1856 Jewish students were the Hartog brothers Numa and Marcus (who sat the Natural Sciences Tripos and became a botanist and zoologist), whose father was a teacher of French. The Rothschilds appear to have financed their studies.

One particularly informative example is provided by Phoebe Sarah Marks (otherwise Hertha Marks), the daughter of a poor watchmaker from Portsea, who initially studied with the Hartog family in London. Mixing with women of progressive views and becoming increasingly distant from her religion, she entered Girton in 1876, where she focused on mathematics and science subjects, but could not graduate. She subsequently studied applied science at Finsbury Technical College, where she met William Ayrton, one of the professors, whom she later married. She is now celebrated as one of the first women to pursue a research career in science, her initial scientific papers being on the electric arc. Her trajectory is interesting, because her repudiation of religion and her commitment to agnosticism were closely allied to her scientific and intellectual odyssey. These strands can be traced back to before her time at Girton. As one fellow student later noted, many of her contemporaries were repelled by 'her advanced opinions and want of religion'.[123] Unlike any of her Jewish, male contemporaries at Cambridge, she adopted a strong independent line on politics, religion, and science.[124]

During the closing decades of the nineteenth century a Cambridge education was an attractive proposition to an increasing number of Jews. Cambridge could enhance their intellectual standing and career prospects. For some, too, it could aid escape from the Jewish community. While Endelman is correct in claiming that the 'offspring of Anglo-Jewish magnates did

[121] Jordan and Rothschild, *Ectoparasites*.

[122] Rothschild, *Dear Lord Rothschild*.

[123] Sharp, *Hertha Ayrton*, 55. Amy Levy (1862–89), her contemporary at Cambridge, violently criticized the Jewish community in her novel *Ruben Sachs*.

[124] Rothschild, *Dear Lord Rothschild*.

not for the most part abandon the City for new spheres of activity that, in other national contexts were considered more prestigious, such as law, medicine, the civil service, and the university'[125]—to which we might add science—the examples offered above indicate that some sons of élite families were attending institutions like UCL and Cambridge, and that some of these studied the sciences and mathematics. More interesting still were those students from non-élite families who turned to science as a career.

3.4.2 *Quakers at Cambridge*

In the years following the 1854 and 1856 Acts, very few Quakers attended either Cambridge or Oxford, and even the repeal of the remaining religious tests in 1871 had little immediate effect.[126] Interestingly, Quaker women arrived in Cambridge before their brothers. The College at Hitchin was founded in 1869, with strong Quaker support, and moved to Cambridge, becoming Girton College, in 1871, the same year that Newnham was founded. A number of Quaker women were among the first cohorts to enter these colleges, which enabled female students to pursue their studies alongside male students but without conferring eligibility for university degrees. Several of these Quakers studied science or mathematics. For example, Sarah Woodhead, one of the earliest students at Hitchin, was an accomplished mathematician who proceeded to the Mathematics Tripos. A few years later Margaret Chorley Crosfield proceeded from the Mount School to Newnham, where she read geology, but was soon forced to abandon her studies owing to ill health.[127] Only in the early 1880s were a significant number of male Quakers admitted to the University. One crucial indicator of an enlarged Quaker presence was the reopening of the Cambridge Meeting in 1884, after a lapse of several decades. John William Graham (1852–1932), who was studying for the Natural Sciences Tripos, records that after hearing that the old meeting-house was for sale, he consulted the respected Quaker minister Joseph Bevan Braithwaite, and they managed to generate a list of Quakers, from both within and outside the university, that justified reviving the Meeting. At that time (*c.*1883) there were approximately ten Quaker students, including three women at Newnham College (one of whom was studying for the Mathematics Tripos and another the Natural Sciences Tripos). The presence of a Quaker Meeting doubtless

[125] A comparable literary figure is Amy Levy; see n. 123.

[126] E.g. John Tindall entered Oxford, from Bootham, in 1866, and William L. Barclay, a member of that banking family, matriculated at Trinity Hall in 1865. Edward Alfred Pease entered Trinity College in 1876. It is not clear whether he was a practising Quaker; his biography claims that he became an Anglican, but gives no date. J. G. Pease, *Wealth of Happiness*, p. xiii.

[127] *Girton College Register*; *Newnham College Register*.

made Cambridge more attractive to potential students. By 1887 the Quaker student body almost doubled to eighteen, and numbers continued to rise during the closing years of the century.[128]

The reason why Quakers, especially male Quakers, did not enter Cambridge during the quarter-century between the 1856 Act and the early 1880s reflects the sect's insularity. One indication is the almost total lack of coverage in the Quaker periodical press of either the parliamentary debates over the repeal of the religious tests in the mid-1850s and early 1870s or of the changes that resulted.[129] This evidence suggests that contemporary Quakers saw little value in the education offered by Cambridge or Oxford. Most of the Quakers who pursued university-level studies during the third quarter of the century either continued the medical tradition or studied for the external London degree to complete their training as teachers. However, in the wake of the schism with the Manchester rationalists and the Unitarians, during which the evangelical wing asserted its control over the Society of Friends, moderate Quakers adopted a more outward-looking stance. Dissatisfaction with the Society's intellectual insularity eventually found expression in an educational conference in 1879 at which 'a discussion of great interest [took place] on the importance of not overlooking the educational requirements of those Friends who look for the highest educational advantages for their children'. Several speakers supported this viewpoint, including Alfred Bennett, who argued that Quakers had not availed themselves sufficiently of the education offered by UCL, Cambridge, Oxford, and the German universities. Such institutions were of educational value, he insisted, not only because they provided students with greater knowledge than could be obtained from studying at the Flounders Institute, but also because students could gain 'that wider experience which can only result from intercourse with mankind', and not just from liaising with other Friends. Although some participants at the conference expressed their concern that students who attended such institutions of

[128] Graham, 'Reminiscences'; Brown and Peckover, 'Brief history of the Cambridge Meeting'. See also Box 1, John William Graham Papers, John Rylands Library, University of Manchester.

[129] One Quaker response to the 1854 and 1856 Acts was that, although they enabled Quakers to enter and take degrees at the two ancient universities, they were inadequate because religious tests still remained for appointments to university posts. This response was implied in a table published in 1898 summarizing the growth of religious liberty. Here the 1854 and 1856 Acts were described as the 'partial removal of religious tests', whereas the 1871 Act removed religious tests from the universities of Oxford, Cambridge, and Durham. (See Rowntree, 'Place of the Society of Friends'.) According to Rufus Jones (*Later Periods of Quakerism*, i. 702): 'In 1871 the religious tests which prevented dissenters and nonconformists from attending Oxford and Cambridge were removed, and from this period onward Friends began to go in ever-increasing numbers to these universities.' Yet this is not a satisfactory explanation, since Quakers had studied medicine at Edinburgh for more than a century before academic positions in the Scottish universities were opened to Dissenters.

higher education might abandon the Society, it was agreed to initiate a scheme that offered two scholarships (worth £100–150) each year, enabling Quakers to proceed to a university education. The conference reflected the increasing desire that the Society should be less insular and should engage the intellectual issues of the day. Its recommendations, together with the practical assistance offered by these scholarships, positively encouraged Quakers to attend universities, especially Cambridge.[130]

Those late nineteenth-century Quakers who attended the ancient English universities strongly favoured Cambridge over Oxford, and two of the Cambridge colleges in particular. Trinity College attracted a number of Quakers, including several who studied for either the Natural Sciences or the Mathematics Tripos. The choice of Trinity appears to have been partly due to its mathematical and scientific reputation. That Isaac Newton and many other eminent mathematicians and scientists had attended Trinity may have increased its attraction to such Quakers as Francis Wall Oliver (son of the Daniel Oliver, Professor of Botany at UCL), who studied there from 1883 to 1886, and Arthur Stanley Eddington, who entered the college in 1902. Moreover, Whewell's successor as Master—from 1868 to 1888—was William Hepworth Thompson, who had grown up in York and was largely responsible for reforming the College's statutes so as to remove impediments to non-Anglicans. By contrast, some of the other college heads had tried to hinder reform.

More surprisingly, as L. P. Wilkinson has noted, King's College soon became the favourite college choice for Quakers. Until 1861 King's recruited almost exclusively from Eton. Although the College's new statutes of 1861 opened it to pupils from other schools, and swept away some other anomalies, eighteen years passed before the College admitted its first Quaker—Frank Morley, who later became Professor of Mathematics at the Johns Hopkins University. He was soon followed by other Quakers, and of the eighteen Quaker students at Cambridge in 1887, eight were Kingsmen. It is not clear why King's achieved such popularity among Friends. Wilkinson suggests that the friendship between Henry Bradshaw, the college librarian, and the Quaker Pease family from Darlington was responsible.[131] However, since a number of contemporary members of the extended Pease family attended Trinity College (and a few entered Trinity Hall), the connection with King's via Bradshaw does not appear a very convincing explanation.

Although King's attempted to discard its élitist image by admitting non-Etonians in 1861, it also addressed its intellectual shortcomings, and in

[130] *Report of the Educational Conference*, 115, 125–44, 173–5.
[131] Wilkinson, *Century of King's*, 30–1; *idem*, *Kingsmen of a Century*, 14–18.

particular the absence of tutors in either science or mathematics. During the ensuing two decades, King's initiated major academic reforms that resulted in its reputation as one of the most innovative and least hidebound colleges. Paradoxically, despite its long-term association with Eton, it became one of the colleges least beholden to the gentry, aristocracy, and the public schools. It admitted pensioners; the first two, who were appointed in 1865, were mathematicians, whose presence was intended to raise the College's standing in mathematics. Further evidence of the College's commitment to academic values was its decision a few years later that all students should sit the Tripos examinations leading to honours degrees. Relations between Fellows and students were good, and the College inculcated a high degree of religious tolerance. King's was the first Cambridge college to remove the requirement to attend weekday chapel. Although a fashionable clique of ex-Etonians continued to exist, their influence declined as the College attracted increasing numbers of students with intellectual aspirations, including Dissenters and even a few committed atheists. Thus the Quaker contingent would have found a wide diversity of opinion within the College and would not have felt isolated, as they would in the more traditional colleges. Yet, Karl Pearson (1857–1936), who had already shed his Quaker heritage and become a strident free-thinker, could still find fault with the statutes at King's. In 1878, during his third year at the College, he refused to sit the compulsory divinity examination and managed, with his father's help, to persuade the College to abandon these examinations.[132] His actions, in turn, smoothed the way for subsequent Quaker students.

The Quaker contingent was atypical, since it included an unusually high proportion of northerners from such industrial cities as Sheffield, Darlington, and Newcastle. Moreover, although some of the less strict Quaker families sent their children to English public schools, many of the Quakers who entered Cambridge during the final quarter of the nineteenth century had been educated at Quaker schools, principally Bootham, Ackworth, Kendal, and Oliver's Mount School in Scarborough. Several of these students had also studied at the Flounders Institute shortly before admission to Cambridge. Being products of the Quaker school system, which placed less emphasis on classics than did most public schools, Quaker students were particularly receptive to the sciences, and many of them studied the natural sciences or mathematics. Thus Frank Morley became the eighth Wrangler in 1883, and Eddington succeeded as first Wrangler in 1904. Among the Quakers to pursue the Natural Sciences Tripos, in one or both of its parts, were Francis

[132] Private communication from Eileen Magnello, who is writing a biography of Pearson and to whom I am much indebted.

Oliver (Trinity, graduated 1886), Hugh Richardson (King's, 1887), Herbert Jones (King's, 1890), John Doncaster (King's, 1894), and Joseph Barcroft (King's, 1896).

A number of the Quakers who studied at Cambridge were from wealthy families, such as the Peases, Rowntrees, Doncasters, Mounseys, and Gillettes. The sons of bankers and successful businessmen, they too often became bankers and businessmen. Some of these sons of the Quaker aristocracy drifted away from the Society of Friends. For example, Alfred Edward Pease, who had attended Grove House School, was admitted to Trinity College in 1876, two years before his brother Joseph. Although Alfred 'took a fairly desultory interest in the subjects he had to read up', fox hunting was his passion. The Pease brothers brought with them 'a groom and valet, three hunters and terriers'. Much of their time at Cambridge was spent at various local hunts, and Alfred was appointed Master of the Cambridge Drag Hounds.[133] By contrast with the profligate Peases, most Quaker students were the sons of schoolmasters and small manufacturers, and those who studied mathematics and science were intent on science-related careers.

By the mid-century some new career routes were becoming established. Among those Bootham pupils who proceeded to higher education, medicine was the preferred subject. Even after the mid-nineteenth century, Edinburgh remained popular for medicine, but Boothamites also studied at St Bartholomew's Hospital (London), UCL, and Dublin. For those pursuing non-medical subjects, the new northern colleges—Manchester, Leeds, Durham, and Newcastle—were popular, as they were often close to home and did not discriminate on religious grounds. The opening of Dalton Hall, a specifically Quaker residence, in 1876 provided a further incentive to study in Manchester. Although the Flounders Institute was established as a training college for Quaker teachers, some of its students either sat the University of London BA degree or subsequently proceeded to other institutions of higher education.[134] For example, Silvanus Phillips Thompson (1851–1916), who had been a student at Bootham, studied at the Flounders Institute, gaining his BA in 1869. He then returned to Bootham as a teacher, but in 1875 he commenced his advanced scientific studies at the Royal School of Mines in South Kensington, a move that marks the start of his successful scientific career.[135] During the final quarter of the century, and particularly after the 1879 educational conference, significant numbers of Quakers entered the universities.

[133] Not surprisingly, Pease subsequently resigned from the Society of Friends. A. E. Pease, *Half a Century of Sport*, 12–20; J. G. Pease, *Wealth of Happiness*, 10–13.

[134] According to the *Bootham School Register*, 46, William Henry Brown was the first Flounders student to take a London BA (1862).

[135] Thompson and Thompson, *Silvanus Phillips Thompson*, 7–19.

This new generation of university-educated Quakers exerted a considerable impact on the Society of Friends during the closing years of the century. They were not only well educated and socially at ease with non-Quakers, but also outward-looking and increasingly uncomfortable with the dominant evangelicalism. One of the first Quakers to attend Cambridge was John William Graham, a Kingsman who studied for the Natural Sciences Tripos and later became principal at Dalton Hall.[136] He was, according to Kennedy, one of the key figures in the liberal Quaker revival of the 1880s and 1890s.[137] Likewise, as we shall see in Chapter 7, Thompson and George Stewardson Brady were among the other scientifically educated Friends who vocally pressed for reform. The exposure of Friends to secular education, especially in the sciences, thus affected the direction of Quakerism, and encouraged the rejection of its evangelical mould.

3.5 Scientific and science-related careers

The educational routes discussed in previous sections played an important role in the spread of science and of scientific modes of thought to the Quaker community and, more slowly, to Anglo-Jewry. Moreover, both Quakers and Jews were able to pursue the study of medicine, often leading to careers as apothecaries, surgeons, or physicians, as noted above. A small number, however, pursued other forms of scientific or science-related careers. It is to these that we now turn.

The problems associated with creating a scientific career in the eighteenth century are illustrated by the struggles of Emanuel Mendes da Costa (see section 5.2), who traded in scientific specimens, lectured on fossils and shells, and also for a five-year period held the post of Clerk at the Royal Society. He was one of the very few Jews to have been a professional scientist, in the sense of making a living from science—an aim in which he was only partially successful. The only other significant pre-1850 examples are Israel Lyons jun. and Nathaniel Wallich, both of whom appear to have drifted away from Judaism. At Cambridge Lyons pursued mathematics, botany, and astronomy, published a *Treatise on Fluxions* in 1758 and, five years later, a new edition of *Fasciculus Plantarum circa Cantabrigiam*. In 1773 he was appointed by the Board of Longitude as superintendent astronomer on a voyage to the North Pole, but subsequently he became embroiled in a controversy over the data he

[136] Graham did not sit the Tripos examination owing to ill health.
[137] Kennedy, *British Quakerism*, 141–3.

obtained. Evidence from the closing years of his short life—he died in 1775—suggests that he became 'very debauched'.[138]

By contrast, Wallich (1786–1854) was from a merchant family in Copenhagen, and had studied at his home university. In 1814 he joined the East India Company as a surgeon, and later obtained a medical degree from Aberdeen. His scientific career began in 1815 with his appointment as superintendent of the Calcutta Botanic Gardens. He was later appointed to the Chair of Botany at Calcutta Medical College and published extensively on the botany of India, probably his most famous work being the three-volume *Plantæ Asiaticæ Rariores* (1830–2). He became a member of both the Royal Society and the Linnaean Society, being particularly active in the latter after his return to London in 1847.[139]

A small number of Jews and Quakers became opticians, an occupation that required a knowledge of optics and a high level of technical skill in grinding lenses and constructing optical instruments. By the 1830s Jewish opticians were to be found not only in London but also in many other cities. For example, Alexander Alexander (whom we will encounter in section 8.3) built up a successful practice in Exeter, Solomon Marks plied his trade in York, David Cohen in Newcastle, and various members of the Abraham family in Liverpool. During the second half of the century, William Aronsberg pursued a flourishing business in Manchester as an optician and scientific instrument maker.[140] Probably the most celebrated Quaker optical instrument makers were the brothers Richard and Joseph Beck, who traded in London as Smith, Beck & Beck, and later as R. & J. Beck, and were particularly famed for their microscopes. The Beck brothers were nephews of Joseph Jackson Lister, who pioneered the achromatic microscope and who helped them (and their business partner James Smith) introduce a number of improvements in the design of microscopes.[141]

Quakers pursued other science-related—especially botany-related—careers that were acceptable as 'innocent trades'. In the eighteenth century Quakers became horticulturalists, traders and collectors of plants, botanical illustrators, and publishers of botanical periodicals. For example, Peter Collinson (whom we encounter in section 5.2) developed a prosperous business importing exotic plants from North America. His business activities involved other Quakers, especially John Bartram and his son William, who collected

[138] Glyn, 'Israel Lyons'; I. Lyons, *Treatise on Fluxions*; *idem*, *Fasciculus Plantarum circa Cantabrigiam*.

[139] Wallich, *Plantæ Asiaticæ Rariores*; Desmond, *European Discovery of Indian Flora*, 81–98.

[140] Clifton, *Directory of British Scientific Instrument Makers*; B. Williams, *Making of Manchester Jewry*.

[141] Beck, *Treatise*; G. L'E. Turner, *Great Age of the Microscope*, 171.

and exported botanical specimens. It has been claimed that the elder Bartram collected approximately half the 600 new botanical finds to reach Europe between 1734 and 1776. Through Collinson's influence he was appointed the King's Botanist in America in 1765, with a stipend of £50 per annum.[142]

The Quaker horticultural connection (which we encounter again in section 5.3) was particularly prominent in Scotland. A volume containing the names of Quakers cited in the minutes of the Edinburgh Yearly Meeting from the middle of the seventeenth century to the late eighteenth includes information on the trade or profession of each person cited. Of approximately 120 names where this data has been recorded, there are nineteen weavers, ten merchants, six tanners, and lower numbers from other occupational groups. More surprisingly, there are nineteen gardeners and seedsmen, including a number of members of the Miller family.[143] For example, William Miller I (1653–1743), the 'Patriarch', was first employed as a gardener to the Duke of Hamilton and, after a period in Glasgow, accepted the position of gardener at the Abbey of Holyrood House (*c.*1689), probably on the Duke's recommendation. One of his sons, George I, followed in his father's footsteps, and was subsequently employed for some years as gardener at Kinniel House, the residence of the dukes of Hamilton. Another son, William II (1684–1757), is said to have rented the Royal Garden at Holyrood and to have become a highly successful seedsman and nurseryman who was able to raise £20,000 for the purchase of land. Among his customers was Sir Robert Gordon of Gordonstoun, to whom he supplied seeds, plants, and tools; documents from 1718 and 1739 indicate that Gordon placed orders worth £30 and £60 respectively. In the nineteenth century, one of the Millers—another William—became an engraver and specialized in producing plates for botanical publications.[144]

Another science-related career is illustrated by the Edinburgh-born artist Sydney Parkinson (*c.*1745–71). Probably with Fothergill's assistance, he and his mother moved to London, where he was employed as a drawing master and was introduced to the young Joseph Banks, the great impresario of British science. Banks hired Parkinson to illustrate some of the zoological specimens he had collected during his recent expedition to Newfoundland and Labrador. Banks, however, was also planning a further expedition with James Cook aboard the *Endeavour*. Although the voyage was ostensibly to observe the transit of Venus from Tahiti in June 1769, Banks intended to record the exotic

[142] Slaughter, *Natures of John and William Bartram*, 51.

[143] W. F. Miller, 'A dictionary of all names of persons mentioned in the meeting books belonging to Edinburgh Yearly Meeting of the Society of Friends (commonly called Quakers) from the first recorded date 1656 to about 1790' (MS vol. 27, LSF).

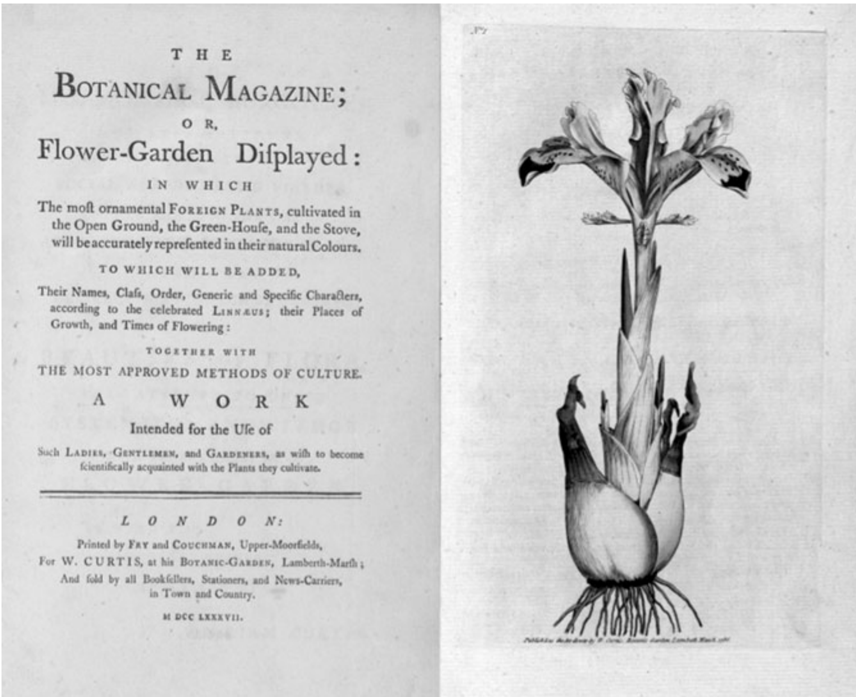
[144] W. F. Miller, *Memorials of Hope Park*. One of his earliest commissions was to engrave illustrations for vols. 5 (1820), 6 (1821), and 7 (1822) of *The Botanical Cabinet*.

flora, and he included Parkinson and another artist among his assistants. Departing from Plymouth in the summer of 1768, the *Endeavour* sailed first to Rio de Janeiro and then down the coast of South America and into the Pacific. The next few months were spent on various Pacific islands before the ship headed off to New Zealand and the west coast of Australia. During an intense two and a half year period Parkinson produced an impressive quantity of drawings and paintings. Although there were birds, fish, landscapes, humans, and boats in some of his pictures, the majority, and certainly the most deftly executed, were his botanical illustrations. On the return journey, the *Endeavour* called at Batavia (Java), where dysentery claimed the lives of many members of the crew, Parkinson included. Yet his work became widely known through his *Journal of a Voyage to the South Seas* (1784), which John Coakley Lettsom edited.[145]

The Quaker entrepreneur who specialized in botany, and especially botanical publications, was William Curtis (1746–99), who founded the *Botanical Magazine* in 1787. Curtis, from a respected medical family living in Alton, Hampshire, was first apprenticed to his grandfather before moving to London, where he became assistant to Thomas Talwin, a Quaker pharmacist. However, Curtis appears to have found natural history much more enticing than pharmacy, and he soon began to publish on entomology. Moreover, he began to lecture on botany, and became Demonstrator of Botany to the Society of Apothecaries. Another venture was a series of three botanical gardens located in the environs of London.[146] In 1777 the first part of his *magnum opus*—*Flora Londinensis*—was published. This beautifully illustrated folio work severely strained his finances, and a patron, apparently Lettsom, had to mount a rescue operation to the tune of £500. Although only 300 copies were sold, Quakers featured prominently in the subscription list, including members of the Barclay, Gurney, Harford, and Fothergill families. Although a work of the highest quality, the *Flora Londinensis* was a financial failure.

A decade later, Curtis devised a far more successful project oriented towards a much wider readership. The *Botanical Magazine* displayed ornamental foreign plants, and was intended for '*such Ladies, Gentlemen, and Gardeners, as Wish to Become Scientifically Acquainted with the Plants They Cultivate*' (Fig. 3.5). Each octavo volume contained approximately three dozen beautifully coloured plates, which are said to have required thirty colourists, with facing information gleaned from Linnaeus and other authorities. According to Curtis's obituarist, who was soon to take over as editor, the

[145] Carr (ed.), *Sydney Parkinson*; Lettsom (ed.), *Journal of a Voyage*.
[146] Noblett, 'William Curtis's botanical library'.



THE
BOTANICAL MAGAZINE;
OR,
Flower-Garden Difplayed:
IN WHICH
The moft ornamental FOREIGN PLANTS, cultivated in the Open Ground, the Green-Houfe, and the Stove, will be accurately reprefented in their natural Colours.
TO WHICH WILL BE ADDED,
Their Names, Clafs, Order, Generic and Specific Characters, according to the celebrated LINNÆUS; their Places of Growth, and Times of Flowering:
TOGETHER WITH
THE MOST APPROVED METHODS OF CULTURE.
A WORK
Intended for the Ufe of
Such LADIES, GENTLEMEN, and GARDENERS, as wifh to become fcientifically acquainted with the Plants they cultivate.

LONDON:
Printed by FRY and COUCHMAN, Upper-Moorfields,
For W. CURTIS, at his BOTANIC-GARDEN, Lambeth-Marfh;
And fold by all Bookfellers, Stationers, and News-Carriers, in Town and Country.
M DCC LXXXVII.

Fig. 3.5. Title-page of the first volume (1787) of William Curtis's *Botanical Magazine*, together with the first plate, which is beautifully coloured, showing a Persian Iris. (Can be seen at http://www.nal.usda.gov/curtis/1jpg.shtml) Reproduced with the kind permission of Leeds University Library.

Botanical Magazine 'had such a captivating appearance, was so easily purchasable, and was executed with so much taste and accuracy, that it at once became popular'. Sales soon passed the 3,000 mark.[147] The illustrations in the *Flora Londinensis* and the *Botanical Magazine* required skilled colourists. Little is known about this group of employees, except that they included at least one Quaker, William Graves, a colourist of exceptional skill. Following Curtis's death in 1799, Samuel Curtis (who appears not to have been a

[147] Obituary notices of William Curtis in *Gentleman's Magazine*, 69 (1799), 628–9, 635–9 (the second of which was written by John Sims); William Curtis, *Flora Londinensis*. According to the 'Dictionary of Quaker Biography' (deposited in LSF), Curtis was disowned in 1791 for having neglected to attend Quaker meetings. He wrote that 'he was in the daily practice of things contrary to the principles of Friends and desired not to be considered any longer a member of our Society'. Another Quaker who edited a botanical journal was Edward Beck, editor of the *Florist (and Garden Miscellany)*, 1848–61.

Quaker) became proprietor, from 1800 to 1846, while the Edinburgh-trained Quaker physician John Sims (1749–1831) took over as editor and continued until 1826. In 1815 the proprietorship of the *Flora Londinensis* passed to Sims and George Graves, son of William and also a botanical colourist who produced several other works on natural history.[148]

Hence a number of Quakers and ex-Quakers were involved in intersecting projects to produce illustrated botanical works for the mass market. There were no comparable careers among the Anglo-Jewish community. The closest example is that of Ellis Davidson (1828–78), who published an impressive range of introductory texts dealing with scientific and technological subjects (see section 5.8). Davidson also delivered science and technology lectures to many groups, including Jewish working men. Yet the first English Jew to embark on a career in science lecturing was da Costa, who appears to have delivered a number of courses on shells and fossils during the third quarter of the eighteenth century. His *Elements of Conchology* (1776) contains the substance of his lectures on shells, while a printed *Syllabus of a Course of Lectures on Fossils*, dated October 1778, indicates the subjects he covered in twenty-seven lectures.[149]

Probably the first Quaker to engage in lecturing was the pharmacist William Allen, who delivered courses at both Guy's Hospital and the Royal Institution. From 1802 onwards he assisted William Babbington with his chemical lectures at Guy's, where he also gave courses on astronomy and on natural and experimental philosophy. A diary entry for 1804 reads:

> Lectures given this season:—[Guy's] Hospital—First course, forty-six; Second course, Chemistry, twenty-six: Ditto, Natural Philosophy, fifteen. Royal Institution, twenty-one; Total, one hundred and eight.[150]

Despite this apparently heavy lecturing schedule, Allen's main occupation was as a pharmacist and manufacturing chemist. During the middle decades of the nineteenth century, the number of lecturing posts in science and science-related subjects expanded considerably, and both Quakers and Jews increasingly sought such positions. For example, in 1848 Martin Barry (1802–55) stood as a candidate for the prestigious Institutes of Medicine Chair at Edinburgh University. Having obtained letters of support from several eminent and powerful medical men, he was well placed to gain the Edinburgh

[148] W. H. Curtis, 'George Graves'; Green, 'Quaker medical trio'; Dopson, 'Bicentenary of John Sims'. Sims also co-edited the short-lived *Annals of Botany* (1805–6).

[149] Da Costa, *Elements of Conchology*. A copy of da Costa's *Syllabus of a Course of Lectures on Fossils* is deposited in the Eyles Collection, University of Bristol. I am most grateful to Hugh Torrens for bringing this document to my attention.

[150] [W. Allen], *Life of William Allen*, i. 73; see also Babbington, Marcet, *et al.*, *Syllabus*.

Chair and advance his career. However, he was disconcerted to discover that, if successful, he would be required to take an oath. On the day prior to the election he withdrew, because, although his religious creed was 'in harmony with all the essential doctrines of Christianity, [it] is one that would not admit of my subscribing those "Tests;"... the "Tests" are an insurmountable obstacle to my being elected'.[151]

Although Barry was unsuccessful, an increasing number of Quakers did soon move into academic positions. This trend was reflected in the careers of Daniel Oliver (Professor of Botany at UCL from 1861), Henry Brady (Lecturer in Botany at Durham College from 1861), George Brady (Professor of Natural History at Armstrong College, Newcastle, from 1875), and Silvanus P. Thompson (who taught at Bristol before becoming Principal of Finsbury Technical College, where he also delivered lectures in physics). Likewise, a few members of the Jewish community held academic positions, including Sylvester, whose first appointment was to the Chair of Natural Philosophy at UCL in 1837, and Raphael Meldola, the Professor of Chemistry at Finsbury Technical College. Marcus Hartog lectured in biology at Owen's College, Manchester, and later held posts in Ceylon and Cork, where he was joined by his brother Philip, who lectured in chemistry.[152] These appointments illustrate not only a type of scientific career that was becoming available for Quakers and Jews at this time, but also the increasing attractiveness of gaining science posts in institutions where non-Anglicans did not suffer discrimination.

[151] [Anon.], 'Memoir of the late Martin Barry'; 'Martin Barry', *AM*, 1856, 13–18; W. F. Miller, 'Reminiscences', 9.

[152] If we add ex-Quakers and lapsed Jews, then the following are included: William Miller (Professor of Chemistry at KCL), William Henry Harvey (Professor of Botany at Dublin), Joseph Lister (held the Chairs of Surgery at Glasgow, Edinburgh, and KCL), Edward Tylor (Reader and later Professor of Anthropology at Oxford), J. T. Cash (Professor of Materia Medica at Aberdeen), and Arthur Schuster (Professor of Physics at Manchester).

4
Scientific Institutions

Science, it is often said, is not only a body of knowledge, but also a social activity. This perspective directs our attention to scientific institutions, such as the scientific societies that provide the main loci of interaction between scientists, where scientists meet to discuss issues of mutual concern, such as the latest scientific experiment or the strengths and weaknesses of a contentious theory. But these institutions are also important for maintaining the infrastructure of science, such as the publication of scientific periodicals. Nor should we overlook the internal politics of these institutions, which invariably contain factions and can, for example, be analysed in terms of patronage relations.

At the outset, the enormous variety of scientific institutions deserves emphasis. The Royal Society of London (founded in 1660) may be the oldest and most venerable scientific society in Britain, but it and its activities do not reflect the diversity of British science. For example, by the early nineteenth century many scientists preferred to address other experts, who gathered to form such specialist institutions as the Linnaean Society (founded in 1788) and the Royal Astronomical Society (founded in 1820 as the Astronomical Society of London), rather than to read a paper before the Royal Society, which took all of science under its wing. Again, whereas the Royal Society and some of the specialist societies were metropolitan, much science was pursued in local societies, which attracted local audiences and often addressed regional concerns. For example, John Dalton directed most of his scientific papers not to the Royal Society but to the Manchester Literary and Philosophical Society. Indeed, according to a recent biographer, Dalton 'appears to have been completely indifferent to the [Royal] Society's affairs', having rebuffed the Society when it first approached him in 1810. Only in 1822 was he elected a Fellow.[1] Likewise, the self-effacing Quaker Daniel Hanbury (1825–75, FRS 1867) was active in the Pharmaceutical Society, the Linnaean Society, the Chemical Society, and the Royal Microscopical Society, but

for some time . . . strenuously refused to allow myself to be placed among the candidates to the R.S., feeling that it would be invidious were the honour of membership

[1] Thackray, *John Dalton*, 54; Patterson, *John Dalton*, 218–21.

conferred on a pharmacist who had really accomplished so little for science, and who had in many ways smaller merits than several others who could be selected.[2]

By the early decades of the nineteenth century, the institutions of science had also become socially stratified; the working men who scraped together a few pennies to attend a course at the local Mechanics' Institute had little in common with the dilettantes who (from 1823) paid £10 for admission to the Royal Society and £4 per annum. The institutional structure of British science therefore offered a rich patchwork of social spaces in which Quakers and Jews could operate.

From the standpoint of religious Dissent, scientific institutions frequently served an important social function. Although some scientific institutions were aligned with religious groups, most adopted a religiously neutral stance and endorsed the view that science is a form of knowledge that transcends religious differences. Thus organizations such as the Royal Society and the BAAS were attractive to many Quakers and Jews precisely because they did not discriminate on religious grounds, unlike so many contemporary civic organizations, and even such professional bodies as the Royal College of Physicians. In participating in such religiously open scientific societies, Quakers and Jews could move outside the confines of their religious communities. They could participate in the polite culture of science; they could read papers, hear papers being read, display natural history specimens, and discuss the latest findings with people of very different religious commitments. At the Royal Society's rooms or the annual meetings of the BAAS, Quakers and Jews rubbed shoulders with Anglican clerics, Methodists, Unitarians, Catholics, agnostics, and atheists. In so doing they not only enhanced their own respectability by participating in the burgeoning study of science, but also met and liaised with scientifically literate doctors, politicians, aristocrats, and even Anglican clergymen. While a Jew or a Quaker would refuse to pray with or condone his daughter marrying an Anglican, such differences could normally be ignored in a scientific forum. Through its institutions, science offered a novel social experience, a bridge between the Quaker or Jewish communities and the wider society.

We begin by examining the Quaker and Jewish Fellows of the Royal Society of London.[3] Although membership of the Royal Society is now accepted as a

[2] Hanbury, *Science Papers*, 17.

[3] Salaman, 'Jewish Fellows of the Royal Society'; *idem*, 'Jews in the Royal Society'; Underwood, 'Quakers and the Royal Society'; Cantor, 'Quakers in the Royal Society'; Hankin, 'Mental ability of the Quakers'; *idem*, *Common Sense and its Cultivation*; Mason, 'Religion and the rise of modern science'; A. R. Fry, *Quaker Ways*, 214–15; Raistrick, *Quakers in Science and Industry*, 222. See also Cantor, 'How successful were Quakers at science?'

sign of scientific eminence,[4] we should be careful not to impose this value judgement on earlier periods. Prior to the reforms of 1847, most of those elected to the Society had not published on science. Moreover, the reformers considered that patronage and aristocratic privilege had previously compromised the Society's scientific activities.[5] Thus, although many eminent scientists were Fellows, no strong connection can be drawn between membership and scientific eminence in the pre-1847 period. Why, then, did Quakers and Jews join the Royal Society? What roles did they perform in the Society? These questions are addressed below. In section 4.2 we pose similar questions about a very different type of scientific organization, the BAAS (founded in 1831), which met annually in a different provincial city and attracted a wide range of men and women with scientific interests. Of the specialist societies that were founded in the nineteenth century, the Ethnological Society (founded in 1844) is particularly relevant to the present study, since the religious and ethical concerns of Quakers directed them to the specific view of ethnology that the Society endorsed. Sections 4.4 and 4.5 will examine the place of science in both Quaker and Jewish communal organizations. Finally, we use the Great Exhibition to illuminate Quaker and Jewish attitudes to science and technology in the mid-nineteenth century.

4.1 Quakers and Jews in the Royal Society

Founded in the wake of intense religious and political strife and soon after the Restoration of the Monarchy, the Royal Society adopted a tolerant stance: its first historian stressed that the Society would 'freely admit . . . Men of different Religions, Countries, and Professions of Life'. Moreover, the discussion of religion was banned, since such an inflammatory issue could rupture the fledgling Society. By contrast, experiment was portrayed as religiously neutral and irenic, since men of different religious opinions could witness and discuss an experiment. Thus the early Royal Society sought to create a forum in which scientific knowledge could be promoted free from religious controversy.[6] Moreover, unlike many British institutions, the Royal Society did not require a new member to take a religious oath (although Council members were not exempt from this). By the mid-eighteenth century its membership included Anglicans, Catholics, Dissenters, Jews, and atheists. Even greater religious

[4] Except for those elected as members of certain privileged classes.

[5] MacLeod, 'Whigs and savants'; D. P. Miller, 'Between hostile camps'.

[6] Sprat, *History of the Royal-Society*, 62–3; P. Wood, 'Methodology and apologetics'; Purver, *Royal Society*, 143–58.

diversity can be found among its foreign membership, which will not be discussed here.

In its first decades the Society's existence did not impinge on most Quakers and Jews, whose lives were constrained by the demands of their religion and by the need to earn a living. If the first generation of Quakers noticed it at all, they would probably have agreed with Isaac Penington (1616–79), who, writing in 1668, was highly critical of the activities of this new scientific organization. While he accepted that 'seeking after the Excellency of Nature and Learning' was a legitimate activity, he considered that it did not assist the individual's spiritual quest. Instead, in a work directed to the Royal Society, he encouraged its Fellows to transcend nature in order to discover a far higher form of wisdom: 'Now this Talent is of a higher kind than Nature, and will lead higher than Nature, giving a man to partake of that wisdom from which Nature came; and teach him to order all that is natural to its right end.' In order to 'know and partake of the true wisdom, and feel union with God', Fellows should realize that the study of natural philosophy is inferior to the higher and eternal truths of religion. He therefore urged them to follow the righteous path. The Royal Society was not seen as helping to bring about the New Jerusalem.[7]

William Penn was one of the very few early Quakers to react differently. Having attended Oxford University, attained high social standing, and become well known in polite London society, he was unusual among contemporary Friends. Later, while arranging the purchase of land in North America, he negotiated with men of power and influence, including royalty. Through his social contacts he encountered many leading Fellows, such as Robert Boyle and Sir William Petty. He was proposed for membership on 2 November 1681, and elected by ballot at the following week's meeting. However, perhaps constrained by his preparations for returning to Pennsylvania, Penn failed to complete the admissions procedure. He did not attend any subsequent meeting (at which he would have been formally admitted), nor did he sign his name in the Charter Book. Thus he was not formally a Fellow. Yet he clearly identified with the Society and its activities, and in a letter to John Aubrey, written from Philadelphia in June 1683, he sent the Society information about local flora and agriculture. But the letter opened with a declaration of the 'good opinion' in which he held 'those Ingenious Gentlemen I know of the Royall Society' and a commitment to the Society's aim of promoting natural knowledge. 'I am', he asserted, 'a Greshamist throughout'—Gresham College being the venue for the Society's early meetings.[8]

[7] Penington, *Some Things Relating to Religion*, 3. Geoffrey Morries is currently writing a Ph.D. at Woodbrooke College on early Quaker attitudes to nature.

[8] William Penn to John Aubrey, 13th day, 4th mo., 1683, in Dunn and Dunn (eds.), *Papers of William Penn*, ii. 394–6.

We have to wait until 1698 until the first practising Quaker was fully elected, and another quarter-century until the election of the first Jew, a physician named Isaac de Samuda. In the period to the end of the nineteenth century, some thirty Quakers were admitted, some of whom were subsequently disowned, and approximately eighteen Jews. These Fellows are listed in Appendix 3, which also contains the names of a further twenty-five ex-Quakers, while some of the Jewish Fellows listed appear to have disavowed their Judaism.

4.1.1 *Networks of patronage*

Although the Royal Society certainly promoted science—more effectively at some periods than at others—it also performed other functions. Thus much recent analysis of the Royal Society has concentrated on its internal politics and on the different factions that constituted its membership.[9] Especially prior to the 1847 reforms, one of the Society's most prominent functions was patronage, and many of those who did not contribute to its scientific proceedings (and even a few who did) either received or bestowed patronage through the Society. For example, with the letters FRS after his name, a young medical practitioner might better attract wealthy patients. The meetings of the Society could also foster social intercourse, and potentially patronage, with leading members of the medical profession and members of the aristocracy. The prospect of attracting patronage appears to have motivated many men to join the Society, including some of the earliest Jewish Fellows.

The first three Jews elected to the Royal Society were physicians practising in London: Isaac de Sequira Samuda (FRS 1723), Meyer Schomberg (FRS 1726), and Jacob de Castro Sarmento (FRS 1730). Prior to the middle of the nineteenth century, Jewish—indeed, non-Anglican—physicians possessed an added reason for seeking patronage through the Royal Society. Although they could be licensed by the Royal College of Physicians, allowing them to practise in London, they were debarred from fellowship of the College. Thus they were excluded from the most powerful medical institution in London, and from the patronage that fellowship conferred. Membership of the Royal Society offered, then, the next best hope of securing the desired professional and social contacts.

Samuda and Sarmento were *conversos* who gained their medical education at the University of Coimbra, but left Portugal with the onset of a new wave of persecution of New Christians in 1720. By contrast, Schomberg graduated from the University of Giessen, in 1710. All three were physicians to the *Hebrà*,

[9] E.g. D. P. Miller, 'Between hostile camps'.

which administered medical care to the poor at the Sephardi synagogue in Bevis Marks. Schomberg was also physician to the Great Synagogue in Duke's Place.[10] While their reasons for joining the Royal Society are not known, Samuda and Schomberg may have been motivated more by the search for patronage than by an interest in science. Neither was active in the Society, and each allowed his membership to lapse after a few years. Moreover, both were proposed by James Jurin, one of the most powerful physicians in the Society, and a man who could enhance their careers.[11] Sarmento's motivation is less clear, since, unlike Samuda and Schomberg, he possessed an impressive track record in science and medical innovation, having published several medical works. By the late 1740s Sarmento had resigned from the Sephardi community and espoused deism. Although this change resulted primarily from his attachment to Newtonian scientific ideas, he may also have been influenced by some of the natural philosophers he met at the Royal Society.[12] Several later converts to Christianity joined the Royal Society, such as the eminent historian Frances Palgrave (né Cohen), who was elected in 1821 on the strength of his literary abilities.[13]

By contrast, established members of the Jewish élite, such as Isaac Lyon Goldsmid, Moses Montefiore (FRS 1836), George Jessel (FRS 1880), and Henry de Worms (FRS 1889), would have been welcomed into the Royal Society, because they not only contributed their membership subscriptions, but also conferred social status on the Society. However, the example of Montefiore indicates that even an elite Jew was not unaware of the social benefits of membership. Thus a recent biographer has suggested that Montefiore's election to the Royal Society—and his election to the Athenaeum a few years earlier—indicates his ambition to be 'accepted by intellectuals and patrons of scholarship'.[14] An entry in Montefiore's diary strengthens the view that his aspirations were more social than intellectual. On signing the Charter Book, he recorded that he was 'proud of the honour of enrolling my name in the same book which has already been signed by several of the kings of

[10] K. Collins, *Go and Learn*, 174–5; R. Barnett, 'Dr Jacob de Castro Sarmento'; E. R. Samuel, 'Dr Meyer Schomberg's attack'. According to the minutes of 11 Dec. 1729, the first time that Sarmento's application for membership was put to the ballot, he was rejected, only to be approved several weeks later. CM, iii. 32, 37; JB, xi. 405, 414, 418.

[11] JB, xii. 373, xiii. 15; CM, iii. 257.

[12] On Sarmento see R. Barnett, 'Dr Jacob de Castro Sarmento'; Goldish, 'Newtonian, converso, and deist'; sect. 5.4 below.

[13] Certificate EC/1821/30, RSL; Endelman, *Jews of Georgian England*, 259. The son of a previously prosperous broker who had lost his fortune, Palgrave had already been baptized, distanced himself from the Jewish community, and was avidly trying to establish his reputation as a scholar and an antiquary.

[14] S. Lipman, 'Making of a Victorian gentleman', 18–19. See Certificate EC/1836/23, RSL.

England'.[15] His legitimacy as an upper-class Englishman was further confirmed in the following year by a knighthood. Although he rarely participated in the Society, he was clearly proud of his Fellowship, frequently taking the opportunity to add the letters 'FRS' after his name.

Emanuel Mendes da Costa provides a striking example of how patronage could be attained from membership of the Royal Society. Although we will examine other aspects of his career in sections 4.1.4 and 5.2, here we shall consider only his construction of patronage networks within the Royal Society. Beginning in November 1745 he regularly attended meetings, often as a guest of the Quaker Peter Collinson, the President (Martin Folkes), or another leading Fellow. By May 1747 he had clearly attracted sufficient support for his application certificate to be submitted. It was signed by eight well-established Fellows, six of whom were also Fellows of the Society of Antiquaries. Once elected, he attended regularly, often introducing eminent visitors to meetings. For the period from March 1757 to April 1762 he maintained his own personal account of the proceedings of both societies, which reveal not only that he was rarely absent, but also that he was an active member and liaised closely with other Fellows.[16] His correspondence likewise demonstrates that he was in frequent contact with many Fellows on a wide range of scientific issues.

Through patronage he not only enhanced his standing in the Royal Society but, when specifically required, he could muster the support of many influential Fellows. Prior to the publication of his *Natural History of Fossils* he solicited subscriptions; when the book was finally published in 1757, the names of thirty-eight Fellows appeared on the subscription list, including the current President (the Earl of Macclesfield). The patronage system was most evident early in 1763, when the Royal Society sought to appoint a new Clerk, following the death of the long-serving incumbent Francis Hauksbee, junior. In order to secure this position—one of the very few paid posts in British science—da Costa sought the votes of friendly Fellows. Despite the recent death of his 'most tender and affectionate Father, whose obsequies by my religion I must strictly attend to',[17] over a four-day period he approached at least two dozen friends and patrons, mobilizing votes in his favour.[18] One of

[15] Loewe (ed.), *Diaries of Sir Moses and Lady Montefiore*, i. 106.

[16] 'Minutes of the Royal Society and the Society of Antiquaries of London', Add. MS Egerton 2381, BL. This volume includes various printed lists of members and a register of Fellows to 1730.

[17] Da Costa to Earl of Macclesfield, 19 Jan. 1763, in Nichols, iv. 750–1.

[18] Among those approached were Henry Baker, Thomas Birch, William Brown, Samuel Chandler, Samuel Clarke, Peter Collinson, Andrew Ducarel, George Edwards, Georg D. Ehret, James Empson (who was not a Fellow), Samuel Felton, Martin Hubner, Charles G. Hudson, William Hudson, Gowin Knight, the Earl of Macclesfield, Matthew Maty, Philip Miller, Charles Morton, James Parsons, John van Rixtel, Joseph Salvador, Noah Sherwood, William Stukeley, and William Watson.

his initial concerns was whether his religion would bar him from the post, as it had done when he had applied for another scientific position. He therefore broached the subject with his closest advisers and was pleased to discover that it was no impediment. The aged antiquarian William Stukeley wrote to a colleague:

> My Friend Da Costa must get a paper for his friends to sign recommending him to be clerk and house-keeper to the Royal Society, . . . to be exhibited next Thursday to the Council. The choice is in the Society, Thursday se'nnight. I know he has very many friends. All my corner of the room unanimous: Sir William Brown, [Peter] Collinson, [James] Parsons, [Henry] Baker, [Samuel] Clark, [John] Van Rixtel, &c. &c.[19]

In the ensuing ballot, da Costa attracted far more votes than did his five rivals, who lacked his extensive patronage network, and thus secured the post.

In contrast to da Costa with his need for patronage, several of the early Quaker Fellows were economically and socially secure. Partly owing to their business successes and partly to advantageous marriages, both Collinson and Silvanus Bevan lived in relative affluence. Thus Collinson wrote to a correspondent that 'Good providence has been . . . kind to Mee . . . My Wives Father has Left Us a Comfortable Old Dwelling & Lands & Gardens'.[20] Both men also used their wealth judiciously to earn the respect of others. Their substantial houses and ornamental gardens well stocked with unusual imported plants are indications not only of their wealth, but also of their cultivated and respectable life-style.[21] Moreover, in contrast to those Jews who sought patronage through the Royal Society, most of the practising Quakers who became Fellows during the eighteenth century possessed scientific reputations at the time of their election. For example, John Fothergill (FRS 1763) was the first Quaker physician to join, but he did so in his early forties, long after he had firmly established himself as a leading London doctor.[22] Moreover, as his nomination certificate makes clear, he was 'particularly distinguished by an Assiduous Application of many years to the improvement of Natural History'.[23]

By contrast, the advantages of social and career advancement bestowed on Fellows appear to have motivated a number of ex-Quakers, including Fettiplace Bellers (FRS 1711), the instrument maker George Graham (1721), the

[19] William Stukeley to unknown, 21 Jan. 1763, in Nichols, iv. 506.

[20] Collinson to J. F. Gronovius, 24 Mar. 1753, PCLS.

[21] Chapman-Huston and Cripps, *Through a City Archway*, 21–2. Despite condemnation by some Friends, Bevan also gained a reputation as a *bon viveur* and boasted a well-stocked cellar.

[22] In a footnote to Boswell's *Life of Johnson*, Charles Burney noted that 'Fothergill, a Quaker, and Schomberg, a Jew, had the greatest practice of any two physicians of their time'. Quoted in Corner and Booth (eds.), *Chain of Friendship*, 17.

[23] Certificate EC/1763/09, RSL.

mathematician Benjamin Robins (1727), Thomas Birch (1735), George Witchell (1767), Henry Beaufoy (1782), and Mark Beaufoy (1790). For many of these Fellows, membership of the Royal Society and severance of connections with Friends formed part of the same upward social trajectory taking them away from the restrictive world into which they had been born. The example of Thomas Birch illustrates how a less affluent ex-Quaker could obtain respect, trust, and social status through connection with science and especially the Royal Society. The son of a coffee-mill maker from Clerkenwell, he was educated by Quakers and served as an usher at Quaker schools until 1726. His marriage to a curate's daughter in 1728 probably precipitated his disownment. Two years later he was baptized, and he subsequently made a successful career in the Church of England, rising to the presidency of Sion College. Birch also pursued various literary ventures. Elected to the Society in 1735, he served as one of its secretaries for thirteen years (1752–65), and played a major role in founding the British Museum.[24]

Benjamin Robins (1707–51) likewise abandoned Quakerism early in his scientific career. Born in Bath, he displayed impressive mathematical ability, and was brought to London by Henry Pemberton, a doctor, writer, and prominent member of the Royal Society. Robins soon cast off his Quakerism and was elected to the Royal Society. A highly competent mathematician, he subsequently published extensively on gunnery, his *New Principles of Gunnery* (1742) being an innovative theoretical and experimental discussion of ballistics. Through the Royal Society he met Admiral Lord George Anson, who later became his main patron, and in 1749 he was appointed chief engineer to the East India Company, with responsibility for maintaining their forts, at a salary of £500 a year.[25] One can but speculate why this birthright Quaker reacted so strongly against his upbringing, not only devoting most of his adult life to military engineering but also becoming an active supporter of the Tory cause.

The strong family and communal links that existed within both Quakerism and Anglo-Jewry, which are apparent in their business transactions,[26] also operated through the election procedures in the Royal Society, with Quakers often supporting the election of other Quakers (and ex-Quakers), while Jews often supported Jews. Prior to 1728, the election procedure required a single proposer, but this was then changed to three Fellows, one of whom had to be a member of Council. Three years later the system changed again. After attracting at least three signatures, the certificate was displayed in the Society's

[24] Gunther, *Introduction to the Life of the Rev. Thomas Birch.*

[25] Johnson, 'Benjamin Robins'; Steele, 'Muskets and pendulums'.

[26] E.g. Walvin, *Quakers*; Prior and Kirby, 'Society of Friends'; Corley, 'How Quakers coped with business success'.

rooms for a period of ten ordinary meetings before the applicant was put to the ballot.[27] From the Society's minutes and certificates we can trace the lines of patronage. For example, Bevan proposed both Collinson and the ex-Quaker mathematician Benjamin Robins.[28] Again, taking some later examples, William Allen's signature appears on the certificates of Robert Willan (II), Hudson Gurney, Luke Howard, James Cowles Prichard, J. J. Lister, and Martin Barry, while Lewis Dillwyn, Thomas Young, Daniel Oliver, and Daniel Hanbury each supported the applications of two or more fellow Quakers (or ex-Quakers). By the early nineteenth century, certificates were generally signed by a number of supporters—often a dozen or more—the most common clustering being subject-based. Thus astronomers, tended to sign the certificates of astronomers, and naturalists generally supported naturalists. Although the Quaker vote was not decisive, it indicates that a Quaker support network operated within the Royal Society. A similar but rather more dilute pattern is apparent in the election of Jewish Fellows. Thus Joseph Salvador was supported by his cousin Emanuel Mendes da Costa, and Isaac Goldsmid signed the certificate of the mathematician J. J. Sylvester.

Fellows could also extend patronage to those outside the Society. For example, Fellows with foreign connections were particularly encouraged to liaise with correspondents overseas, in order to bring any scientific intelligence to the Society's notice. With their strong mercantile interests, Quaker and Jewish Fellows proved useful in collecting such information. For example, Collinson (1693–1768) was an avid scientific correspondent with an extended web of contacts across Britain and the rest of the world, especially North America.[29] According to Fothergill, he was 'one of the most diligent and useful' Fellows, 'not only in supplying the Society with many curious observations himself, but in promoting and preserving a most extensive correspondence with learned and ingenious foreigners, in all countries, and on every useful subject'.[30] His letters and commonplace book also show that he often functioned as a middleman. Thus he frequently communicated to the Royal Society papers he had received from his American correspondents, including the famous series of letters on electricity by Benjamin Franklin, later published under the title *Experiments and Observations on Electricity* (1751).[31] He also facilitated the election of several of his foreign

[27] For later changes see H. Lyons, *Royal Society.*

[28] JB, xiii. 133, 254. See also Johnson, 'Benjamin Robins'.

[29] An impressive list of Collinson's correspondents is given in Swem, 'Brothers of the spade', 154–6. See also Darlington, *Memorials of John Bartram.*

[30] Fothergill, 'Memoir of Collinson', 265.

[31] Franklin, *Experiments and Observations on Electricity.*

correspondents.[32] More specifically, Collinson functioned as an intermediary between the Royal Society and the Quaker community, by presenting to the Society papers written by five other Quakers, all of which were subsequently published in the *Philosophical Transactions*.[33] Although Bevan has been called 'the Quaker F.R.S.',[34] Collinson was the Quaker with his finger on the pulse of London science.

Just as Quakers traded primarily with North America, through their trade routes and personal contacts, so Sephardi Fellows gained access to scientifically useful information originating in Spain and Portugal. Despite the Inquisition and the continuing brutal persecution of Jews in both countries, many English Sephardim maintained trading links with the Iberian peninsula. They thus fulfilled one of the Society's recurrent demands on its members: to convey scientific intelligence to the Society. Salvador, for example, communicated a letter sent to him describing the 1761 Lisbon earthquake.[35] Sarmento was likewise the conduit for several papers, including the astronomical observations made in Lisbon by the Catholic Newtonian Jean Chevalier.[36] He actively recruited foreign members, mainly from Portugal, and signed at least seventeen membership certificates between 1731 and 1760. His patronage extended to three distinct groups: physicians possessing royal benefactions, established scientists (like Chevalier), and aristocrats. In the last group were several Privy Councillors from Portugal who had been sent to London as envoys to the British court. Especially interesting is the case of the Duke of Braganza, who was elected to the Society in 1757. Sarmento argued that owing to his social standing Braganza should be treated like a Peer of the Realm and elected immediately as a member of the privileged classes, rather than being subject to the usual, more extended, admission procedure. As this proposal was unprecedented, a 'slight debate' occurred, after which Braganza's application was balloted and he was elected.[37]

[32] E.g. Edward Wright to Collinson, 19 Oct. 1755; 'Peter Collinson's Commonplace Book', Linnaean Society, MS 3236, fol. 56; E. Wright to Collinson, 13 Nov. 1758, ibid. fols. 64–5; J. Platt to Collinson, 26 Dec. 1762, ibid. fol. 238.

[33] The authors of these papers were John Fothergill, James Logan (a leading Quaker politician and fur trader in Philadelphia), Joseph Breintnall (Quaker merchant in Philadelphia), Joseph Hobson (Quaker merchant in Macclesfield), and John Bartram (who collected specimens for Collinson and was sometime disunited from the Quakers). On the scientific activities of Logan, Breintnall, and other Quaker merchants in Philadelphia, see Tolles, *Meeting House*, 205–29. On Bartram, see Berkeley and Berkeley (eds.), *Correspondence of John Bartram*; Slaughter, *Natures of John and William Bartram*.

[34] Chapman-Huston and Cripps, *Through a City Archway*,

[35] 'Account of the earthquake in Lisbon', *PT*, 52 (1761), 141–2. See also 'Observations on an eclipse of the sun', *PT*, 54 (1764), 105–7.

[36] *PT*, 50 (1757), 374–8.

[37] The Royal Society certificates form part of the Sackler Archive, which is searchable online; Da Costa, 'Minutes of the Royal Society and the Society of Antiquaries of London', fol. 20.

Da Costa was likewise active in attracting new members, such as William Borlase, the rector of Ludgvan, near Penzance, a keen antiquarian and natural historian. As well as supplying Borlase with fossils, da Costa offered his services: 'as I am Resident in the Metropolis [you should] command me on all occasions you may want, not only in Philosophical but [also in] worldly affairs'. He also engineered Borlase's election in 1750.[38]

Dissatisfaction with the power of patronage within the Royal Society was one of the causes of discontent that resulted in the 1847 reforms, when an influential group of Fellows introduced a statute limiting the number of new Fellows to fifteen each year, in order to make elections more competitive.[39] After the introduction of this statute, those who did not already possess an established scientific reputation generally failed to gain admission to the Society, and over the ensuing decades the proportion of Fellows who were not scientifically productive fell significantly. While this did not spell the end of patronage relations within the Society, ordinary membership was no longer open to those, like Samuda and Schomberg, whose scientific interests are questionable.

4.1.2 *From counting house to Royal Society*

In exploring the place of science in the City of London, Larry Stewart has identified a number of coffee-houses situated near the Royal Exchange, where courses of lectures on natural philosophy were delivered during the eighteenth century. Here merchants and seamen encountered science that could be applied to their business ventures or to navigation.[40] Although Stewart contrasts these coffee-house lectures with the elite science practised at the Royal Society, nevertheless a few merchants were elected to the Society. According to Michael Hunter, at the end of the seventeenth century, aristocrats, gentlemen, doctors, and scholars dominated the Society, with a fair sprinkling of clerics. By contrast, only six merchants were elected in the 1690s, accounting for a mere 8 per cent of new members.[41] Although no accurate statistics exist for the eighteenth century, the proportion of merchants elected is unlikely to have far exceeded this figure. Yet, of the relatively few merchants, traders, and financiers recruited to the Society during the eighteenth century, several were from the Quaker and Jewish communities, both of which were extensively involved in international trade.

[38] EMdC, ii. 1–63; Pool, *William Borlase*, 123–5.
[39] MacLeod, 'Whigs and savants'; H. Lyons, *Royal Society*, 228–71.
[40] L. Stewart, 'Other centres of calculation'.
[41] Hunter, *Royal Society*, 126.

This perspective helps us appreciate why William Penn was sought as a potential Fellow. His proposer, John Houghton (a non-Quaker), was an apothecary and trader in luxury foods and beverages, who was keen to learn about the agriculture and commerce of other countries—an interest pursued through his own publications and his various activities in the Royal Society, including the recruitment of three other merchants.[42] Also, like many other Fellows, Houghton displayed an enthusiasm for curiosities, both natural and man-made. A few months before he proposed Penn, he read a paper containing useful information about the economic potential of Virginia. Houghton considered that Penn, as the new proprietor of Pennsylvania, would be of service both to himself and to the Royal Society by supplying similar information.[43] Indeed, at the meeting when Penn's application was balloted, Houghton presented the Society with Penn's map of Pennsylvania.[44] In making this gift, Penn was supplying the Royal Society with geographical information of scientific and economic importance.

Several of the early Quaker Fellows were merchants, including Edward Haistwell (FRS 1698), who had been indentured to a Quaker merchant in London involved in the lucrative trade with Philadelphia.[45] In 1685 his apprenticeship ended, and Haistwell commenced trading on his own. His business activities rapidly expanded to include the importation of sugar from Barbados and tobacco from Virginia and Maryland, some of which was subsequently exported to Holland, Germany, and Spain.[46] Another early Quaker Fellow, John Bellers (FRS 1719) traded in cloth and, like Penn and Haistwell, was involved in transatlantic commerce. His investment of £2,000 in London Lead Company shares in 1705 indicates his financial standing.[47]

Another aspect of Quaker trading is illustrated by Silvanus Bevan (FRS 1725), who founded the Plough Court Pharmacy just off Lombard Street in the City of London. Together with his younger brother he rapidly developed Plough Court into one of the most successful pharmacies in the metropolis. An extensive international trade ensued, with medicines being supplied to customers throughout Europe and America. Bevan was also one of the London agents for the Pennsylvania Hospital, and was responsible for

[42] Hunter, *Royal Society*, 67.

[43] Cf. Underwood ('Quakers and the Royal Society of London'), who argues that given Penn's interest in science, especially in horticulture, 'and his place in English society, it is not surprising that Penn was elected Fellow of the Royal Society'.

[44] JB, vi. 255.

[45] Balderston (ed.), *James Claypoole's Letter Book*, 7–8, 127, 200, 226–30, 233–4, 239–42.

[46] Price, 'Haistwell, Edward'. I am most grateful to Jacob Price for providing me with a pre-publication copy of this article. For Haistwell's disputes with other merchants see Underwood, 'Edward Haistwell'.

[47] Raistrick, *Two Centuries of Industrial Welfare*.

negotiating the site with William Penn's son Thomas. Likewise, Peter Collinson (FRS 1728), who is discussed in section 5.2, became the main importer of plants and seeds from America. 'You must remember', Collinson told Linnaeus, 'I am a Merchant, a Man of Great Business & many Affairs in my Head & on my Hands.'[48] The business activities of Collinson and Bevan were significantly enhanced by membership of the Society. Among the Fellows they found customers for their respective commercial ventures (selling plants and medicines), thereby expanding their businesses and personal connections well beyond the Quaker community through their contacts at the Royal Society.

Several of the Jews elected during the eighteenth century were similarly engaged in mercantile activities. For example, Alvaro Suasso (FRS 1735) had settled in London in 1720, in order to expand financial activities that had previously been centred on Amsterdam. He was a renowned financier and exceedingly wealthy, his holdings of Bank of England stock alone amounting to over £13,000 in 1725. He owned or co-owned several large ships and was engaged in international trade with Cadiz, Lima, Bombay, and Calcutta. He was later appointed Commissioner for Georgia. Like Penn, he was clearly regarded as 'a Gentleman of universal [i.e. international] Correspondence, who is well able and much disposed to promote the interests of the [Royal] Society'.[49]

Another example is Joseph Salvador (1700–86) who was a luminary in the Sephardi community and was considered a potentially 'very valuable and usefull member' when elected to the Society in 1759 owing to his extensive contacts abroad. While actively trading with Spain and Portugal, he also developed a lucrative trade in coral and diamonds with India.[50] A small number of Jewish families dominated this trade, including the Francks family, which supplies our final example. Naphtali Franks (FRS 1764) was a leading figure in the Ashkenazi community, who has been described as the 'great Jew'. Born in New York, he and his two brothers moved to London largely because of the financial opportunities it offered. As a diamond trader he became spectacularly wealthy, purchasing a fine house in Mortlake and a country house and estate in Leicestershire. A man of culture and wide reading, he developed a strong interest in botany. As his proposers noted, he was a 'gentleman conversant in Botany and other branches of Literature, and [is] likely to prove a valuable and useful Member' of the Royal Society.[51] His

[48] Peter Collinson to Linneaus, 12 May 1756, PCLS.

[49] Giuseppi, 'Sephardi Jews'; Yogev, *Diamonds and Coral*, 43; Certificate EC/1735/08, RSL.

[50] Woolf, 'Joseph Salvador'; Kielmansegge, *Diary of a Journey to England*, 170.

[51] Hershkowitz and Meyer, *Letters of the Franks Family*; Daiches-Dubens, 'Eighteenth-century Anglo-Jewry'; Certificate EC/1764/10, RSL.

potential value to the Society arose not only from his wealth and status but also from his extensive trading connections, which could yield scientific specimens and information from distant lands.

The link between finance and trade and the Royal Society continued after the mid-eighteenth century, but at a lower intensity, which nevertheless included a few Quakers, such as the wine merchants J. J. Lister (FRS 1832) and Arthur Lister (FRS 1898). Within the Jewish community the connection with finance was continued by Isaac Lyon Goldsmid (FRS 1828) and the redoubtable Moses Montefiore (FRS 1836). In a few instances business and financial concerns intersected with science. For example, as a leading bullion dealer Goldsmid's geological interests were directed to economic geology. Although he did not publish on science, his surviving correspondence shows that he possessed a large collection of geological specimens, and employed his own curator (whom he loaned to the Geological Society). He possessed an extensive knowledge of geology and of the problems of locating and extracting precious metals. Several geologists and other scientists received his patronage, and gold prospectors in his employ were sent to South America.[52]

For its part the Royal Society was keen to attract members who could contribute to its coffers. Thus financially secure and socially respectable Quakers and Jews were welcome, all the more so if they could contribute to the scientific intelligence so avidly sought by the Society.

4.1.3 *Activities within the Royal Society*

In contrast to the open admission procedure, Fellows elected to Council were normally required to take a corporal oath at the first Council meeting attended.[53] Yet when Haistwell first served on Council in 1705, the following entry appeared: 'Mr Haistwell made the affirmation appointed for a Member of the Council as Customary.'[54] Despite this apparent appeal to custom, Haistwell broke with convention by not swearing a solemn oath on the Bible; instead he was allowed to make a declaration that did not infringe his religious beliefs. An entry for 7 December 1721 is rather more explicit about the content of an affirmation: 'Mr [John] Bellers took his Affirmation for the

[52] A. B. Lancaster (?) to Goldsmid, 5 Oct. 1828; G. B. Sowerby to Goldsmid, 20 Nov. 1830; Henry Heulandez to Goldsmid, 28 Apr. 1828; Henry Fitton to Goldsmid, 28 June and 10 July 1828; George Lyon to Goldsmid, 25 Sept. 1829: Isaac Lyon Goldsmid Letterbooks, ii, fols. 20, 47, 62, 63, 67 and 101, University College London Archives.

[53] The procedure is specified in the *Record of the Royal Society*, 253–4.

[54] CM, ii. 129.

faithful Execution of his Trust in Council.'[55] Later, Quakers elected to Council availed themselves of affirmations in place of oaths.

It would appear that during the eighteenth and nineteenth centuries Quakers and ex-Quakers were proportionately more strongly represented on Council than in the overall membership. Ex-Quakers were particularly in evidence among the officers of the Society. Following the example of Thomas Birch, who served as Secretary for thirteen years, four other ex-Quakers held such positions. Thomas Young was Foreign Secretary from 1804 until his death in 1829; the chemist William Allen Miller held the Vice-Presidency (1855–7, 1861–70) and was also Treasurer (1861–70); the neurologist Henry Head was Vice-President in 1916–17, and Lord Lister, after two years as Foreign Secretary, served as President from 1895 to 1900. Having grown up in a strong and highly structured religious community, from which they were subsequently excluded, these five ex-Quakers may have sought the assurance of a similar communal structure in the leading scientific society. Moreover, just as each individual is expected to play a part in the business of the local meeting, both Quakers and ex-Quakers may have been particularly willing to accept responsible positions in the Royal Society, thus perpetuating the ideology of social commitment instilled during their upbringing.

Jews, however, played a far less prominent role in the Society's administration, largely owing to their much smaller numbers. With the exception of da Costa's period as Clerk or Assistant Secretary to the Society—which did not make him officially a member of Council, as he was required to forfeit his membership before accepting the appointment—we have to wait until the actuary Benjamin Gompertz (FRS 1819) was elected to Council in 1832. Later in the century Sylvester served on Council in the 1860s and Raphael Meldola from 1896 to 1898. (He was Vice-President at the time of his death in 1915.) In light of the 'cultural deficit' discussed above, such appointments were celebrated in the Jewish periodical press as important indicators that Jews could be successful in such areas as science.[56] Meldola even received a congratulatory message from the Board of Elders of the Spanish and Portuguese Synagogue:

> The Elders have noticed with extreme gratification the high position which Professor Meldola has by his exceptional abilities attained in the Scientific world; and they trust that his life may be prolonged to continue to shed a lustre not only on this Congregation by which the name he bears is honored, but on the Jewish Community in general.[57]

[55] JB, xii. 172.

[56] *JC*, 12 Dec. 1862, 5; 12 July 1867, 6; 30 Jan. 1874, 731; 24 July 1874, 272; 16 Mar. 1877, 12; 24 Aug. 1877, 13.

[57] Joseph Sebag Montefiore to Raphael Meldola, 12 Nov. 1896, Meldola Correspondence, MS MLDA00148, Imperial College London Archives.

Such a visible recognition of scientific success of an English Jew was seen to reflect well on Anglo-Jewry.

Another form of service to the Royal Society was through financial aid and bequests. Many Fellows, including Quakers and Jews, donated individual items, such as copies of books they had written. For example, the Society received copies of John Bellers's *Essay Towards the Improvement of Physick* (1714) and da Costa's *Natural History of Fossils* (1757).[58] Some donated objects of scientific interest, such as Haistwell's gift of two rattan canes, 'W^{ch} were very long and prickly & inclos'd in a large Bambo'.[59] Occasionally the Society received larger bequests, such as the sum of £500 to the Society's Scientific Relief Fund and the collection of books and papers on protozoa bequeathed by the Newcastle Quaker pharmacist Henry Bowman Brady (FRS 1874), who died a bachelor in 1891. According to his will, Brady wished these items to be maintained undivided in a single collection. If this condition proved acceptable to Council—which it was—he was prepared to donate a further £300 to the Society's Library for the purchase of additional books on his favourite research topic.[60]

Sylvester's death in 1897 led to an unprecedented example of co-operation between the Royal Society and the Anglo-Jewish community.[61] As the best-known Victorian Jewish scientist, he was held in high esteem by both the Jewish and the scientific communities. The chemist and naturalist Raphael Meldola (1849–1915, FRS 1886) quickly recognized that the example of this first-rate mathematician could be used to refute the widespread view that Jews were intellectually inferior. Such arguments were particularly serviceable at a time when anti-Semitism was on the increase, owing to the Dreyfus affair and the mass immigration of poor Jews principally from Poland and Russia. Meldola first suggested a memorial to Sylvester at a meeting of the Maccabæans—the recently formed association of Jewish professionals. The *Jewish Chronicle* endorsed the proposal with enthusiasm, adding: 'It would be most discreditable to the Jews of this country if they allowed to pass by this opportunity of showing their appreciation of the intellectual giant who shed such great lustre upon the [Jewish] community.'[62] Meldola then laid a proposal before the Council of the Royal Society. Initially, Council was less than enthusiastic, but at its next meeting Meldola announced

> that an anonymous donor had offered a sum of money to be administered by the Royal Society for the purpose. Whereupon, it was moved by Prof. Meldola, and duly

[58] JB, xi. 317–18; xxii. 603.
[59] JB, x. 186.
[60] T. C. Watson to Treasurer of the Royal Society, 2 July 1891, MS MC.15.200, RSL.
[61] Grattan-Guinness, 'Sylvester Medal'; Cantor, 'Creating the Royal Society's Sylvester Medal'.
[62] *JC*, 26 Mar. 1897, 19.

seconded,—'That the Royal Society accept the offer to found a medal to be associated with the name of the late Prof. Sylvester, and to be awarded triennially for the encouragement of pure mathematical research, irrespective of nationality.'

The anonymous benefactor who swayed Council with a donation of £100 was Lord (Nathaniel Meyer) Rothschild.[63]

During the coming months, Meldola was busy raising subscriptions from both the Jewish and the scientific communities. The Jewish press and a number of scientific periodicals carried articles soliciting contributions. Yet the fund grew rather slowly, and Rothschild and Meldola made a further appeal through the pages of the *Jewish Chronicle* on 14 April 1898, pointing out that they were still £200 short of their target of £1,000. They appealed to 'the *esprit de corps* of English Jews', and insisted that the Jewish community would be shamed in the eyes of the Royal Society if less than the promised £1,000 were collected.[64] Such blandishments proved insufficient, and on 4 October the fund closed at £880.[65]

The Jewish community contributed more than 70 per cent of the money raised in Britain, and accounted for two-thirds of the subscribers who contributed £5 and above. As well as Lord Rothschild, several other philanthropists from wealthy banking and mercantile families contributed, including Frederick D. Mocatta, Sir Samuel Montagu, Dennis E. Samuel, Sir Edward Sassoon, and Ellis A. Franklin. Jewish political figures were represented by Benjamin Louis Cohen, Herbert Jessel, and Samuel Montagu—respectively Conservative, Unionist, and Liberal MPs. Particularly well represented were the professions, especially the law, and members of the Maccabæans. In addition to the above were a number of communal leaders, headed by the Chief Rabbi. Yet, among the ninety Jews who contributed—from a total of 203 subscribers—there were also many less wealthy and elevated members of the community.

Most of the remaining subscriptions were collected from the scientific community, especially from mathematicians. While more than thirty Fellows of the Royal Society made donations, the strong support of foreign mathematicians is particularly revealing of Sylvester's reputation. There were twenty-nine Americans on the list, mostly mathematicians, as well as such leading continental mathematicians as Charles Hermite, Felix Klein, and Camille Jordan. To Meldola's surprise a group of Russian mathematicians banded together to send a donation in roubles. Many letters praising Sylvester

[63] CM, 8 Apr. and 20 May 1897; Raphael Meldola to Secretaries of the Royal Society, 26 Mar. 1897, MS MC.17.19, RSL; *JC*, 28 May 1897, 10.

[64] *JC*, 15 Apr. 1898, 8.

[65] *JC*, 14 Oct. 1898, 10.

and his mathematical contributions were received. For example, Ferdinand Lindemann, writing from Munich, asserted that 'Sylvester has always been very kind to me; for he wanted myself to be his successor in Baltimore at Jon's Hopkins University', while a mathematician at Cornell described Sylvester as 'a name so well known and so highly esteemed in America'.[66]

Although some would have preferred to celebrate Sylvester's life and work by a bursary to encourage young mathematicians, Meldola considered that a medal for past achievements was more appropriate, since it would provide a readily recognizable demonstration that Jews had made major contributions to science. Council decided that the medal (which joined the seven it already awarded) should 'be awarded triennially for the encouragement of pure mathematical research, irrespective of nationality'. By early 1901 all preparations were complete, and the Royal Society awarded the Sylvester Medal (Fig. 4.1) to its first recipient, the eminent French mathematician and philosopher, Henri Poincaré.

The large donations of Ludwig Mond (1838–1909, FRS 1891) must also be included in this section. Mond grew up in Cassel, in a very Orthodox Jewish family. In reaction he became an agnostic and distanced himself from the Anglo-Jewish community, although during the weeks leading up to his death in 1909, he appears to have made some accommodation with Judaism. His best-known legacy to the Royal Society was a sum of £50,000 to support research in the natural sciences, part of which was used to build and equip the

Fig. 4.1. The Sylvester Medal, first awarded to Henri Poincaré in 1901. © The Royal Society.

66 Ferdinand Lindemann to Raphael Meldola, 12 July 1897; R. S. Woodward to Raphael Meldola, 18 Oct. 1897, Meldola Correspondence, MSS MLDA00340 and MLDA00381, Imperial College London Archives.

Royal Society Mond Laboratory at Cambridge. Yet, during his life he made a number of other benefactions, including 500 guineas to the Scientific Relief Fund in 1886, and from 1892 onwards he made several large contributions that funded the production and publication of that invaluable bibliographical tool, the *Royal Society's Catalogue of Scientific Papers*.[67]

Brief mention should also be made of the Royal Society Club—a dining club closely associated with the Royal Society. Although Collinson and Dalton were occasional guests, no practising Quakers joined this social, political, and fashionable centre of London science, although several ex-Quakers were prominent members, including Thomas Birch, Benjamin Robins, Thomas Young, William A. Miller, and Joseph Lister. Likewise, no practising Quakers joined the far less frivolous Philosophical Club (founded in 1847), which sought to stimulate interest in the scientific activities of the Royal Society. By contrast, Jews, lapsed Jews, and ex-Quakers were much in evidence, including Miller, Jonathan Pereira, and Nathaniel Wallich among its forty-seven founding members, who were later joined by Edward Burnett Tylor, Ludwig Mond, James Joseph Sylvester, and Raphael Meldola. The absence of practising Quakers from both of these high-profile fringe groups indicates that, although they willingly co-operated with non-Quakers on scientific matters, they were disinclined to socialize.[68] Writing to an American correspondent, Collinson stated:

> I hate to be idle & think all Time Sadly lost that is not usefully Imployed, for which Reason, Clubbs, Taverns, & Coffee Houses Scarsly know Mee. Home is the most Delightfull place to Mee where I Divide My Houres in Business[,] in Innocent Amusements [i.e. botany] and in the Dear Society of a Tender Good Woman, A Boye & Girle.[69]

Although botany became a substantial part of his business, and his customers included many Fellows, this quotation reflects the Quaker emphasis on sobriety and disinclination to participate in such social formations as the Royal Society Club and even the Philosophical Club.

4.1.4 *Da Costa's activities in the Royal Society and the Society of Antiquaries*

The fluctuating career of Emanuel Mendes da Costa (1717–91) casts considerable light on the Royal Society and the Society of Antiquities during the middle years of the eighteenth century, and also provides us with a specifically

[67] J. M. Cohen, *Life of Ludwig Mond*; *Record of the Royal Society*, 126–7, 144–5, 180–2.
[68] Bonney, *Annals of the Philosophical Club*; Geikie, *Annals of the Royal Society Club*.
[69] Collinson to Cadwallader Colden, 7 Mar. 1742, PCLS.

Jewish focus. Having established himself as an able and respected naturalist, da Costa was elected to the Royal Society in 1747, and to the Society of Antiquaries in 1752 on account of his antiquarian interests. There was considerable membership overlap between these two societies, and he encountered many of the same 'philosophers' at both sets of meetings. Thus, on Thursday afternoons there would have been a mass migration following the meeting at the Royal Society's rooms in Crane Court to the Antiquaries, which met at the nearby Mitre Tavern (later Robin's Coffee House). In the eyes of his fellow philosophers, da Costa was not only a knowledgeable naturalist, but, being one of the few Jews who moved in enlightened circles, he was also valued as an authority on Hebrew and Jewish learning. For example, he was approached in 1752 by the noted antiquary Andrew Ducarel with a query about the weapons and uniforms of Jewish soldiers in biblical times. On that occasion he could not answer the question, 'not being any wise greatly conversant in Rabbinical learning', and enlisted the help of a more scholarly member of the Sephardi community.[70] A few years later he corresponded with Joseph Ames, the Secretary of the Society of Antiquaries, and others about a number of Hebrew documents, including a medieval property deed from Dorset signed by 'Rabbi Rushall'. Da Costa discussed this document, which Ames had loaned him, at a meeting of the Society. Ames and da Costa also discussed a text carved into the stonework of the London Wall, which some thought was written in a form of Hebrew.[71] Knowledge of Hebrew also proved useful at a subsequent meeting of the Society of Antiquaries in 1757, when da Costa addressed the chairman, pointing out that in his paper on Druids the eminent antiquarian William Stukeley 'had been Guilty of Error in saying that Cassiteros [?] was the name for Tin in Hebrew'. He subsequently pursued this matter in correspondence with Stukeley and at a later meeting of the Society.[72]

Although he readily offered colleagues advice on Jewish topics, the subject that most exercised him and several contemporaries was that of the Jews of China, whose existence had been reported by earlier travellers. As David Katz has argued, such Christian scholars as Benjamin Kennicott were keen to locate these Jews, because they were thought to possess an uncorrupted copy of the Old Testament. They argued that since the Chinese Jews were descended directly from the Lost Tribes of Israel, the Torah text in their possession

[70] Da Costa to Andrew Ducarel, 10 Mar. 1752, EMdC, iii. 136.

[71] Da Costa to Joseph Ames, 14 July 1756, in Nichols, iv. 227–8; Da Costa to Henry Rooke, 14 July 1756, EMdC, ix. 75. See also Da Costa to Ames, 27 Nov. 1755, Minute-book, Society of Antiquaries.

[72] Egerton MS 2381, fols. 5–7; Da Costa to William Stukeley, 19 Apr. 1757; Stukeley to Da Costa, 20 Apr. 1757, in Nichols, iv. 505–6.

would be pure and untouched by the medieval rabbinic commentators who had defiled the scrolls that were to be found in Europe. Hence the Jews of China might provide the key source for perfecting the scriptural text.

George Costard, Kennicott's near contemporary at Wadham College, Oxford, was also interested in China, but for a very different reason. Costard was concerned with the history of science, and in his writings he sought to demonstrate that the scientific pursuit of astronomy had originated in ancient Greece. Other early civilizations, including the Chinese, had not contributed to this grand enterprise. Costard had discussed his views on Chinese astronomy with Thomas Shaw, the Professor of Hebrew and Oriental Languages at Oxford, who thought them worthy of communication to the Royal Society. Thus on 30 April 1747 Shaw entertained the Fellows with a diatribe demonstrating that Chinese astronomy was 'very erroneous . . . quite fabulous and fictitious'. Not only was their astronomical knowledge rudimentary, confused, and relatively modern, but the records maintained by the Chinese were flawed, because astronomers had falsified observations in order to report favourable conjunctions to their rulers. Thus the Chinese posed no threat to Costard's theory of Greek superiority. Yet, it should be noted, Costard had derived his knowledge of the Chinese from Jesuit missionaries, who were hardly unbiased in their judgements.

Da Costa was present at that meeting. Although the formal minutes make no reference to Jews, an entry in da Costa's commonplace book notes that Shaw claimed that he had 'a record that about 200 years after Christ a number of Jewish families from the Western parts of the World went to settle' in China.[73] This implies that for Shaw the Jews of China were not remnants of the Lost Tribes, and that the search for the uncorrupted Torah text was fruitless. Shaw's possibly informal comment clearly gripped da Costa's imagination, raising the possibility that a Jewish community might still be living in China.

Another Christian who wanted to trace the Jews of China because they might possess the uncorrupted Torah text was John Collet, probably the doctor of that name from Newbury. In 1752 he wrote to them through an intermediary in Russia, but he was also in contact with 'the Jews of London', who likewise sent a letter to China. By early 1756, at least two Fellows of the Royal Society were drawn into Collet's orbit—da Costa and the merchant and philanthropist Robert Dingley. Through contact with da Costa, Collet hoped to encourage Jews to send letters to all possible locations where the descendants of the Lost Tribes may have settled in order to elicit 'all the Antient

[73] JB, xix. 245–7; Da Costa's commonplace book, Add. MS 29,867, fol. 101, BL; quoted in Katz, 'Chinese Jews', 894. I have drawn extensively on this excellent paper.

Books . . . [and to] bring to light some books that would explain and illustrate the Holy Scriptures'.[74] In 1760 da Costa himself wrote to an unnamed correspondent, who was evidently well informed about the Chinese language and customs, and had been recommended by a leading member of the Sephardi community. Clearly, too, da Costa had been liaising with knowledgeable members of the Royal Society 'and other Persons'. He asked his correspondent to ascertain the 'manner of living, writings and customs' of the Jews of 'Peking, the Province of Honan and particularly Caifung'. Also enclosed was a letter in Hebrew from the Jews of London to be forwarded to their co-religionists in China, in which they sought to establish contact. However, da Costa also warned his correspondent to

> be cautious that this design should not be known to the papists, and particularly the Jesuits, lest they should endeavour to hinder our discoveries; for tis possible, were such a thing to prove true, that the British interest might be strengthened in China, and some new branches of commerce opend to the Hon^{ble} Company, all which I ardently hope to promote.

The letter ended with da Costa offering to cover any expenses incurred, 'not exceeding Fifty Pounds Sterling'.[75] It is not clear whether this money would come from his own purse, but if so, it was a remarkably high sum given his financial difficulties and would indicate his commitment to the project. However, after sending this letter, to which no reply was received, it appears that da Costa made no further attempts to contact the Jews of China.

In his account of the history of the search for the Jews of China, Katz notes that da Costa and the Jews of London were not motivated by the quest for the original Torah text. For them the Masoretic text was a faithful transcription of God's word and not a defective copy. Instead, they sought contact with a long-lost branch of Judaism.[76] Da Costa was probably impelled by the same motive, but as a man of science and an antiquary, he also sought ethnological information about their 'manner of living, writings and customs'.

Da Costa's role as adviser on Jewish matters may have raised his standing among his fellow philosophers, but it did not increase his income. He therefore sought one of the very few paid positions within a scientific institution. Thus in 1757 he sought the post of Curator of Natural History at the newly founded British Museum. Despite gaining the patronage of 'the Dukes of Argyle & Portland & the Hon[or]able Charles Stanhope Esq^{r} [,] M^{r} Watson the great Botanist and [a] great part of our Royal Society', he was not

[74] John Collet to Da Costa, n.d., EMdC, iii. 219.
[75] [Da Costa] to ?, n.d., Collections relating to the Jews, Add. MS 29,868, fol. 4, BL.
[76] Katz, 'Chinese Jews', 905.

appointed because of 'my religion'.[77] However, as religion proved no bar to his being appointed Clerk to the Royal Society in February 1763, he became the first Jew to hold a paid position in a scientific institution. He generally acquitted himself well in performing his duties, which included taking minutes, writing letters, and helping to collect subscriptions. Moreover, he took charge of the Society's library and repository, which his predecessor had left in a parlous state.[78] Animals and vegetable specimens were totally decayed; 'not only useless and disgraceful, but even as pernicious'. A mummy was so far decayed as to be 'useless and offensive'. Much of the repository's contents were either destroyed or missing. The library was no better; books and manuscripts had been lost, and the catalogue was in a deplorable condition.[79] Despite his enthusiasm and his sense of pride in the Society, repairing the repository and library proved laborious, and compromised other aspects of his life: 'consider [my] private affairs', he wrote to the Society's Treasurer, 'and you will find that, wretch as I am for the sake of literature, I have even invaded the Holy Decalogue by not having a seventh day of rest, so strictly ordered by the Law of Moses'.[80] Yet he did manage to effect a considerable improvement to the library and repository. However, after almost five years in this post, a substantial sum was found to have disappeared from the Society's coffers. The finger of guilt pointed at da Costa, who was dismissed and sent to a debtors' prison.[81]

Despite da Costa's enthusiasm for the Royal Society, he was often critical of its dilettantism and its failure to advance science actively. Thus in one letter he deplored the 'State of Litterature in England': 'Idleness & Luxury take the head of the Sciences even so much that to my thinking our Royal Society declines daily.'[82] He also clearly concurred with William Stukeley, who, at one meeting in 1759, attacked the Society for failing to cultivate correspondence with the world of learning and for rejecting outright all papers on longitude, squaring the circle, perpetual motion, and the philosopher's stone. Moreover, da Costa complained that the Society's formal minutes had purposely omitted Stukeley's critical remarks.[83] Late in his life he reported on the state of the Royal Society to his cousin Joseph Salvador, who had moved to South Carolina after incurring extensive financial losses.

77 William Borlase to Charles Lyttelton, Apr. 1763, in Pool, *William Borlase*, 238; Da Costa to T. Needham, 18 Mar. 1760, EMdC, vii. 93.

78 CM, v. 4–8; entry for 17 March 1763.

79 CM, v. 15; JB, xxiv. 820–9.

80 Da Costa to James West, 17 Oct. 1764, in Nichols, iv. 792–4. Under other circumstances it seems unlikely that he would have kept the Sabbath.

81 Cantor, 'Rise and fall of Emanuel Mendes da Costa'.

82 Da Costa to John Albert Schlosser, 29 Mar. 1762, EMdC, ix. 137–8.

83 Egerton MS 2381, fol. 87, BL; Haycock, *William Stukeley*, 224–30.

> Learning is now Esteem'd of very little consequence. The Royal and Antiquarian Societies...droop daily. The first published (as usual) yearly its Transactions, which most generally speaking are not held in high Repute, or valuable publications as they formerly were. The Squabbles among those *learned fellows* last year were little less than Riots, and caused much scandal to the Society. Both Parties, tho headed by Learned & Able Men, were wrong: The President [Joseph Banks] & his Party showing much Despotism & Rancour, without judgement; which the opponents resisted with equal Rancour, and as little reason. The meetings during this Civil War, very often did not break up till Eleven or Midnight, & all was cavilling and confusion. However, the opponents were at length banquish'd in pitch'd battles...This King Joseph [Banks] is despotical, neither attentive, Affable, Humane, or eminently Learned; & has alter'd many rules & Customs of the Society; therefore his government is disagreeable to many.[84]

The ageing and disillusioned da Costa doubtless revelled in any bad publicity about the Royal Society. Yet, despite his somewhat jaundiced view, historians now recognize that throughout much of the eighteenth century the Society was in the doldrums, and that there is more than a grain of truth in da Costa's assessment. Although da Costa was a political animal, he possessed a commitment to science unmatched by many of the leading figures in the Royal Society.

4.2 The British Association for the Advancement of Science

Following its establishment in 1831, the annual meetings of the British Association for the Advancement of Science (BAAS) became a major event in the scientific season, attracting not only those who practised science but also a large number of predominantly middle-class men and women, who constituted an audience for science. There were many reasons for attending: scientists could present their findings to a varied audience (including the press) and participate in controversies; less exalted members could listen to the leading lions of science, hobnob with each other and with their betters, and be entertained by the promenades and other social events.[85] Quakers constituted a small but visible contingent at the BAAS, doubtless finding its meetings congenial for any or all of the above reasons. These annual scientific meetings also enabled visiting Quakers to meet, and often stay with, members of the local Meeting.

Among the Quakers who attended the first meeting, which was held in York, was 'Atomic Dalton', whose lecture greatly impressed the geologist

[84] Da Costa to Joseph Salvador, 30 Jan. 1786, EMdC, ix. 93–4.
[85] Morrell and Thackray, *Gentlemen of Science: Early Years.*

Roderick Impey Murchison, who savoured the memory of Dalton 'reading his own memoirs and replying with straightforward pertinacity to every objection in the highly instructive conversations which followed each paper'.[86] Dalton was the only practising Quaker to serve as a Vice-President during the early years, the positions of President and Vice-President being invariably occupied by titled patrons of science and by scientists of high repute; indeed, he was selected on two occasions—at Cambridge in 1833 and Manchester in 1842. However, Quakers were often involved in the less exalted, but highly demanding, position of Local Secretary. Robert Were Fox served in that role when the Association visited Plymouth in 1841, the Leeds pharmacist William West was Local Secretary for the 1844 York meeting, and the industrial chemist Robert Calvert Clapham for the 1863 Newcastle meeting. A Quakerly presence was most evident at Ipswich in 1851, when three of the four Local Secretaries were not only Friends but partners in the firm of agricultural implement makers that bore their surnames: George Ransome, Charles May, and William Dillwyn Sims.

The diaries of individual participants reveal the form and extent of Quaker involvement. For example, William Lucas, a brewer from Hitchin, was among the Quakers who took a keen interest in science, but never contributed a paper. As a well-read, affluent, and enthusiastic follower of science, he attended meetings at Birmingham in 1839, Ipswich in 1851, and Oxford in 1860. Through these he was able to keep abreast of scientific developments and hear—and even meet—the leading scientists of the day. He found the BAAS meetings both enjoyable and informative. His account of the Birmingham gathering is particularly full and lively. Spending most of his time at the geological section, he heard Charles Lyell speak on the origin of sand and gravel pipes in chalk deposits near Norwich, which prompted an animated discussion by several other scientific lions, including Henry de la Beche, William Buckland, Roderick Murchison, and the Marquis of Northampton. He reported the discussion, in which his fellow Quaker Thomas Hodgkin participated, arising from Prichard's paper on the extinction of various human races.[87] He also participated in organized visits to the Dudley caves, to an art gallery, the Geological Museum, the Medical Museum, a saw mill and a rolling mill, a gun factory (which supplied muskets 'for the infernal African trade'), a glassworks, and a papier-mâché manufacturer. Despite this

[86] Roderick Murchison to William Whewell, 2 Oct. 1831, in Morrell and Thackray (eds.), *Gentlemen of Science: Early Correspondence*, 77–9. In reply, Whewell wrote that the 'old Quaker philosopher [Dalton] . . . is indeed a most excellent person and I can only imagine how much of the right character he would give to the meeting': Whewell to Murchison, 10 Oct. 1831, ibid. 82–4.

[87] E.g. report of Lyell's paper and subsequent discussion in *Athenaeum*, 1839, 645–6.

full schedule, he encountered several Quakers living in the Birmingham area.[88] At Ipswich twelve years later he heard contributions by such luminaries as the astronomer George Airy, the palaeontologist Richard Owen, and the geologists Charles Lyell and Adam Sedgwick. Perhaps the high point of the Ipswich meeting was a dinner with 'the most eminent Savants', at which he had 'the pleasure of conversing with [Michael] Faraday, the greatest of English Chemists'.[89]

Although Lucas attended alone, Robert Were Fox from Cornwall often travelled to meetings with his wife and his adult children; hence the diaries of Barclay Fox and Caroline Fox shed considerable light on the participation of young Quakers in these annual celebrations of science. Barclay attended four meetings between 1835 and 1841, and recorded his impressions of the speakers, cultural visits, and even the fleas that assaulted him at night during the Dublin meeting.[90] He was often separated from the rest of the family and allowed greater freedom than his sister, who had to be chaperoned throughout the meeting. Yet Caroline's journal is particularly important for her insights into the role of women at BAAS gatherings. Women formed a sizeable constituency and one that the organizers soon recognized as important to the success of the meeting. Although they were barred from both participating in committees and attending banquets, and rarely read papers, yet women were generally viewed as essential both to the genteel ethos of the event and to the finances of the Association.[91]

Caroline, aged 18, accompanied her father and brother to the 1837 Liverpool meeting, where she conversed with her father's friends. They talked to the 'most agreeable and enjoyable' Charles Wheatstone, who informed them of his telegraphic researches, which enabled communication between Liverpool and London. Next morning they walked with the scriptural geologist Sharon Turner, and met other scientists during their perambulations, including Sir William Hamilton (the Irish astronomer and mathematician, whom she described as a 'delightful person') and Lord Burlington. She visited the residence of Sir Charles Lemon, where she met his sister, Lady Harriet de Dunstanville. The social round was punctuated by papers, including ones by David Brewster, the polymath William Whewell, and the electrician William Snow Harris. Some speakers enjoyed playing to the gallery, particularly if it was crowded with women: 'after saying many soft things to the soft sex, our glorious chairman [Adam Sedgwick], . . . gave the moral of the science

88 Bryant and Baker (eds.), *Quaker Journal*, i. 176–80.

89 Ibid. ii. 450–1. For the 1860 Oxford meeting see ibid. 538.

90 Brett (ed.), *Barclay Fox's Journal*, 79–82, 94–5, 115, 238–40.

91 Morrell and Thackray, *Gentlemen of Science: Early Years*, 148–57; Browne, 'A glimpse of petticoats'.

[geology], that if he found it [to] interfere in any of its tenets with the representations or doctrines of Scripture, he would dash it to the ground'. In another delightful vignette Caroline describes a breakfast at which she sat between Lord Compton and the Marquis of Northampton, who aimed some critical remarks against phrenology. During the ensuing discussion this plucky 18-year-old Quaker argued vociferously with the Marquis (who became the next President of the Royal Society).[92] As Janet Browne has noted, social rank could sometimes be more important than gender.[93] Caroline's position, as daughter of a well-known and highly respected scientist, enabled her to mix freely not only with leading scientists but also with aristocrats.

We gain another rare insight into the participation of female Quakers from an incident that occurred at the 1838 Newcastle meeting, which was particularly well attended by women, because local members had insisted on paying an extra subscription that entitled them to bring female guests. One of the lectures delivered before the Natural History Section was by Richard Owen, the comparative anatomist, who subsequently claimed that 'Mrs Buckland and lots of ladies, *mostly Quakeresses*', were present. However, since he was talking about marsupials, he was forced to modify 'the reproductive part . . . as delicately as possible'.[94] That Owen singled out 'Quakeresses', who would have been readily identifiable by their dress, indicates that they constituted a visible and sizeable group at his lecture. Although some Quaker women would have come from other parts of the country, their prominence at Newcastle was in part owing to the existence of a large local Quaker community with strong links to science and industry.

The next meeting, which was held in Birmingham, included a session at which Quakers were again much in evidence. As we shall see in the next section, Quakers were prominent in the Aborigines' Protection Society, which sought to draw attention to the exploitation of indigenous peoples. Prior to the Birmingham meeting, Thomas Hodgkin, the Society's Secretary, persuaded the BAAS to mount a session at which the ex-Quaker anthropologist James Cowles Prichard spoke 'On the extinction of human races'. His address was attended by 'crowds of most respectable people, male and female, [who] assembled at an early hour, and completely filled, in a short time, the spacious apartment'. Even standing room was at a premium.[95] In his 'very forceful and pertinent' talk Prichard urged support for the Aborigines' Protection Society and the need for urgent action to prevent aboriginal groups from extermination by Western colonialization. After the paper Hodgkin and several others

[92] Pym (ed.), *Memories of Old Friends*, i. 41, 259–60; ii. 103.
[93] Browne, 'A glimpse of petticoats'.
[94] Owen, *Life of Richard Owen*, i. 126; italics added.
[95] Gibson, *Rambles in Europe*, 274.

were engaged in an extended dispute. One of those summoned to speak was a visiting American physician, William Gibson, a non-Quaker friend of Prichard's from their student days at Edinburgh. Somewhat alarmed to find that tempers were becoming frayed during the discussion period, Gibson tried to avoid having to declare his own views in public. Prichard, however, insisted that, with his experience of native Americans, he should settle some contentious issue. Much to Prichard's consternation, Gibson supported the opposing camp, even arguing that, rather than try to preserve their indigenous culture, native Americans should be encouraged to marry Caucasians! This proposal and the subsequent suggestion that it should be implemented by sending 'respectable spinsters from the British Isles' earned Gibson the contempt of Prichard's supporters and particularly 'the Quaker ladies present'.[96] The near riot at this session must have alarmed the organizers of the BAAS, who considered that science should be pursued in a calm and apolitical environment.[97] After the meeting, Prichard persuaded the BAAS to assist the Aborigines' Protection Society by providing a small sum of money in order to draw up a questionnaire that would glean ethnological data from travellers. Such a questionnaire could be tolerated, but the patently political agenda of the Aborigines' Protection Society did not sit comfortably with the Association's aim of creating a broad following for science by appealing to its apolitical, non-sectarian, and progressivist ethos.[98]

Such eminent Quakers as Fox and Hodgkin were highly regarded by participants at these meetings. As one visitor commented after the 1839 Birmingham gathering, Hodgkin had clearly been a 'favourite', especially among the medical men present, who 'greeted him in the kindest manner'.[99] Yet the Quaker with the highest profile at early BAAS meetings was undoubtedly John Dalton, the elder statesman of science from Manchester, who came to symbolize 'non-sectarian endeavour, provinciality, virtue, self-help and scientific genius'. In 1831 he delivered two papers at York, where he 'became the life of the Meeting' and 'delighted us all'. At Oxford in 1832 he was one of four distinguished Dissenters who were awarded honorary degrees at an imposing ceremony. In the following year at Cambridge, he was loudly cheered when news reached the meeting that he had been awarded a Royal pension. Since many of his Manchester contemporaries did not share his

[96] Gibson, *Rambles in Europe*, 275.

[97] *Athenaeum*, 1839, 704.

[98] Kass and Kass, *Perfecting the World*, 390–1; Morrell and Thackray, *Gentlemen of Science: Early Years*, 284–5.

[99] Gibson, *Rambles in Europe*, 280. At the 1844 meeting Hodgkin presented a paper on the evolution of the dog—see Hodgkin, 'On the dog'. According to *Punch* (7 (1844), 159), this worthy Quaker 'imitated the barkings' and 'various looks' of dogs.

enthusiasm for the BAAS, he faced an uphill struggle in persuading local interest groups to work together in order to bring the Association to their city. The first Manchester meeting was not until 1842, by which time Dalton had suffered two strokes and was no longer able to play an active role. However, his name was evoked as the local scientific hero, and his spirit—though not his body—pervaded the meeting. A medallion was struck for the occasion, showing Dalton's profile, and a gold copy was presented to him at a small and select gathering.[100]

As Jack Morrell and Arnold Thackray have stressed in their history of the BAAS, early meetings were dominated by Dissenters and Broad Anglicans. Clearly, Quakers conformed to the Association's ethos. They would have found the Whig, reformist ambience congenial; no oaths were required and no religious tests; instead, the meetings were open to all—at least all who could afford tickets (which included the majority of scientifically informed Quakers).[101] The Quakers who attended these annual gatherings, both men and women, mingled freely with the other genteel ticket holders. Indeed, the Association was particularly attractive to Quakers because it enabled them not only to meet other Friends, but also to encounter other respectable people, from outside the restricted Quaker community, who shared their scientific interests. However, less charitable motives were attributed to William West (1792–1851), the Leeds Quaker pharmacist, by one contemporary, who noted his enthusiasm for evening promenades which enabled him to appreciate the 'unreserved appearance of beautiful women than is strictly allowable in their own [Quaker] circles. . . . Between friends, West is a nuisance.'[102]

In contrast to the prominence of Quakers at BAAS meetings, Jews rarely participated. In 1842 the *Voice of Jacob* reported that a Professor Möser (who was either Jewish or a convert to Christianity) had read a paper on an improvement to photography at the recent meeting in Manchester. Subsequent occasional reports appeared in the Jewish press concerning the participation of Jews; for example, a paper by Mr Sturm, a Viennese optician, was read in 1855.[103] Subjects of specifically Jewish interest were sometimes reported, albeit fairly briefly. Thus, a report appeared in 1862 of a heated discussion on the subject of consanguinity (the marriage of cousins being permitted under Jewish law), and, in the following year, Benjamin Ward Richardson's paper arguing that Jews possess superior health to Christians

[100] Morrell and Thackray, *Gentlemen of Science: Early Years*, 228, 396–406. On a later BAAS meeting in Manchester see Sturge, 'A sketch of the British Association'.

[101] Morrell and Thackray, *Gentlemen of Science: Early Years.*

[102] W. Hatfield to J. Phillips, 11 Aug. 1844, ibid. 444–7.

[103] *VoJ*, 7 Oct. 1842, 36; *HO*, 6 Oct. 1854, 530.

was warmly welcomed.[104] The first substantial report of a BAAS meeting was carried by the *Hebrew Observer* in 1855, but we have to wait until 1868 when, probably owing to Michael Henry's intervention, meetings began to receive fairly extensive coverage in the *Jewish Chronicle*.[105]

While the few established Jewish scientists like Sylvester participated in meetings of the BAAS—he was a Vice-President of Section A (Mathematics and Physics) in 1875—other Jews rarely attended. One notable exception was Bethel Jacobs (1812–69) of Hull. As the Association was not a metropolitan society, but met every year in a different city, Jacobs typified its provincial following. A silversmith and leading member of the local Jewish community, he was a well-known local figure and served on the town council for three years. A stalwart of the Hull Literary and Philosophical Society, he was twice elected its President, and delivered papers on such subjects as 'On the characteristics of animals named in the Hebrew Scriptures'. A Freemason and a lieutenant in the East Yorkshire Regiment, he helped organize the Hull General Infirmary, the Mechanics' Institute, the Dispensary, the Ragged School, and the Subscription Library. In his 'intense self-conscious civic earnestness and attachment to Jewish tradition and practice', writes Israel Finestein, 'he was the archetype of the educated, well-read and self-reliant element among middle-class Jews of the emancipation era'.

Although Hull had previously offered to host the annual meeting, in the early 1850s Jacobs worked hard to generate local support for attracting the BAAS. He was one of the delegates from the Hull Literary and Philosophical Society to attend the 1852 meeting in Belfast, where he made a strong and successful bid for the following year. Jacobs was also prominent in raising money and in persuading his fellow citizens that the forthcoming meeting would result in a significant boost to the cultural, educational, and economic life of the city. As one of the two Local Secretaries, he shouldered much of the responsibility for organizing the meeting. He also served on the committee of Section E (Geography and Ethnology). Yet, despite Jacobs's prominence at the Association's meeting, it failed to attract other members of the Hull Jewish community.[106] Unlike Quakers, most Jews evinced no enthusiasm for this annual celebration of science, and their absence from its meetings further confirms the widespread indifference to science by the mid-nineteenth-century Jewish community.

[104] *JC*, 24 Oct. 1962, 7; 7 Sept. 1866, 5; 11 Jan. 1867, 7.

[105] *HO*, 20 Oct. 1854, 552; *JC*, 4 Sept. 1868, 4.

[106] Finestein, 'Jews of Hull', 77–80; *Thirtieth Annual Report*; [BAAS], *List of Resident and Non-Resident Members.*

4.3 The Aborigines' Protection Society and the Ethnological Society

James Cowles Prichard, Henry Christy, Thomas Hodgkin, and Edward Burnett Tylor were among the better-known Quakers and ex-Quakers who contributed to the early histories of ethnology and anthropology. Yet their writings in these areas were informed by the Quaker opposition to slavery and concern to prevent the sufferings of 'aborigines'. Moreover, these Quakers and ex-Quakers adopted a perspective which, while not totally unique, set them apart from most British ethnologists and anthropologists.

Prichard's first engagement with ethnology was his 1808 Edinburgh medical dissertation. Five years later, his *magnum opus*, *Researches into the Physical History of Man*, appeared in print, by which time he had married the daughter of a Unitarian, left the Quakers, and joined the Anglican Church. The problem that inspired this work, and the dissertation on which it was based, was how to explain human diversity. He collected information from the ancient historians, from travellers, from orientalists, and from military men concerning the peoples of Egypt and India, the Celts, Moguls, Easter Islanders, and many other 'races'. Yet the information contained in his book was pressed into the service of one major thesis. It is said that at an early stage in his ethnological studies he was advised by his Quaker father never to forsake the biblically justified certainty that all human races were derived from Adam and Eve. Whether or not in obedience to his father, in his *History of Man* Prichard argued strenuously for monogenism—the unity of the human races, since all races are descended from the first family. In order to explain the considerable differences between the currently existing races in various geographical regions, he appealed not to the idea of separate origins but to such causes as differences in climate and the modifying power of civilization.

Although an avowedly secular work, the *History of Man* was prompted by Prichard's concern to reconcile the apparent diversity of races with the Bible. As he wrote in his preface: 'My attention was strongly excited to this inquiry ...by happening to hear the truth of the Mosaic records...denied on the alleged impossibility of reconciling the history contained in them with the phænomena of Nature, and particularly with the diversified characters of the several races of men.'[107] For Prichard, as for other evangelical Friends, belief in the veracity of the Bible, combined with a commitment to treat aborigines as brothers, led them to adopt the monogenist theory.

A similar outlook was adopted by Hodgkin, Prichard's Quaker friend and biographer. For example, in a paper read before the Ethnological Society at its

[107] Symonds, *Some Account of the Life...James Cowles Prichard*; Hodgkin, 'Obituary of Dr Prichard'; Prichard, *Researches*, p. ii.

foundation meeting in 1844, he outlined his views about the emerging science of ethnology, noting that a major issue facing ethnologists was whether the different human races were derived from the same stock (monogenism) or whether they represented distinct species (polygenism). Hodgkin portrayed the former position as 'actually embraced by many of the best inquirers', and as an issue that had been resolved scientifically. Moreover, he turned to the Bible as providing evidence that confirmed this viewpoint. But he also sought to clear ethnology of the charge that it might challenge religion: 'I am glad to have this opportunity of expressing my firm persuasion, that religion has nothing to fear from the strictest scrutiny of the characters and history of varieties of mankind.' However, he also argued that the most civilized races had developed from races very similar to presently existing uncivilized peoples. Thus, just as naturalists could reconstruct the historical development of earlier animal species, ethnologists could trace the history of the various races of humans. In this sense Hodgkin was an evolutionist.[108]

During the middle decades of the nineteenth century, Quakers were prominent in the movement to protect those indigenous inhabitants whose existence was threatened by British commercial, military, and political interests. Events in Africa, especially the sixth 'Kafir War', in which many aborigines were slaughtered by the Boers, and the situation of the indigenous people in the Cape Colony, were specific causes of concern. Thus Hodgkin argued at the 1837 Meeting for Sufferings that Quakers should form a committee to investigate the condition of aborigines in the British colonies. Hodgkin was also active in orchestrating the Aborigines' Protection Society, founded in 1837; the main mover was Thomas Fowell Buxton (1786–1845), an ex-Quaker philanthropist, who had been the major proponent of the bill, passed by parliament in 1833, for the abolition of slavery from the British colonies. The Aborigines' Protection Society set out, first, to collect accurate information from travellers about the conditions of 'the defenceless or uncivilised tribes'. Second, it aimed to disseminate such information through inexpensive publications, in order to influence public opinion. Finally, it sought to influence those who (directly or indirectly) affected the quality of life of the aborigines. The Society saw itself as a pressure group on governments, administrators, and European settlers, who needed to be persuaded that aborigines should be treated humanely. Although many in the Society were evangelicals, it sought to persuade Europeans to behave humanely towards aborigines, and was less concerned with converting them to Christianity.

The Aborigines' Protection Society struggled on its meagre subscriptions, which were totally inadequate to fund the vast agenda set by Hodgkin and his

[108] Hodgkin, 'On the progress of ethnology', 119, 126–8. See also *idem*, 'On the dog', 1098.

associates. Yet, as the Society's motto made clear, its members were committed to the view that, since the human races form a unity, the aborigine is no less human than the European. The motto—'Ab uno sanguine'—and the frontispiece of its journal, *The Colonial Intelligencer; or, Aborigines' Friend* (Fig. 4.2), summarize the underlying ethos. Of the donors and life members listed in 1851, nearly 60 per cent were Quakers, and a further 15–20 per cent were descended from Quaker families. These lists read like a roll-call of the most prominent British Quakers, including many Quaker elders. Samuel Gurney, the banker, was President and Hodgkin the Honorary Secretary.[109]

By the early 1840s the agenda promoted by the Aborigines' Protection Society was becoming a source of dissension. Moreover, the Society was frequently in conflict with missionary societies, settlers, and other parties who pursued their own self-serving policies towards aborigines, but ignored their welfare. However, during its early years the Society succeeded in collecting substantial amounts of information about other cultures. This orientation appealed to some of its members, who began to pursue ethnology as a scientific project relatively independently of the Society's humanitarian concerns. This project appealed particularly to Richard King, the Society's Honorary Secretary and a non-Quaker, who in 1842 issued a prospectus for a new organization devoted to the study of ethnology. Although the response was initially rather muted, during the ensuing months he attracted enough support to found the Ethnological Society of London, in January 1844.[110] In his prospectus King had argued both that the new Society was necessary in order to 'complete the circle of the sciences' in London and that it should be devoted to 'the promotion and diffusion of the most important and interesting branch of knowledge, that of man,—ETHNOLOGY'. Although some of its members were drawn from the Aborigines' Protection Society, many were not.[111] While humanitarianism remained a significant motive for some, especially Hodgkin, the new Society was not explicitly committed to this objective. Quakers were less prominent in this new Society, although during its early years Prichard served as President, Hodgkin as Vice-President, and a trickle of Quakers and ex-Quakers joined, including Henry Christy, George Buxton, T. Harington Tuke, Joseph Lister, and Edward Tylor.

The early minutes of the Ethnological Society indicate that it struggled to survive. Fees were insufficient to maintain its activities and its library; new

109 'List of donors and subscribers for the year ending 31st December, 1851', *Colonial Intelligencer; or, Aborigines' Friend*, 4 (1852), 12–13.

110 Stocking, 'What's in a name?' On the role of Hodgkin, see Kass and Kass, *Perfecting the World*, 373–400.

111 List of Members of the Ethnological Society, MS A/2:1, Library of the Royal Anthropological Institute. Few Quakers straddled both societies. Cf. Stocking, 'What's in a name?'

APRIL.] [1852.

FIFTEENTH

ANNUAL REPORT

OF THE

ABORIGINES' PROTECTION SOCIETY.

LONDON:
PRINTED AND PUBLISHED FOR THE SOCIETY,
BY C. GILPIN, 5 BISHOPSGATE WITHOUT;
AND MAY BE HAD ALSO OF MESSRS. WARD, PATERNOSTER ROW.

Fig. 4.2. The fifteenth annual report of the Aborigines' Protection Society (1852), emphasizing the unity of the human races—'Ab uno sanguine'. The same device was used on the cover of *The Colonial Intelligencer; or, Aborigines' Friend*, which the society also published. Reproduced with the kind permission of Anti-Slavery International.

members were few, and many resigned within a few years of election; its periodical publications appeared irregularly, and ceased altogether for a decade after the appearance of the 1856 volume.[112] Moreover, the Society became a battleground between the (predominantly Quaker) monogenists and the supporters of the polygenist theory. According to James Hunt, a polygenist, the Quaker contingent had in 1855 been responsible for blackballing the application of Robert Knox, who had argued in his *Races of Man* (1850) that, far from humankind constituting a unity, each race was a distinct species. Knox had achieved notoriety in the mid-1830s as the anatomist at the centre of the Burke and Hare body-snatching case in Edinburgh. Hodgkin would not have wanted ethnology tarred by association with this dubious character and his racist views. However, recalled Hunt, Knox was elected as an Honorary Fellow, 'to the horror and indignation of the Quakers'. Furthermore, when John Crawfurd, another polygenist, was elected President in 1858 he was, according to Hunt, treated by the Quakers in 'neither a friendly nor respectful' manner.[113]

Yet the growing dissatisfaction with the Ethnological Society resulted in a schism and the formation of the Anthropological Society of London. Hunt, who considered that the Ethnologicals had become moribund, was the main precipitator of this schism. Warmly supporting Crawfurd's election as President in 1858, Hunt particularly approved of Crawfurd's 'views on certain scientific subjects [which] had been far from popular with a faction of Quakers, who, headed by Dr. Hodgkin, were dominant in the Society'. This appears to be an exaggeration, since, although Hodgkin was doubtless highly influential in the Society's affairs, the 'faction of Quakers' constituted a small proportion of the total membership. In opposition to Hodgkin's commitment to the universality of humankind, Crawfurd and Hunt argued that the human races were of distinct origin. On this polygenist view, the exploitation of aborigines was justified by proto-scientific arguments based on physical taxonomy and by the assumption that the white races were manifestly superior. This orientation was subsequently to mar the reputation of the Anthropological Society, a number of whose members constituted themselves into a dining club which, with bravado, they designated 'The Cannibal Club'. Only

[112] Minute Book of the Ethnological Society, MS A/1, Library of the Royal Anthropological Institute.

[113] J. Hunt, 'Origin of the *Anthropological Review*', 432. Hunt's account of the Knox affair does not tally with the Society's minutes (cited in n. 112), which show that Knox had earlier been a member but was dismissed in 1845 for failing to pay his dues. Moreover, Hunt's claim that a vendetta had been waged against Knox seems difficult to reconcile with the minute showing that a copy of his *Races of Man* had been purchased for the Library in 1851.

in the early 1870s, after the deaths of the main protagonists, did a *rapprochement* occur between the two societies.[114]

For Quakers ethnology was unique among the sciences, since its subject-matter was intimately connected with Quaker social and ethical commitments. The sufferings of aborigines impinged directly on Quaker participation in that science, and they were therefore prominent in the Ethnological Society and in ethnological sessions held at meetings of the BAAS. By contrast, when other sciences were discussed at such societies as the Royal Society and the BAAS, Quakers were not encumbered by their own specific social and ethical commitments.

4.4 Quaker cultural and scientific organizations

Although many Friends pursued science, they rarely founded scientific institutions specifically for fellow Quakers. However, at the end of the eighteenth century, a small society that was dominated by Quakers met in the Plough Court Pharmacy, just off Lombard Street in the City of London. Founded in 1796, the Askesian Society—from 'ascesis', the practice of self-discipline—comprised mainly young men in their twenties who were enthusiastic about recent developments in science, particularly chemistry, mineralogy, and, latterly, electricity. For example, at one meeting members prepared and inhaled a recently discovered gas: 'It [nitrous oxide] had a remarkably inebriating effect', remarked one youthful experimenter.[115] Of the seventeen full members, at least ten were Quakers, including William Allen, William and Richard Phillips, and Luke Howard. These Quakers were from affluent backgrounds, and many were in the early stages of science-related careers. The Askesians also attracted visitors, including several other Quakers. The membership of this society, which lasted a little over a decade, overlapped with several existing, embryonic scientific organizations. Thus many of the same names appear on the membership lists of the Physical Society at Guy's Hospital, the British Mineralogical Society (founded in 1799), and the Royal Institution (founded in 1799), while subsequently several became Fellows of the Royal Society.[116] The active participation of these young Quakers in

[114] J. Hunt, 'Origin of the *Anthropological Review*'; Stocking, 'What's in a name?'

[115] [W. Allen], *Life of William Allen*, i. 47.

[116] Inkster, 'Science and society in the metropolis'; Weindling, 'British Mineralogical Society'. The ten Quaker members were William Allen, Arthur Arch, Dr Joseph Fox, Joseph Fox, Luke Howard, Richard Phillips, William Phillips, Samuel Mildred, Joseph Woods, and Samuel Woods. Another member, William Haseldine Pepys, adopted Quaker habits, but appears never to have joined the Quakers; see Searle, 'William Haseldine Pepys'.

London science indicates the existence of a new generation that was keen to participate in the latest scientific developments and looked to science as a career or a pastime that conformed to their religious beliefs.

Turning to the Quaker community at large, the founding of the *Friend* and the *British Friend* in 1843 provided new public forums in which to air Quaker issues. However, the more evangelical *Friend* paid considerably greater attention to scientific topics than did its more traditionalist rival. For example, the first volume included a series of letters (aimed at younger readers) discussing a wide range of astronomical phenomena.[117] During the next few years articles appeared on several other sciences, including ethnology, botany, meteorology, chemistry, geology, and, more contentiously, phrenology. In keeping with Quaker humility, neither periodical commented on the innovations or successes achieved by Quakers. Instead, reports engaged a wide range of scientific and technological issues. Some were of general interest and possessed no specific connection with Quakerism: for example, a report of Michael Faraday's Royal Institution lecture on 'The philosophy of the tea-kettle' and an anecdote about honey-bees (copied from Edward Newman's *Zoologist*).[118] On the other hand, a report of a series of lectures on the cotton trade more directly engaged Quaker business and humanitarian concerns.[119] Particularly relevant to Quaker religious concerns was the inclusion of an article on the interpretation of the 'fourth day' of Genesis and an extract from Edward Hitchcock's *Religion of Geology* on the relevance of the sciences to humankind's future state.[120] Although the *Friend* carried both book reviews and reports, the latter sometimes being transcribed verbatim from other sources, Quakers also contributed a number of original articles. The quantity of scientific material included varied, depending in part on the editor's interest in scientific issues. Alfred Bennett's editorship, which spanned the period 1858–66, reflected his scientific and especially botanical interests, and also his friendship with Newman, who wrote a regular natural history column. The *Friends' Quarterly Examiner* (founded in 1867) carried longer signed articles, including a number that explored scientific issues. These periodicals will receive further analysis in the examination of Quaker responses to Darwin in Chapter 7.

Science was also disseminated through the libraries at Quaker meeting-houses. The extent of these libraries can be gauged from a report issued by the York Quarterly Meeting, which noted that under its jurisdiction there were

[117] *Friend*, 1 (1843), 76.
[118] *Friend*, 8 (1850), 193–4.
[119] Ibid. 8–9.
[120] Ibid. 114; 9 (1851), 172.

thirty-nine libraries, each of which contained on average 120 volumes.[121] The records of the Friends' Institute in Dublin show that in the early 1850s the stock numbered some 1,500 volumes, with borrowings running at about 1,770 per annum. Of these, 6 per cent were works on science, including natural history, with travel and topography accounting for another 24 per cent. For the Birmingham Friends' Reading Society the same categories yield 10 and 17 per cent respectively, on a rather lower borrowing rate for the years 1855–7.[122] Such figures indicate that science books were in reasonable demand in these libraries patronized exclusively by Quakers.

Especially in some of the larger cities, Quaker Meetings often organized educational ventures. For example, in the late 1850s the *Friend* carried advertisements for forthcoming lectures at the Birmingham Friends' Reading Society, the Dublin Mutual Improvement Society, the newly opened Manchester Friends' Institute, the North Shields Friends Literary and Scientific Institution, the Stoke Newington Mutual Instruction Society, and the Liverpool Friends' Essay Society.[123] Approximately a quarter of these lectures were on scientific subjects, often delivered by Quakers proficient in science, although occasionally by local non-Quakers. For example, the Birmingham society sponsored lectures on the chemistry of the atmosphere and on the life and work of John Dalton, while the Dubliners heard talks on 'The varieties and distribution of the human race' and on respiration. Science, then, engendered significant interest in Quaker circles.

Nineteenth-century Newcastle provides a rich case study of local Quaker cultural and scientific activities, including the only instance of a Quaker society devoted solely to science. Although Meetings had been founded in Newcastle and Gateshead in the mid-seventeenth century, the increasing opportunities offered by the growth and industrialization of the Tyne estuary drew many Quakers to the area during the late eighteenth and early nineteenth centuries. John Richardson established a dynasty of Quaker tanners. William Beaumont, John Richardson Proctor, and Jonathan Priestman added to the number of Quaker tanners, while among the industrial chemists were Frederick Clark and members of the Clapham family, who from 1831 manufactured soda at the Friars Goose Chemical Works in Gateshead. The Quaker ironmaster Thomas Whitwell established a factory at Stockton on Tees, and several Quaker engineers worked in the Newcastle area, including Jeremiah Head, who was apprenticed to Robert Stevenson and later became a leading engineer in Cleveland.[124] Quaker bankers also gravitated towards

[121] *BF*, 10 (1852), 320–1.
[122] Ibid.; *BF*, 11 (1853), 296–7; 13 (1855), 286–7, 302.
[123] *Friend*, 16 (1858), and 17 (1859), *passim*.
[124] Campbell, *Century of Chemistry on Tyneside*.

Newcastle, while a local Quaker surgeon, Henry Brady, attracted several Quaker apprentices.[125]

Many of these Quakers were prominent in local scientific organizations, especially the Literary and Philosophical Society of Newcastle upon Tyne (founded in 1793) and the Newcastle Chemical Society (founded in 1868).[126] Moreover, Quakers founded the Newcastle Friends' Book Society in 1826, which continued well into the 1880s. Initially limited to twelve members, it attracted both men and women from the leading Quaker families. The Society's prospectus articulates its rationale:

> The Society of Friends are not more generally distinguished by their Religious Peculiarities than for their general character for Intelligence. It has long been a desideratum with the best informed and most enlightened members of our Society, to encourage the acquisition of useful knowledge, and utterly to preclude that of a decidedly hurtful tendency.

The need for such a society was further justified by the all too ready access that public libraries allowed to 'books of an injurious tendency'.[127] Works on religious topics, biographies (especially of Quakers), history, geography, and travel dominate the lists of purchases. In the early years books on scientific subjects were far less prominent. Among the first to be ordered were a two-volume work on scriptural geology by Granville Penn and Robert Dick's *Christian Philosopher*, which articulates divine design. Subsequently a rich diet of scientific works was offered, including Justus von Leibig's *Chemistry and Physics*, Roderick Impey Murchison's *Siluria*, Hugh Miller's *Old Red Sandstone*, and Thomas Henry Huxley's *Physiography*. Many of the periodicals purchased, including the *Eclectic*, *Edinburgh*, *Westminster*, and *Monthly Reviews*, regularly carried substantial articles on scientific subjects.[128]

A particularly interesting development was the founding in 1853 of another Askesian Society, which held its meetings in the Newcastle meeting-house and lasted 'rather more than five years'. Unfortunately, the minute-book of this society has not been located, but its membership appears to have been limited to Quakers. That these Newcastle Quakers chose the name 'Askesian' indicates that they sought to emulate their London namesake that had existed half a century earlier. Although little is known of the proceedings of the Newcastle Askesians, they held fortnightly lectures and followed their London

[125] Phillips, *History of Banks*, 284–6; Corder, *Life of Robert Spence Watson*, 14–15; Creighton, *Life and Letters of Thomas Hodgkin*, 55–6.

[126] Russell, 'Scientists'.

[127] 'Prospectus of Friends Book Society, Newcastle upon Tyne', fols. 1–2, Tyne and Wear Archives, microfilm 207.

[128] Ibid., *passim*.

counterparts by covering a wide range of scientific topics, including astronomy, chemistry, meteorology, and geology.

A Scientific and Literary Society was founded in 1855. From the limited information available, its membership overlapped considerably with the Askesians. With two non-Quakers among its membership, it was not confined to the Society of Friends and met in members' houses. Since it is sometimes referred to as the Literary Society, the scientific content may have been rather limited. Like the Askesians, this group was fairly short-lived, and apparently ceased functioning in 1859.[129] Most members of the Askesian and Literary Societies were in their early to mid-twenties and had attended one of the Quaker schools, usually Bootham, Wigton, or Ackworth. It thus appears that they were seeking to extend the scientific and literary interests that they had developed while at school only a few years earlier. Moreover, these young men were beginning to make their way in the world, in medicine, pharmacy, leather goods, but particularly in engineering.

4.5 Jews' and General Literary and Scientific Institution

In George Eliot's perceptive novel, Daniel Deronda visits the Hand and Banner public house and is introduced by Mordecai Cohen to a small group of earnest 'philosophers', which includes three Jews—a watchmaker, an optical instrument maker, and Mordecai himself (who works in a bookshop). The instrument maker describes himself as 'a rational Jew', who has little attachment to religious practice but is totally opposed to conversion. Among the topics discussed heatedly by these 'poor men given to thought' is whether Jews have made a contribution to civilization.[130] It is not known whether this fictional gathering was based on a discussion group that existed in the 1870s, but if it was, it is unlikely that its proceedings would have been recorded for posterity. However, the Victorian Jewish press did carry reports of a number of more formal organizations at which Jewish, literary, and scientific issues were discussed. The most prominent was the Jews' and General Literary and Scientific Institution (hereafter JGLSI), which existed for fifteen years around the mid-century.

The JGLSI was founded in 1844, principally to combat the charge that Jews had not made a substantial contribution to English culture—a charge we have already encountered on several occasions. Bemoaning this lack of

[129] The main source is Steel, *Historical Sketch*, 100–2. See also [Watson], *Reminiscences*, 6; *AM*, 1918, 95, where Daniel Oliver is referred to as a member of the 'Arkesian Society'.

[130] Eliot, *Daniel Deronda*, 444–60.

achievement, which allowed anti-Semites to claim that Jews were lacking in intelligence, the Jewish press argued that Jews could improve their position only through education. Yet, in contrast to the Quakers, Jews (especially poorer Jews) had few educational opportunities at this time. Outside the community there existed a vast array of educational institutions, including Mechanics' Institutes, which were intended for working men. Writing in the *Jewish Chronicle* in 1842, a correspondent noted that such institutes had 'effected a great revolution in the affairs of the working classes', but, he complained, there existed no such establishment where Jewish working men could be taught about literature and science.[131]

Over the next two years a small group of promoters formed round Hananal de Castro, a well-respected financier and community leader. With strong support from the Jewish press, they attracted subscribers and presented their proposals at a packed and enthusiastic meeting held in May 1844. Soon a building was obtained just off Leadenhall Street, within a reasonably short distance of the majority of London's Jewish population. It was renamed 'Sussex Hall', after the recently deceased Duke of Sussex, a son of George III and President of the Royal Society, who had supported Jews and Jewish causes. A magnificent ceremony was held on 20 January 1845: 'The theatre [which could hold 1,000] was filled to an overflow, almost wholly by members of the Jewish community of both sexes, and of every rank of life.' The Jewish aristocracy, headed by Sir Moses and Lady Montefiore and Sir Isaac Lyon Goldsmid, were much in evidence, as were the *dayyanim* (the judges in the Jewish court of law) and representatives of the London synagogues.[132]

It has been argued that the JGLSI was a Mechanics' Institute. However, the evidence, especially the subscription rate of 30*s.* per annum, indicates that, despite the intention of some of the projectors to cater for Jewish working men, it was directed principally to the wealthier artisans and the rising lower to middle sections of the middle class.[133] Modelled on similar societies outside the Jewish community, the JGLSI followed a well-established range of activities: it possessed a library, a reading-room, a museum, educational classes, and a large and imposing theatre where lectures were held. During each session between twenty and twenty-four lectures were delivered in the main Thursday evening series.[134] Musical and dramatic entertainments proved most popular. Lectures on English literature also attracted large audiences, as did such historical topics as the English Civil War and 'England under the Stuarts'—indicating the enthusiasm of this upwardly mobile section of the

131 *JC*, 14 Feb. 1842, 72.

132 *VoJ*, 31 Jan. 1845, 89–91: *JC*, 24 Jan. 1845, 81–4.

133 A. Barnett, 'Sussex Hall'; Cantor, 'Sussex Hall'.

134 Lists of forthcoming lectures were advertised in *JC* and *VoJ*.

Jewish community to learn about English culture and to identify themselves as English in outlook. A 'pilgrimage' was even made to Stratford-upon-Avon during the 1855–6 session.

Although considerable emphasis had been placed on scientific and technological subjects during the institution's early years, they proved less popular than did literary events. As the long-serving Secretary Morris Oppenheim admitted,

> when such eminent [scientific] men as D^{r} Lankester, D^{r} Letheby, M^{r} Robert Hunt, &c lecture in this institution, the hall has been very thinly attended, but when M^{r} George Dawson of Birmingham has lectured [on a literary or historical subject], Miss Glyn given her dramatic readings or M^{r} H^{y} Phillips his Vocal Entertainment, the Hall has been crowded; . . . at scientific lectures only 4 or 5 shillings are taken for admission from members friends, whilst on other evenings as many pounds are received.[135]

By the mid-century this complaint was to be heard in many similar institutions. None the less, the JGLSI followed other improving institutions in its choice of scientific topics, among the most popular being astronomy, chemistry, electricity, physiology, and recent technological developments, such as the telegraph. The men who delivered these lectures were either established members of the scientific community or professional lecturers, or sometimes a combination of the two. Science lecturers included Henry Letheby (Lecturer in Chemistry at the London Hospital), Edward Brayley (Librarian and Lecturer at the London Institution), Edwin Lankester FRS (writer on medical and scientific topics), William Benjamin Carpenter FRS (Professor of Physiology at the Royal Institution), Robert Hunt (Lecturer at the Royal School of Mines), and that supreme showman John Henry Pepper (Lecturer at the Royal Polytechnic in Regents Street). Lectures were often illustrated by diagrams and experimental demonstrations. As with literature, a smattering of scientific knowledge was deemed an essential acquisition for the cultured English man and woman.

When Sussex Hall first opened, it offered classes in Hebrew, German, French, and mathematics (which soon ended). Although the languages were taught over a number of years, only the French class attracted significant numbers. The only group that flourished was the discussion class that met on Sunday evenings.

The institution's sizeable library was a further attraction. Augmented considerably by donations, the library stock expanded rapidly to some 4,000 volumes. As the 1847 catalogue indicates, the collection was strongest in the areas of 'History & Antiquities', 'Voyages, Travels & Geography', 'Poetry

[135] Morris Oppenheim to George Grove, 29 Apr. 1852, MS PR.GE/119/15, Archives of the Royal Society of Arts.

& Drama', and, not surprisingly, 'Novels, Tales and Romances'.[136] By contrast, the stock of scientific and technical books was small, and did not reflect recent developments. Prominent among the works on natural history were several from Lardner's Cabinet Cyclopaedia by the prolific William Swainson, who subscribed to an idiosyncratic system of classification. Doubtless the library's most substantial scientific holdings were a set of 'Bridgewater Treatises' that offered solid overviews of major areas of science together with a predominantly non-denominational religious gloss. First published in the mid-1830s, these treatises formed the staple diet in the libraries of many improving institutions.[137]

Early in 1848 the level of subscription provoked an interesting reaction. A meeting held at the Montefiore Arms in Houndsditch attracted 150 working men keen to found a Jewish mutual instruction society. Subscriptions to this City of London Mechanics' Athenaeum and Mutual Instruction Society (hereafter Athenaeum) were set at 1*s*. a quarter (i.e. 4*s*. per annum) and 6*d*. a quarter for class books. This was a typical level for a Mechanics' Institute. In contrast to the experience of the JGLSI, the educational classes proved very attractive, with 140 young working men enrolled. Moreover, lectures were held on Friday evenings, so that working men could devote the Sabbath to rational instruction and thus be saved from the evils of the public house. Although some lectures were delivered by visiting speakers, who offered their services gratis, working men themselves often took to the podium. Many of the lectures addressed the practical applications of science, such as glass manufacture, the natural materials used by craftsmen, and the uses of wild flowers—topics that were not generally discussed at the JGLSI. Scientific, literary, and historical lectures were also popular, ranging from comic literature to astronomy and from English drama to the history of the French Revolution. The only specifically Jewish topic was a talk on the position of the Jews in England. During its short existence the Athenaeum proved an impressive example of a working-class self-help educational institution; in contrast to Sussex Hall, it was managed *by* working men, *for* working men.

Despite the initial enthusiasm and support of the Jewish press, this exciting educational venture survived for little more than a year. By early 1849, there were financial difficulties, and reports of its activities ceased after the end of March. Ironically, the demise of the Athenaeum affected the educational fare offered by Sussex Hall. Since many young operatives who had attended the Athenaeum's educational activities now possessed no institutional base, the management committee of Sussex Hall was persuaded to inaugurate a series

[136] *Catalogue of the Library of... Sussex Hall.* An addendum was issued in Oct. 1849.
[137] Topham, 'Science and popular education'; *idem*, 'Beyond the "common context"'.

of free Friday evening lectures in the autumn of 1850.[138] These proved very attractive, and for the first time brought significant numbers of working-class men and women to Sussex Hall. Compared with the regular lecture series, these free Friday lectures were primarily concerned with practical and improving topics, ranging from 'The eye' and 'Modern Egypt' to 'Popular fallacies' and 'The progress of the human mind'. The *Jewish Chronicle* repeatedly stressed the size, enthusiasm, and decorum of the working-class audience that gathered every Friday evening 'listening with gratifying attention to the remarks of the lecturer'. The 1,000-seat theatre was 'very full, occasionally even crowded'; indeed, these lectures were generally far better attended than the Thursday series directed to the JGLSI's subscribers.[139]

However, the JGLSI was also in financial difficulties by the mid 1850s.[140] A last-ditch attempt to enrol working-class members at a lower subscription rate failed to generate the necessary income, and the JGLSI was forced to close in the summer of 1859. Later in the century a number of attempts were made to provide education for adults; for example, the Sussex Jewish Literary Club existed for some years from the early 1860s onwards. By the mid-1870s an annual series of lectures was established for Jewish working men; thus Ellis Davidson spoke on technical drawing and human physiology, Lionel Alexander on photography, and Raphael Meldola on astronomy.[141] Yet, with these notable exceptions, there was no forum within the Jewish community for discussing or teaching scientific subjects on a regular basis.

Although the *Jewish Chronicle* carried occasional articles on scientific subjects, the Jewish press gave significantly less coverage to science than did the Quaker press. Most evident during the 1840 and 1850s were reports on the proceedings of the JGLSI and the short-lived Mechanics' Athenaeum. Occasional snippets of scientific and technological intelligence also appeared, such as a brief report on William Scoresby's magnetic experiments on board the ship *Royal Charter*.[142] The *Chronicle* also alluded to science and technology whenever an English Jew had made an innovation, such as patenting a new machine. For example, the gas engineer Nathan Defries was congratulated in 1849 on having obtained a contract to manufacture 'the Monster Gas Meter for the House of Lords', a feat that, according to the *Jewish Chronicle*, demonstrated the ability of Jews in the arts and sciences.[143] (As Defries noted with bitter irony, 'although a Jew is not yet allowed to sit in Parliament,

138 *JC*, 22 June 1849, 296–7.
139 *JC*, 4 Dec. 1857, 1236–7.
140 Discussed in Cantor, 'Sussex Hall'.
141 *JC*, 2 Jan. 1874, 670; 2 Apr. 1875, 845; 20 Feb. 1874, 788; 12 Jan. 1877, 6.
142 *JC*, 11 Jan. 1856, 443.
143 *JC*, 9 Feb. 1849, 147.

he nevertheless supplies the meter through which they [MPs] receive light, and the gas-stove by which the members' meals are cooked'.[144]) He also patented a bath that was supplied with hot water from a gas stove; this news item prompted the *Jewish Chronicle* to note 'that the Jews only require fair play to be on a par with Christians in arts and sciences'.[145] His firm's many public successes were also reported; for example, it supplied the illuminations at the wedding of the Prince of Wales, as well as the lighting fixtures in many institutions and private buildings, including those of 'Messrs Samuel Brothers of Ludgate Hill, the National Gallery, Treasury and War Offices'.[146] The examples of Defries and other scientists and inventors were mobilized to refute the perceived 'cultural deficit'.

In the middle of the nineteenth century the provision of science education for adults within the Jewish community was significantly less than that available to Quakers within their own community. The contrast is all the more striking when we remember that the Society of Friends was at that time approximately half the size of Anglo-Jewry. In part, the difference can be explained socially, since Quakers were predominantly middle class and comfortably settled, whereas the Jewish community included a large proportion of poor families and paupers. But, owing to the positive evaluation by Quakers of the sober study of nature, they were generally far more inclined than were Jews of a similar social standing to take an interest in science. Although much of Anglo-Jewry was upwardly mobile, both economically and socially, few middle-class Jews looked to science as a means of self-improvement, although to acquire a smattering of science and literature was considered appropriate. The JGLSI had been moderately successful in educating the Jewish middle classes in scientific topics, but, like the limited science content of the Jewish periodical press, its history reflects the community's low level of support for science. Paradoxically, the greatest enthusiasm for science is to be found not among the middle classes but in the working men's Athenaeum and in the free Sussex Hall lectures attended by working men and women. Both these initiatives were, however, short-lived.

4.6 The Great Exhibition

As Jeffrey Auerbach has insisted, the 1851 Great Exhibition of the Works of Industry of all Nations 'was throughout a protean event, its meaning diffuse

[144] *JC*, 4 Apr. 1851, 207. See Nead, *Victorian Babylon*, 89, for views of contemporaries, some of whom accused a Jewish business of using gas light ostentatiously.

[145] *JC*, 5 July 1850, 311.

[146] *JC*, 13 Mar. 1863, 5.

and subjective'.[147] In confronting that defining event of early Victorian Britain, every group and individual forged its own narrative. Thus for many protectionists it smacked of free trade, while others considered it a means of reasserting Britain's trading supremacy. Some claimed that it would increase the prospect for international peace, while others recoiled at the prospect of hordes of unwashed and dishonest foreigners descending on London. The working classes were divided between those who considered the Exhibition a means of bettering themselves and those who believed that it would only add to their oppression by making their masters richer.

While much has been written about social and political responses to the Exhibition, far less is known about the reactions of different religious groups. A secular tone was set by the composition of the Royal Commissioners, none of whom was a clergyman, although individual Commissioners ranged from devout Anglican to Unitarian. Yet, as in all aspects of Victorian life, religion was deeply implicated in the Exhibition. The Archbishop of Canterbury intoned a prayer at the grand opening ceremony, thus asserting the central place of the Anglican Church in a Crystal Palace filled with dignitaries, including many Dissenters, Catholics, and non-Christians. Although religious organizations played little role in mounting the Exhibition, they soon recognized that they could exploit it for their own purposes. For example, many churches in the vicinity of Kensington sought to extend their missionary activities by waylaying visitors. But the religious significance of the Exhibition can also be analysed through the participation of members of different religious communities. Thus Dissenters, drawn from both the London financial community and northern manufacturers, featured prominently among those who made large financial contributions to the fund supporting the Exhibition.

How, then, did British Jews and Quakers interpret the Great Exhibition? What roles did they play in that most public event? Although it is impossible to provide a definitive answer owing to the paucity of documentary evidence, the periodical press of both communities, supplemented by a small amount of other material, provides a basis on which to draw some meaningful comparisons. But the coverage of the Exhibition should be understood against the established norms in reporting scientific and technological topics in both the Quaker and the Jewish press. As noted above, the *Friend* carried considerably more on science and technology than did the *Jewish Chronicle*. Moreover, these subjects usually entered the *Chronicle* in its attempt to address the 'cultural deficit', either by citing examples of Jews who had succeeded in science and technology or by urging the need for Jews to be better educated.

[147] Auerbach, *Great Exhibition*, 56.

Jewish perceptions of the Exhibition were also affected by the contemporary struggle for political emancipation, which was approaching its peak in the early 1850s. Indeed, on the very day that the Queen opened the Exhibition, Lord John Russell moved the second reading of the Oath of Abjurations (Jews) Bill intended to remove the offending phrase—'on the true faith of a Christian'—and thus enable Baron Lionel de Rothschild to enter parliament. (Despite the Bill being passed by twenty-five votes, it was subsequently rejected by the House of Lords.) Reflecting on the Exhibition's magnificent opening ceremony at which Baron Rothschild had mixed freely with representatives of many different nations and also with the cream of English society, the *Jewish Chronicle* wryly noted that this most worthy English Jew was not permitted to take his seat in parliament![148]

4.6.1 *Preparation*

Beginning in December 1849, the *Jewish Chronicle* took a keen interest in the project, reporting that a Royal Commission was being established to instigate the Exhibition. A few weeks later the five treasurers, in whose names the Exhibition's account at the Bank of England was opened, were announced: all were respectable men of business. They were the brewer Arthur Kett Barclay, the merchant William Cotton, the banker and astronomer Sir John Lubbock, the builder Samuel Peto, and Baron Rothschild. Three of the five—Cotton, Peto, and Rothschild—were widely known for their philanthropic activities. The choice of treasurers reflects an interesting diversity of religious opinion, since three were Anglican, Peto was a prominent Dissenter, and Rothschild a Jew. In the choice of Rothschild the *Chronicle* considered that the reputation of the Jewish community had been enhanced, adding, 'Will the Lords again reject the man whom the Queen delighteth to honour?'[149]—a clear reference to the first occasion on which the House of Lords had dismissed the bill, thus preventing Rothschild from taking his seat in the Commons.

The project received the endorsement of the City at a crowded meeting held at the Mansion House on 25 January 1850. Under Prince Albert's watchful eye, several proposals were enacted that placed the project on a sound footing. Among these was Lord John Russell's proposal that the Exhibition should be liberally funded, and that the funds should be raised by voluntary contribution and not drawn from the public purse. Russell's motion was seconded by Rothschild, who was 'much applauded' when he rose to speak.

[148] *JC*, 2 Apr. 1852, 207. The Montefiores attended both the opening and closing ceremonies: Loewe (ed.), *Diaries of Sir Moses and Lady Montefiore*, ii. 23–5.

[149] *JC*, 11 Jan. 1850, 111.

Acknowledging that the exhibition would benefit the arts and manufactures and would spread 'the blessings of peace among the nations', Rothschild urged manufacturers to mount exhibits because, even if they did not win prizes, they were sure to benefit from the orders received. Returning to Russell's motion, he then implored those present to contribute generously to the scheme. However, he warned that if insufficient funds were obtained, then the exhibition would be a failure and a disappointment to Londoners. Prompted by Russell's and Rothschild's speeches, the City men assembled at the Mansion House subscribed over £10,000 that evening, with both Rothschild and his brother Sir Anthony de Rothschild giving £500 each, making them among the largest donors. David Salomons, the first Jewish alderman and a tireless advocate of emancipation, expressed the hope that the recent outbreaks of social violence would not be repeated in 1851 and donated 50 guineas.[150]

In the weeks leading up to the opening, the *Jewish Chronicle* enthusiastically carried reports of Jews who would be exhibiting: Nathan Defries would (of course) demonstrate innovations in gas engineering; Morris Lyons of Birmingham ('the first person to apply electro-deposition to the decorative art') would display examples of electroplating; and S. L. Finzi would exhibit several magnificent sets of teeth made from hippopotamus.[151] The Jewish community was ready to make its mark on this grand event that was both quintessentially English and excitingly international.

By contrast, preparations for the Great Exhibition failed to attract much reportage in the Quaker press, despite the fact that several Quakers had donated significant sums to Albert's appeal; Samuel Gurney, for example, gave £500. Again, when the names of exhibitors were published, neither the *Friend* nor the *British Friend* drew attention to the many Quakers among them.[152] Despite the large number of Quakers who exhibited or attended, this lack of reportage may indicate that the Exhibition was perceived as in some sense irrelevant to the life of the Quaker community. This is confirmed by an entry in the diary of Edward Pease, the ageing railway entrepreneur who visited the Exhibition for several hours during his trip to the Yearly Meeting in London. He was, he claimed, 'greatly gratified' by what he had seen and proclaimed the Exhibition 'most wonderful'. Yet he was clearly troubled by its inestimable impact on British society and sought to place the event in a proper religious perspective. The night after visiting the Exhibition he

[150] *Times*, 26 Jan. 1850, 5.

[151] *JC*, 28 Feb. 1851, 167; 7 Mar. 1851, 175, 179; 16 Apr. 1851, 219.

[152] Quaker exhibitors included Ransomes & May (agricultural implements, for which they received a prize medal), Robert Were Fox (a magnetized balance), Smith & Beck (microscopes), and Reckett & Son of Hull (starch). For information on exhibitors see *Official Catalogue of the Great Exhibition*; *Reports of the Juries*.

wrote: '[O]n laying my head on the pillow, and remembering how the day had been spent, I thought one hour's communing with, and a feeling of my Saviour's confirming, cheering love, was to me of more value than all my eyes beheld [at the Exhibition].' In religious terms—the only terms that really mattered—the numerous exhibits and manifold inventions were of no real significance. This sentiment was probably shared by many other Quakers.[153]

Although the official preparations for the Exhibition evoked little interest, in the months preceding the opening the Quaker community raised a number of concerns about the forthcoming event. One was whether the date of the Yearly Meeting, usually held in late May, should be moved so as to avoid a clash. This matter had been raised at the 1850 Yearly Meeting, which had asked the Meeting for Sufferings to maintain a watching brief and decide whether an alternative date should be adopted. Correspondents were divided on this matter. One writer in the *Friend* expressed the hope that the Meeting would not be moved, since Quakers visiting London the following May would then be able to attend both events and even bring junior members.[154] Another, who contributed to the more conservative *British Friend*, considered that it would be 'very undesirable that the young people who go to the Yearly Meeting, should have their attention divided between its sittings and the Exhibition'. Moreover, given the great influx into London, lodgings would be difficult to find.[155] As it transpired the Meeting was held at the normal time of year (although it did not attract as many as usual), but there was a heightened concern about security, lest unwelcome visitors should invade the proceedings.

Despite worries about security, the presence of large numbers of visitors, foreigners included, provided a welcome opportunity for Quakers to evangelize. Quakers visiting the Exhibition were urged to fortify themselves with tracts and pamphlets in various languages explaining Quaker beliefs and practices. One correspondent urged that Jonathan Dymond's *Essays on Morality*, first published in 1829, was particularly suitable.[156] In his editorial in the *Friend*, published on the day of the opening, Joseph Barrett reflected on the significance of the forthcoming event that had already attracted so much attention. While clearly supporting Albert's vision that the Exhibition would extend peace and industry, he also perceived its religious and moral significance:

[153] A. E. Pease, *Diaries of Edward Pease*, 295.
[154] *Friend*, 9 (1851), 16.
[155] *BF*, 8 (1850), 333.
[156] *BF*, 9 (1851), 115. Dymond, *Essays*.

To the serious mind, it will be suggestive of ideas of the power and goodness of God; for none can survey this vast assemblage of the products of nature, and of human skill, without being reminded that it is through His bounty, and under His control, that we are permitted to enjoy them—and well will it be if the moral sense of Christendom should be quickened to a more practical perception of the truth, that 'the earth is the Lord's, and the fulness thereof'.

Furthermore, the Exhibition would enable evangelicals to co-operate in their fight against both Catholicism and infidelity. Yet, having identified the opponents of evangelical Christianity, Barrett ended his editorial by also cautioning the faithful against the temptations that would accompany the Exhibition, invaded as it would be by hordes of people bent on amusement and evil. The forthcoming Exhibition thus represented exciting possibilities for the Quaker, but was also fraught with moral danger.[157]

An issue of specifically Jewish concern was raised by Morris Oppenheim, the Secretary of the JGLSI, shortly before the Exhibition opened. Writing to the Commissioners in a private capacity, he identified a problem faced by Jewish season ticket holders who wished to attend on Saturdays. Since a signature was required to gain entry to the Crystal Palace, observant Jews, who were not prepared to write on the Sabbath, were thereby debarred. Initially the Commissioners could not see any way to circumvent this difficulty.[158] However, after submissions by other Jews, including the persuasive Sir Moses Montefiore, a satisfactory solution was found; on *Shabbat* Jews could present themselves at a specified box office in order to gain entry without a signature.[159] This correspondence suggests that Jewish families were to be seen promenading in the Crystal Palace on Saturday afternoons, presumably having attended synagogue in the morning.

4.6.2 *Significance of the Exhibition for both communities*

In his account of the opening ceremony, the reporter from the *Friend* saw a young child run out among the honoured guests, transfixed by them and by the opulent surroundings. For this Quaker the image of childhood innocence symbolized the love, unity, and pacifism that characterized the Exhibition. Here were representatives of many nations prepared to abandon their traditional conflicts and work together in harmony.[160] For many Quakers the Exhibition connoted international peace, and its significance should, moreover, be understood in relation to the Fifth Peace Congress, which was held

[157] *Friend*, 9 (1851), 89.
[158] *JC*, 25 Apr. 1851, 227.
[159] *JC*, 9 May 1851, 247; Loewe (ed.), *Diaries of Sir Moses and Lady Montefiore*, ii. 24.
[160] *Friend*, 9 (1851), 99–100.

in Exeter Hall, some two miles away, in late July 1851. Delegates from several countries, including over a thousand from Britain, converged on the Congress. 'And once more', wrote the editor of the *British Friend*, 'this light [of peace] has been concentrated in a focus, in that city where the gathering of the people of all nations to share in the Industrial Jubilee of 1851 affords the best omen of the approaching realization of the brotherhood of nations.' The Crystal Palace exerted a magnetic attraction over all of London, and shaped the rhetoric deployed by the peace delegates. For them the Peace Congress and Albert's 'Temple of Peace' merged together in a unified chorus. Even in his opening remarks the physicist and Scottish Free Churchman Sir David Brewster, who occupied the presidential chair, conceived the Exhibition as a harbinger of the epoch of peace and harmony, and 'the first Temple of Peace that modern hands have reared'. Particularly apposite was the motto from Ovid's *Metamorphoses* (1: 25) that Albert had applied to the Exhibition: *Dissociata locis concordi Pace ligavi* ('What space has separated, I have united in harmonious peace'). Brewster added: 'This is to be our motto [of the Congress], and to realize it is to be our work.' Brewster also held up for praise the annual scientific meetings, such as the meetings of the BAAS, that performed a similar irenic function, since they 'revive our better feelings, and soften the asperities of rival and conflicting interests'. For Brewster, and doubtless for many of his audience, science and technology greatly promoted the progress of peace.

The confluence of these two momentous events provided a recurrent theme. One contributor likened the Crystal Palace to the Tower of Babel, since it gathered together into a single brotherhood speakers of many different languages. At another point in the proceedings a group of fifteen French working men were shepherded towards the dais; they had been sent to London by Victor Hugo and other philanthropists, in order to participate both in the Congress and in the Exhibition. Although members of many other churches participated, Quakers such as Charles Gilpin (publisher of the *Friend*), Joseph Sturge, and Samuel Gurney were among the principal speakers and most active participants. For Elihu Burritt, from New England, 'the lines of the Great Exhibition, and the annual Peace Congress of Christendom, have already merged into the great highway of peace and harmonious brotherhood. It is not our doing. It is the work of Divine Providence, and it is marvellous in our eyes.'[161] On another occasion, when in the company of Quakers, Burritt drew attention to 'the happy omen, indicated by the Great Industrial Exhibition, of a brotherhood of nations'.[162] For Quakers the

[161] Ibid. 141–53; *BF*, 9 (1851), 173–92.
[162] *BF*, 9 (1851), 195–6.

Exhibition's main religious significance lay in its role in promoting world peace. Not surprisingly, Quaker visitors were repelled by the gunnery displayed on the Spanish and American stands; these exhibits seemed so contrary to the pacifist ethos advocated so forcefully by Prince Albert.[163]

With extensive displays of the arts and manufactures from around the world, the Exhibition was a panopticon linking the visitor with nations and races previously encountered only in travel narratives. Thus the Exhibition displayed 'the character and position of each in the social scale of humanity'.[164] Yet it also engaged Quaker social concerns, especially on the topical issues of race and slavery. Writing in the *Friend*, James Bell expressed his admiration for the native crafts he had seen at the Exhibition, which clearly demonstrated that members of those races were not '*mere animals*... [but] differ from us rather in the *degree* than in the *kind* of skill they exhibit'. Looking forward to increased trade between England and these less advanced races, Bell also envisaged the potential for missionary work, since English Christians carried the responsibility of spreading the true religion and its associated system of morality.[165] Another correspondent reported the plight of a group of Caughnawaga Indians, from Sault St Louis, who had brought with them a large number of beautiful objects for display, only to face a heavy charge levied by customs officials.[166]

By contrast, the Jewish press drew a very different moral from the Exhibition. For the *Jewish Chronicle*, by far the most salient aspect of the Great Exhibition was the participation and success of a large number of Jewish exhibitors. While standing in the Crystal Palace, the editor, Marcus Bresslau, reflected on the question often raised by anti-Semites, 'Are the Jews given to Intellectual Pursuits?' Anyone inclined to answer in the negative should, he asserted, visit the Exhibition, 'official catalogue in your hand, [and] tell us whether among the many artistic and scientific benefactors and competitors which the mighty exhibition has drawn together, the derided and contemned Jew does not make a fair and honourable stand'.[167] In reports extending well into the autumn of 1851, the *Jewish Chronicle* drew its readers' attention to examples of Jews whose work was exhibited, ranging from Joseph Braham's patent spectacles to the great bed displayed in the needlework section by Faudell and Phillips.

One exhibit particularly attracted Bresslau's attention, since it symbolized the potential of Jews to contribute not only to technology but also to the

[163] *BF*, 9 (1851), 201.
[164] *Friend*, 9 (1851), 203–4.
[165] Ibid. 158–60.
[166] Ibid. 214.
[167] *JC*, 11 July 1851, 313.

highest levels of intellectual culture. During his perambulations he encountered at the Russian stand a calculating machine and its inventor from Warsaw, named Israel Abraham Staffel. So impressed was Bresslau that he devoted more than a full-page spread to it in the issue of 18 July, which also included a testimonial from the Imperial Academy of Sciences and an illustration of the machine (Fig. 4.3). As the *Jewish Chronicle* had not previously printed illustrations (except a few small advertisements), this departure signalled the importance that Bresslau attached to Staffel's invention. Not only did he describe the machine and its mode of operation, but he also noted that Staffel was widely acknowledged for his inventions, had displayed his calculator at the Imperial Russian court, and had received the patronage of various Russian and Polish nobles. Staffel was not merely an able mechanic, but a philosopher who rubbed shoulders with the intellectual giants of the day. The example of Staffel provided Bresslau with a convincing rejoinder to those who claimed that Jews were intellectually inferior.

Staffel also won the esteem of Sir Moses Montefiore, who invited him to his home, made him a 'handsome present', and lectured him on the importance of extending education in Russia and Poland. During one of their many visits to the Exhibition, Victoria and Albert examined Staffel's calculator and were greatly impressed. The Governor of the Bank of England also closely inspected the calculator and another machine, for testing precious metals, that Staffel had invented. This was later transferred to the Bank for further tests. As a

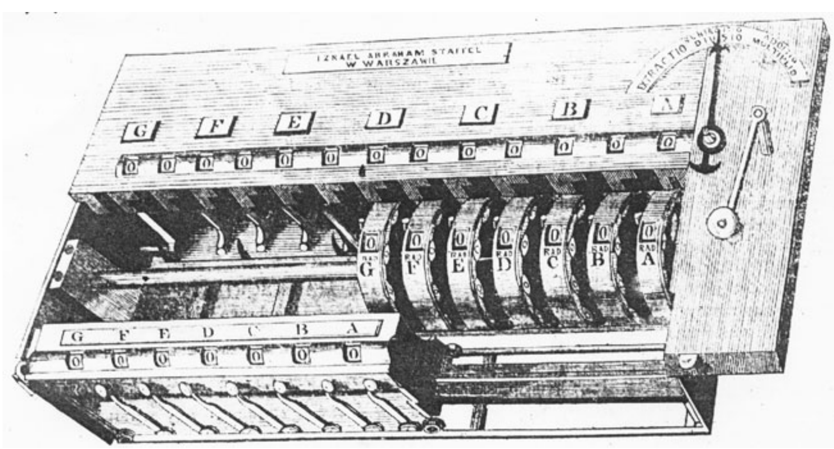


Fig. 4.3. Staffel's calculator, displayed at the Great Exhibition of 1851 and published in the *Jewish Chronicle*, 18 July 1851, 324. With the kind permission of the *Jewish Chronicle*.

coda to Staffel's successes in London, Prince Albert sent him £20, 'in appreciation for his invention'.[168]

The accolades accorded to Staffel and other Jewish exhibitors were reported with a sense of pride:

her Majesty and Prince Albert, accompanied by the Princess of Coburg and Saxe-Gotha, the Duke of Wurtemberg, and their suite, inspected Classes 5 and 6 [Machinery]; when our co-religionist, Mr. [Morris] Lyons, of Suffolk-street, Birmingham, had the honour of explaining the apparatus and process of bright electro-plating. Her Majesty graciously condescended to accept of a specimen, where she personally had seen developed the progress of the process. Prince Albert, having minutely examined the specimens and mode of their production, signalled his great pleasure at the improvement made in this branch of science. Mr. Lyons stand is the centre of attraction in this Class; and their Royal Highnesses, the Prince of Wales, Prince Alfred, and the Duchess of Gloucester; the Duke of Wellington, the Duchess of Sutherland, the Duke of Argyll, Earl Granville, Don Miguel, the Turkish Admiral, the President of the French Chamber of Assembly, Sir David Brewster, etc., have been among the crowd of distinguished visitors by whom Mr. Lyons is daily surrounded, and who have been gratified by receiving specimens.[169]

The *Jewish Chronicle* also identified those English Jews who were awarded medals by the panels of judges. A panel was appointed to assess each of the thirty classes into which exhibits were divided, and the winning entries were accorded either medals or honourable mentions. Among those awarded medals were Nathan Defries, Faudel and Phillips (needlework and embroidery), B. Jonas and brothers (cigar makers), Barnett Meyers (walking sticks), S. and M. Meyer (imitation furs), Moses, Son and Davis (tallow), and M. Myers and Son of Birmingham (steel pens).[170] Although the electroplating techniques developed by Morris Lyons, so admired by the royal family, were praised in the appropriate panel's report, Lyons did not win a prize. However, Staffel received a prize for his calculating machine, which was judged the best machine of its kind to be exhibited.[171] Three Dutch Jews and ten French Jews received medals, and a further ten French Jews received honourable mentions.[172]

Both Jews and Quakers considered that the Exhibition would have long-term beneficial effects. Thus the *Jewish Chronicle* praised as morally and politically valuable the visits by pupils from several Jewish free schools, with

[168] *JC*, 18 July 1851, 324; 25 July 1851, 336; 1 Aug. 1851, 339; 24 Oct. 1851, 23; 21 Nov. 1851, 55; Loewe (ed.), *Diaries of Sir Moses and Lady Montefiore*, ii. 23–4.

[169] *JC*, 13 June 1851, 287.

[170] *JC*, 24 Oct. 1851, 23; 24 Sept. 1852, 407.

[171] *Exhibition of the Works of Industry of all Nations*, 310.

[172] *JC*, 31 Oct. 1851, 30; 14 Nov. 1851, 47–8.

the financial help of some of the more affluent members of the community. The Exhibition, claimed Bresslau, 'is a mirror of reflection, and conveys a light to the youthful mind that will impress it with an eternal recollection of its wonders'. He envisaged that at a much later date these young visitors would come to recognize how their lives had been changed by the works of industry first seen at the Exhibition.[173] Quaker visitors, who were likewise enthusiastic about the 'the all-absorbing wonderful Exhibition',[174] also dwelt on its long-term consequences. Thus one Quaker, writing in the *Friend*, claimed that it would improve relations between working men and their employers, increase the dignity of labour, and inspire to high achievement poor children who visited the Exhibition. The model houses that Albert supervised would improve not only the living conditions of the working classes but also their moral state: 'The public-house will be deserted for his [the labourer's] own *home*.' International trade would also expand, bringing benefits to both the exporting and the importing nations. But, insisted this correspondent, trade with other countries possessed another crucial advantage; missionaries following the routes opened by traders would spread the word of God to the heathen.[175]

A more secular but still distinctly Quakerly assessment appeared in *The Grove House Magazine*, the house journal of the Quaker school at Tottenham, a few weeks after the Exhibition closed. While extolling the benefits of trade, this Quaker considered that

> [the Great Exhibition] has roused men's minds and spurred on their genius in order to complete some of the most wonderful inventions; it has stimulated the desire for excellence, and has shown to the world the astonishing effect of science; it has brought together the wonders and contrivances of every part of the globe; furnished men with a source of reflection for years to come; and united people of nearly every nation under its roof.[176]

Yet although both Jews and Quakers shared an appreciation of the Exhibition as a catalyst to invention and commercial expansion, evidence from the periodical press of both communities suggests that they interpreted this major public event very differently. For Jews, deeply concerned about their standing in British society and mired in their struggle for political emancipation, the Exhibition provided timely confirmation that they were not inferior to Christians but could stand proud because Jewish exhibitors had acquitted

[173] *JC*, 25 July 1851, 331.

[174] Bryant and Baker (eds.), *Quaker Journal*, ii. 449. See also John Lamb writing in *BF*, 9 (1851), 200–2.

[175] *Friend*, 9 (1851), 203–4.

[176] *Grove House Magazine*, 1 (1851–2), 89; see also 13, 25–6, 45–6, 47.

themselves admirably. Quaker reactions were both more diverse and more ambivalent. While some expressed their reservations about the Exhibition, Quakers generally welcomed it warmly, because it cohered with their pacifist ideals. In more complex ways it also intersected with their social and ethical commitments; they may have welcomed the displays of aboriginal artefacts, but saw them as inferior to the productions of British industry; their commitment to industrial progress stood uncomfortably with their condemnation of the military and exploitational aspects of other exhibits. Nor could they overlook the opportunities that the Exhibition offered to aid the spread of Christianity.

5
Trajectories in Science

One of the central points made in the introductory chapter is that both Quakers and Jews engaged science in many different ways and that we misrepresent science–religion interrelations if we fail to acknowledge this diversity. The aim of this chapter is to convey this diversity by examining nine modes of scientific activity. These nine modes do not exhaust the ways in which science was practised during the eighteenth and nineteenth centuries. Nor does this discussion include all those individuals who might have been discussed under any heading; rather, a very small number of individuals are featured, and these have been selected because they illustrate interesting examples of how Quakers or Jews engaged science. Where appropriate, a comparison—sometimes a contrast—is drawn between the participation of Quakers and of Jews in a particular activity.

5.1 Wealthy amateurs: science among the Quaker and Jewish élites

As noted in section 2.2, Anglo-Jewry was dominated by a small number of wealthy London-based families. Likewise, the Quaker community, which outwardly eschewed distinctions of wealth, included a similar moneyed élite. In both communities we find prominent families that made their fortunes in banking and mercantile pursuits. However, by the closing decades of the eighteenth century, wealthy Quakers also included an increasing number of manufacturers. Like other prosperous Englishmen, these prosperous Jews and Quakers purchased estates where they could create their pastoral idylls with fine country houses and landscaped gardens. With the expansion of overseas trade, exotic species of plants imported from North America or from the East were particularly welcome additions to their ornamental gardens. Such gentlemen were avid collectors, and happily filled their cabinets with shells, minerals, plants, and insects. They grew exotic plants, bred ostriches, built observatories, hothouses, and even laboratories. Gardens and cabinets well stocked with unusual specimens were also status symbols reflecting the owner's gentility and social standing. Thus, for example, a Jew might purchase a large house with an attractive garden, in order to emulate the English aristocracy. For some Jews and Quakers the strength of their collecting habits led them to join other gentlemen-naturalists in the Royal Society or the Linnaean Society. Science might be a hobby and a form of recreation, but gentlemen amateurs often became leading and respected authorities in their chosen subjects, pursuing research with dedicated enthusiasm.

Throughout the eighteenth century, some wealthy Jews left London to take up residence in villages, such as Highgate, Isleworth, Whetstone, and Twickenham, that were beyond the city's grime and smog but still allowed access to their businesses.[1] For example, Moses Isaac Levy, an army contractor who settled in Wimbledon in 1768, built a villa with impressive views. Here he constructed a garden, with 'hot houses and forcing-walls', where, according to one contemporary, he produced 'the earliest, largest and finest fruits in the country'.[2] Another army contractor, Abraham Prado (d. 1782), settled in Twickenham and became a keen horticulturalist. His knowledge of gardening was 'extensive; and he was a celebrated cultivator of the vine'. He introduced into Britain many varieties of natural and cultivated fruit, 'and had the finest of every kind of any gentleman in this part of the country'. He was particularly celebrated for importing 'large white and red Syrioc grapes, which have produced some bunches, weighing upwards of 14 lb'.[3] A slightly less grandiose bunch was the subject of a letter written in 1774 by Prado's neighbour, the prominent literary figure Horace Walpole:

> The greatest event I know was a present I received last Sunday . . . It was a bunch of grapes as big—as big—as that the two spies carried on a pole to Joshua [Num. 13: 23] . . . In good truth this bunch weighed three pounds and a half, côte rôtie measure; and was sent to me by my neighbour Prado, of the tribe of Issachar.[4]

Walpole portrayed Prado and his wife as 'the most accomplished persons' he was acquainted with.[5] In transcending his status as a military contractor and becoming a gentleman, Prado's social identity was expressed through expertise in viniculture.

Although Benjamin Goldsmid (1755–1808) made his money as a bill broker and utilized it for a wide range of philanthropic endeavours, he also possessed strong intellectual interests. As his career progressed, he moved from an

[1] M. Brown, 'Anglo-Jewish country houses'; Daiches-Dubens, 'Eighteenth-century Anglo-Jewry'; Finberg, 'Jewish residents in eighteenth-century Twickenham'; Katz, *Jews in the History of England*, 255–6.

[2] *Picturesque Views of the Principal Seats of the Nobility and Gentry, in England and Wales* (London, [1786–8]), cited in M. Brown, 'Anglo-Jewish country houses', 30.

[3] Ironside, *History and Antiquities of Twickenham*, 107.

[4] Horace Walpole to Lady Ossory, 14 Sept. 1774, in Lewis *et al.* (eds.), *Yale Edition of Horace Walpole's Correspondence*, xxxii. 205–8.

[5] Ibid. ii. 373.

elegant house in Stamford Hill to Roehampton, where he purchased an estate of 150 acres in the early 1790s and constructed Elm Grove, a magnificent 'Mansion suitable to his Rank in Society'. He spared no expense on his estate, which included a private synagogue and lavish gardens. According to Goldsmid's biographer,

> His grounds were most admirably laid out with taste and judgment with shaded walks, and his fruitery or orchard ground abounded with every luxury of nature excited by art. The walks were clothed with the most exquisite and juicy fruits, and every thing in the highest order of cultivation, having upwards of twelve Gardeners, besides labouring men from the village.

It is interesting to note that, like Levy and Prado, Goldsmid concentrated on growing exotic fruit—he particularly cultivated peaches—which connoted social refinement. His eldest son John Henry Goldsmid helped him create a library that housed not only books but also

> the most useful philosophical [scientific] apparatus of every kind, to put in practice whenever it was required the theories contained in the curious *volumes*... Here the Bookish man or the practical Philosopher might retire, and enjoy himself according to his taste or fancy with these silent friends without interruption.

It is not clear whether these instruments were used by Goldsmid and his family or whether they were available for his guests, who might try an experiment before dinner instead of viewing his fine art collection. From contemporary accounts it would appear that Goldsmid was widely known as a gracious host who entertained the powerful and influential, even royalty, at Elm Grove.[6]

Benjamin's brother Abraham (1756–1810), who was also a financier, purchased a large estate at Morden a few miles south of Roehampton. Soon after its completion, he held a magnificent fête attended by some 300 members of fashionable society, including the Prince of Wales and the Dukes of Kent and Cambridge. Contemporary reports stressed the magnificence of the house (Morden Lodge), the gardens— which were illuminated by 3,000–4,000 lamps—and the entertainment. Particularly popular were the boat rides on the illuminated River Wandle. One guest described the house as fronted by 'a beautiful lawn, diversified with orange and lemon trees, [fragrant] aloes, and the various exotics of the most luxuriant climes'. Tropical birds filled the aviary, while the conservatory contained 'the choicest productions of the vegetable world'. Another visitor described the house being located

[6] L. Alexander, *Memoirs*, 94–102.

in the midst of a beautiful lawn, interspersed with various sorts of shrubberies, so contrived as to assist nature, avoiding the formality too frequently seen in gentlemen's grounds. The river Wandle, winding through the grounds, has a rich and pleasing effect, and over it are bridges at once simple and elegant. The gardens are capacious, and well-stocked with every vegetable, flower, and fruit, foreign or native, that can be procured. The pineries, graperies, &c are well worthy of the attention of the botanist and curious.

With his gardeners' assistance, Goldsmid had created a landscape that impressed his aristocratic and fashionable visitors and added considerably to his reputation as a botanist. As one commentator asserted, a 'more picturesque and romantic place in point of rural scenery cannot be imagined'.[7]

The Goldsmid brothers were not only exceedingly wealthy, but manifestly genteel, mixing freely in aristocratic society and possessing none of the brashness of the *nouveau riche*. The houses they built and the gardens they created reflected their social standing. The exotic plants, tropical birds, and exquisite fruit spoke not only of the Goldsmids' wealth, but also of their willingness to use their wealth to create gardens that reflected their good taste, and thus their social standing. As the visitors cited above appreciated, Elm Grove and Morden Lodge reflected the qualities of simplicity, elegance, good taste, and judgement. The well-cultivated gardens of these urbane financiers also showed them to be the very antithesis of the miserly Jew or the immoral and gauche 'Jew slopseller' characterized in contemporary fiction.[8]

Likewise, Peter Collinson (who will be discussed further below) and the apothecary Silvanus Bevan (1691–1765), exemplify wealthy eighteenth-century Quaker naturalists who cultivated attractive and well-stocked gardens. One visitor was greatly impressed by Bevan's 'beautiful garden' in Hackney, which contained

every kind of flowers, plants, and vegetables, also fruit trees and flowering shrubs, etc., the noble statue of the Gladiator, mentioned by Pliny to have been found in Britain and other curious figures.... In the house [were] a variety of curious paintings and rich old china, and a large library.... He is visited by most great men of taste.[9]

Collinson likewise cultivated his attractive gardens at Peckham and later at Mill Hill, which were admired by many visitors. While attending the 1762 Yearly Meeting, the Cumberland Quaker Elihu Robinson described his visit to 'Friend Collinson's Country seat [at Peckham], about 3 Miles from London situat[e]d in a Very Pleas[an]t Part of ye Country & quite retired, the gard[e]n

[7] Fretwell, 'The fête of Abraham Goldsmid', gives unsourced quotations from *Bills Weekly Messenger*, the *Courier*, and the *Gentleman's Magazine*, 1806.

[8] [Anon.], 'Jew slopseller'.

[9] Chapman-Huston and Cripps, *Through a City Archway*, 21–2.

is large and very Elegant, well furnish[e]d with a Great Variety of scarce and valuable Shrubs & Plants'. Another visitor reported that Collinson's garden was 'full of all kinds of the rarest plants, especially American ones which can endure the English climate'; there was, he asserted, 'scarcely a Garden in England in which there were so many of the kinds of trees and plants, especially of the rarest'.[10] Frequently complaining about the temptations of London and the many pressures of business, Collinson retreated to his garden for peace, quiet, and the opportunity to appreciate nature. His garden was a source not only of pleasure but of revenue. As he wrote to Linnaeus in 1747, 'My Garden is a great Beauty... The Vine yards turn to good profit.'[11]

One of Collinson's customers was the eminent Quaker physician John Fothergill, who became a keen collector of exotics from North America and the ready purchaser of unusual specimens from around the world. In 1762 he purchased a 30-acre estate at Upton (Fig. 5.1), which provided new challenges for his botanical enthusiasm. Since London was readily accessible from Upton, he could tend his garden throughout the year; nevertheless, the demands of his patients kept him in town far longer than he would have liked, and he was sometimes to be seen at night inspecting his plants by lantern light. Upton became one of the outstanding gardens of Georgian England; indeed, Sir Joseph Banks, whose judgement on botanical matters carried much weight, considered that Upton contained more rare and valuable plants than any other contemporary garden in England.[12] John Coakley Lettsom, who compiled the catalogue of Fothergill's hothouse plants after his death, described how the visitor could walk from the house, through glass doors leading to the 'suite of hot and greenhouse apartments'. These 'apartments' were 'nearly 260 feet in extent, containing upwards of 3400 distinct species of exotics, whose foliage wore a perpetual verdure'. A further 3,000 species were to be found in the ornately designed external gardens.[13]

Prosperous provincial Quakers frequently invested in land and planted attractive gardens. One example is Robert Were Fox (discussed further in section 5.7), whose gardens at Penjerrick near Falmouth enjoyed a Mediterranean climate. There he cultivated a great variety of unusual and exotic plants and bred parrots. According to one obituarist, his garden was 'one of the loveliest... in England'.[14] Many later Victorian Quakers who had been

[10] Elihu Robinson's diaries, 4th day, 6th mo., 1762, MS Box R3/1, LSF; *Kalm's Account of his Visit to England*, 66–7.

[11] Collinson to Linnaeus, 26 Oct. 1747, PCLS.

[12] Quoted in Corner and Booth (eds.), *Chain of Friendship*, 18.

[13] Ibid. 18. See also Lettsom, *Hortus Uptonensis*; Hayden, *Mrs Delany*, 153–4. For the latter reference I am grateful to Mrs J. E. Mortimer.

[14] J. H. Collins, *Catalogue of the Works of R. W. Fox*, 6; Fox's obituary in *AM*, 1878, 82–91.

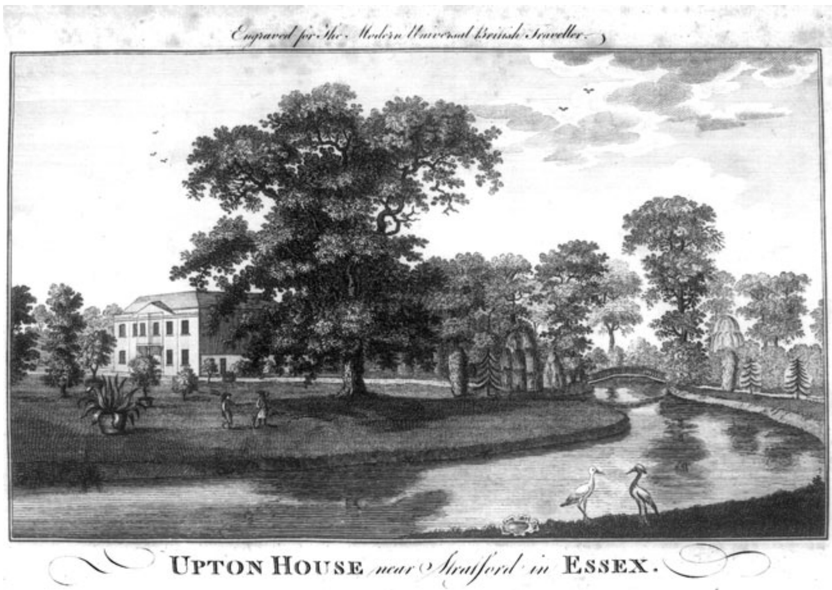


Fig. 5.1. John Fothergill's garden at Upton. After Fothergill's death, John Coakley Lettsom compiled *Hortus Uptonensis; or, a Catalogue of Stove and Green-House Plants, in Dr Fothergill's Garden at Upton* ([1783]), which lists more than 1,200 varieties. From Charles Burlington, *The Modern Universal British Traveller* (London: Cooke, 1779), facing p. 80. Reproduced by permission of the Syndics of Cambridge University Library.

successful in the professions moved out of London and purchased estates on which they lavished their botanical skills. For example, Jonathan Hutchinson (1828–1913), senior surgeon at the London Hospital and one of the most highly respected medical men of his generation, acquired 200 acres near Haslemere in 1872 and built his house with a 'very large garden, and well laid out, with a charming old orchard, and two massive ancient Yew Trees just behind the house'.[15] Likewise, Lord Justice Edward Fry purchased a rambling old house at Failand, overlooking the Bristol Channel. Its garden included a pinetum and many species of tree, but its dominant feature (which he designed) was 'a straight walk tiled with red bricks and with wide borders of grass and of herbaceous plants, leading to a small pond behind which Diana stands robing herself'.[16]

[15] H. Hutchinson, *Jonathan Hutchinson*, 121.
[16] A. Fry, *Memoir of the Right Honourable Sir Edward Fry*, 100.

One 'Quaker' garden even achieved an international reputation: Thomas Hanbury's La Mortola estate in the hills above Menton, Italy, which he purchased in 1867. Although Hanbury was an heir to his family's pharmaceutical fortune, his wealth was based primarily on the China tea trade. Assisted by his eldest brother Daniel, who was a Fellow of both the Royal and the Linnaean Societies, and by a young German gardener, Hanbury established an impressive botanical garden. Within a few years La Mortola had become one of the most celebrated gardens in the world, and was visited by many serious botanists.[17]

Men like Fox, Hutchinson, Fry, and Hanbury represent the rich, accomplished, and cultured Victorian Quakers whose well-stocked gardens and libraries were statements of social stability and respectability. Yet such Quakers also played an active role in botany, thereby combining their social positions, their research interests, and their aesthetic and moral appreciation of the natural world.

Two rather unusual and eccentric members of the Jewish élite deserve particular attention. At an early age Walter Rothschild (1868–1937), the second Baron Rothschild, began collecting zoological specimens, initially with the help of a skilled taxidermist who worked on the family's Tring estate.[18] Tutored at home, Rothschild's knowledge of zoology was greatly enhanced by visits to the Natural History Museum and by the encouragement of one of its curators. He then proceeded to Magdalene College, Cambridge, in 1887 with the intention of pursuing the Natural Sciences Tripos. He did not thrive at Cambridge and left after two years. Although he joined the family finance house, he was clearly not suited to the life in the City. Instead, his family's wealth, which his father continually tried to prevent him squandering, enabled him to collect natural history specimens on a magnificent scale.

According to his biographer, Rothschild 'combined a collecting hobby with straightforward original research, and turned it from an agreeable, leisured pastime into an arduous life-work'—one might almost say obsession.[19] As a twenty-first birthday present his father built him a museum at Tring, which soon became the focus for his passion for collecting. He appointed his staff, including curators, and avidly purchased specimens from around the world, including giant tortoises from the Galápagos Islands (Fig. 5.2). His enthusiasm far outweighed prudence, and he was sometimes cheated by unscrupulous dealers. But his collection mushroomed to include every branch of natural history that took his fancy. Insects, butterflies, birds, snakes, antelopes, and zebras were crowded into the museum's bulging cabinets.

[17] Muratorio and Kiernan, *Thomas Hanbury.*
[18] Rothschild, *Dear Lord Rothschild.* [19] Ibid. 10.

Fig. 5.2. Walter Rothschild, suitably attired, riding a giant tortoise, presumably a Galápagos tortoise, at Tring. Reproduced with the kind permission of the Natural History Museum.

Not content with a museum of stuffed specimens, he commandeered large tracts of Tring Park for live animals, including a stable of zebras, which he used (in place of horses) for drawing his coach. He was also very successful at propagating orchids. Rothschild was a natural showman who greatly enjoyed displaying his remarkable natural history collections to famous house guests and admiring public alike.

Despite his sheer obsession with collecting, he contributed to science. Although he was often at odds with the scientific establishment, his social and financial position enabled him to pursue independent lines of enquiry. From 1894 onwards he published his own periodical, which he co-edited with two of his curators. The forty volumes of *Novitates Zoologicae, a Journal of Zoology* (1894–1938), contain the wealth of research conducted at Tring. Although this house journal may not merit inclusion among the first rank of scientific publications, it contained a fund of valuable information. He also financed expeditions to collect specimens from such exotic locations as the Hawaiian island of Laysan, the Galápagos Islands, and the Solomon Islands.

He was elected to a number of scientific societies, even the Royal Society of London (in 1911, as a candidate of the privileged class), and published many papers in the *Philosophical Transactions.* For his work on orchids he received the Veitch Memorial Medal from the Royal Horticultural Society in 1897.

In contrast to Rothschild's fascination with natural history, David Lionel Salomons (1851–1925), the second baronet, turned his country seat into a laboratory for technological innovation. The son of Philip Salomons, a financier, he inherited the baronetcy from his uncle, David Salomons, the first Jewish Lord Mayor of London. Having been both privately educated and a pupil at University College School, he proceeded to University College London, where he studied mathematics and physics. Matriculating at Caius College, Cambridge, in 1870, he studied for the Natural Sciences Tripos, gaining first place in the second class list four years later. His return from Cambridge marked the start of his research into several technological problems, some of which resulted in patents. In 1874–5 he patented 'an invention relating to [an] apparatus for indicating the speed of shafts'; he also patented an improved method for signalling on railways, and invented a process for taking instantaneous photographs. The last of these was described as '[a]n exceedingly... ingenious electrical apparatus [which] enables any one, by simply turning a handle, to take a perfect photograph in a fraction of a second'.[20]

A contemporary newspaper noted that it is 'unusual to find a young man who has succeeded to a baronetcy distinguish himself as an inventor. He does not allow the claims of society to absorb all his time, but at his beautiful seat [Broomhill] near Tunbridge, where he is very popular, he has a scientific laboratory.'[21] As Salomons's activities testify, he was an atypical baronet and an even more extraordinary member of the Anglo-Jewish aristocracy. It is claimed that Broomhill became in 1874 the first house in England to be lit by incandescent lamps and, at a later date, the first household to use electricity for cooking and other domestic chores. Many of the electrical components used at Broomhill were of his own design and construction. As well as a laboratory, he built a large room to house accumulators (Fig. 5.3). In the mid-1890s he added a science lecture theatre, said to be the largest one privately constructed in England at that time (Fig. 5.4). A photographic studio, dark rooms, and a chemical laboratory were attached. No less enthusiastic than Walter Rothschild, Salomons was far more innovative. By the end of the

[20] *JC*, 21 Aug. 1874, 336; 1 Jan. 1875, 641; 25 June 1875, 210; *JW*, 4 June 1875, 2; Salomons, *New Method of Signalling.*

[21] *JW*, 16 June 1875, 2. This report was taken from the *Liverpool Journal.*

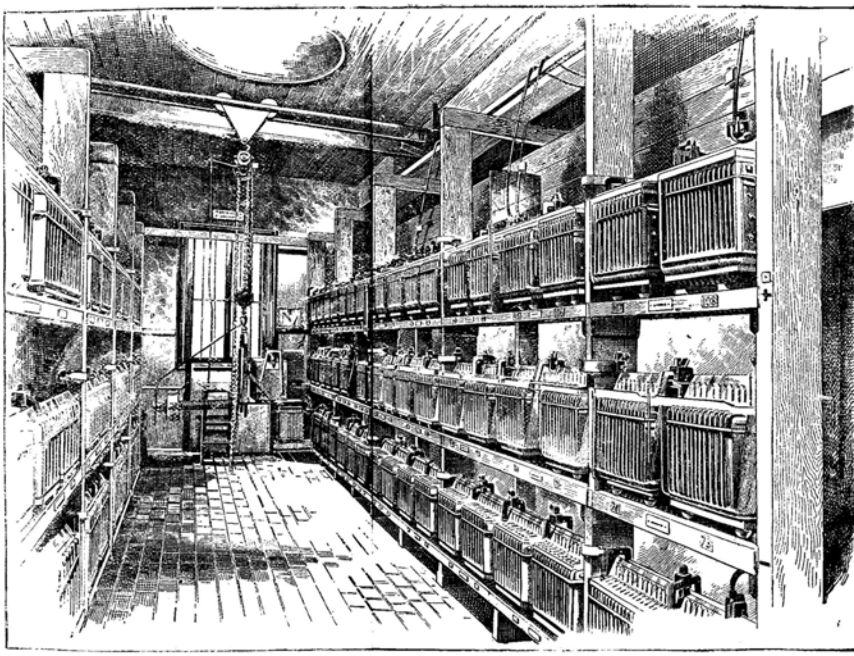


Fig. 5.3. The accumulator room at Sir David Salomons's country residence, Broomhill. From David Salomons, *Electric Light and the Management of Accumulators. A Practical Handbook*, 6th edn. (London: Whittaker, 1891), frontispiece.

century some twenty of his patent specifications had been approved, and a number of his papers had been published in scientific periodicals. His main publication, *Electric Light Installations and the Management of Accumulators* (1886), became a standard work that passed through eleven editions and was translated into several languages. He was elected to the Royal Astronomical Society, the Physical Society, the Geological Society, the Royal Microscopical Society (of which he became President), the Royal Photographic Society, and the Institution of Electrical Engineers (IEE). He was also a director and first chairman of the City of London Electric Lighting Company.

Salomons's involvement in the IEE, which he joined in 1875, illustrates the changing position of the amateur scientist in late Victorian Britain. In 1881 he was elected to Council and served as Treasurer for several years, during which time he placed the institution on a secure financial footing. Elected Vice-President in 1891, he would, on the basis of precedent, have expected to be elected President a few years later. However, he encountered stiff opposition from those members who wanted the institution to become the exclusive

Fig. 5.4. David Salomons's theatre for experiments at Broomhill. Reproduced with the kind permission of the Salomons Centre.

preserve of practising professional engineers, and thus sought to rid it of its gentlemen amateurs. After an extended controversy, Salomons failed to be elected President in both 1895 and 1896. Following this defeat, he resigned as Treasurer and withdrew from the Institution's administration.[22] By contrast, a naturalist like Walter Rothschild could continue his career well into the twentieth century, despite his research not being at the cutting edge. Yet both men were unusual among the Anglo-Jewish aristocracy, because they not only practised science but also pursued expensive and demanding research projects.

[22] Reader, *History of the Institution of Electrical Engineers*, 54–8; Appleyard, *History of the Institution of Electrical Engineers*, 57–62; *Journal of the Institution of Electrical Engineers*, 63 (1925), 1158–9.

5.2 Traders: Peter Collinson and Emanuel Mendes da Costa

With the proliferation of their settlements in North America, particularly in Pennsylvania, Quakers developed a flourishing trade between the Old World and the New. One example of a trader whom we have already encountered is Edward Haistwell, the first Quaker to join the Royal Society, who imported sugar and tobacco into England.[23] Another is Thomas Corbyn (1711–91), a pharmacist and manufacturer of pharmaceutical preparations, who traded with fellow Quakers, including physicians, surgeons, and agents, across the North American map from Nova Scotia to Jamaica.[24] Among the Anglo-Jewish community the lucrative trade with India—exporting coral and silver, importing diamonds—proved particularly attractive.[25] In this section we examine how a Jew (Emanuel Mendes da Costa) and a Quaker (Peter Collinson) developed careers trading in scientific specimens.

Although da Costa gained the notarial faculty and later the freedom of the Scriveners' Company, the work of a notary did not attract him; instead, from his late teens, he avidly pursued science.[26] As he informed one correspondent, 'the persuit of Natural History first gained Access to my thoughts about the year 1736 when I became patronized by' such eminent individuals as Sir Hans Sloane (President RS, 1727–41), Martin Folkes (President RS, 1741–52), the Duke of Richmond, Dr Richard Mead, the Duchess of Portland, and the Bishop of Exeter (Charles Lyttleton).[27] Not only was da Costa dependent on patronage to initiate his scientific career, but (as noted in section 4.1.1) he subsequently gained the patronage of many savants whom he encountered through the Society of Antiquaries and the Royal Society, where he was employed as Clerk from 1763 to 1767.

Da Costa possessed an extensive knowledge of minerals, fossils, and shells, leading one contemporary to describe him as the 'Grand Monarch, des Fossilistes', while another praised him as 'such an experienced Master' of natural history.[28] Yet science was a costly avocation, and in the absence of family money, it was imperative for him to turn the practice of science to his financial advantage. His paid position at the Royal Society was only one of the ways in which he sought to create a career in science. (See section 4.1.4.)

[23] See sect. 4.1.2.

[24] Porter and Porter, 'Rise of the English drugs industry'; Palmer, 'Illustrations from the Wellcome Institute Library'.

[25] Yogev, *Diamonds and Coral.*

[26] E. R. Samuel, 'Anglo-Jewish notaries'. Da Costa's 'Notary Business' accounts are deposited in the Library of the Royal College of Surgeons.

[27] Da Costa to A. E. Buchner, 11 Apr. 1755, EMdC, ii. 279.

[28] Isaac Romilly to da Costa, 15 Dec. 1757, EMdC, ix. 27; J. R. G. Andreæ to da Costa, 30 Apr. 1757, EMdC, i. 64.

He also traded in scientific specimens. From the mid-1740s onwards he used his networks of patronage across Europe to buy and sell fossils, shells, and minerals. This may seem an unusual business for a young Sephardi, but it is strikingly similar to the international trade in coral and diamonds pursued by a number of Jews, including his brother Jacob and his cousin Joseph Salvador. What is remarkable is his tenacity. A significant proportion of the 2,500 letters that comprise the extant da Costa correspondence concern the selling, purchase, and exchange of specimens. His correspondence demonstrates how a dedicated entrepreneur could gain a foothold in science by creating a customer network that linked dukes and duchesses, country clergymen, Fellows of the Royal Society, lowly quarry workers, and the likes of Linnaeus and Sir Hans Sloane. Manuscript catalogues (often containing several hundred entries), fossils, and shells flew back and forth, not only across the length and breadth of Britain, but across the whole of Europe. He soon became one of a small number of specialist dealers in London who supplied specimens to wealthy collectors and academies.

Correspondence on scientific issues often shaded into business enquiries, and then into the exchange or sale of specimens. Many of da Costa's letters recorded the sale of collections of specimens for as much as 30 guineas. In a few cases da Costa's lack of adequate business acumen led to conflict; for example, an apothecary named Johan Andreæ from Hanover complained bitterly that in failing to fulfil an order da Costa had cheated him.[29] By contrast, John Fothergill, the Quaker physician, was not only a customer, but also one of da Costa's staunchest supporters.[30] Over many years Fothergill purchased numerous fossils from da Costa, and also assisted him in producing his *Natural History of Fossils* (1757), by supplying specimens and reading the preface in manuscript. The two men often exchanged gifts: Da Costa even sent Fothergill 'the usual Tribute of our Passover Cakes'. They were also involved in collecting together and finding a buyer for the papers of the geologist Edward Lhuyd, which had been scattered after Lhwyd's death in 1709.[31]

To his correspondents and patrons da Costa proved highly useful. He frequently advised those who were about to travel on whom they should meet, where they should stay, which collections they should examine, and which natural phenomena they should observe. He provided letters of

[29] Correspondence with J. R. G. Andreæ, EMdC, i. 35–105; Rousseau and Haycock, 'Jew of Crane Court'.

[30] Fothergill remained da Costa's patron even after da Costa had been imprisoned for diverting money from the Royal Society. On da Costa's activities in the Royal Society, see also Cantor, 'Rise and fall of Emanuel Mendes da Costa'.

[31] Correspondence with John Fothergill, EMdC, iv. 121–57; Corner and Booth (eds.), *Chain of Friendship*, 294–6; Lhuyd and Huddesford, *Eduardi Luidii*.

introduction that enabled travellers to gain access to foreign naturalists. For example, da Costa's letters of introduction resulted in Thomas Percival, a young physician from Warrington, being warmly received by leading savants in Leiden, Amsterdam, and Paris.[32] Da Costa also assisted his friends and patrons to gain election to the Royal Society through collecting signatures in support of their candidatures. Thus he suggested that his Cornish clergyman correspondent William Borlase seek election to the Society, and then adroitly shepherded the certificate through to Borlase's election a few months later.[33] Da Costa also acted as London agent for many of his correspondents, to whom he frequently sent information about the proceedings of the Antiquarian and Royal Societies. Based in London and enjoying a flourishing international correspondence, he created for himself the role of scientific intelligencer, as Henry Oldenburg had done several decades earlier. Not only did he trade in shells and fossils, he also traded in scientific intelligence.

Lecturing provided another source of income for da Costa, but this too depended on patronage. For many years he offered courses on fossils and shells, usually at 2 or 3 guineas for a series of twenty-seven lectures, including a course for boys in the Sephardi community.[34] Even during his second term in gaol, he was able to maintain his collections and offer subscription lecture courses.

Another source of income was from writing science books, which also raised his standing as a 'philosopher'. Thus he wrote (partly while in prison) the first part of the first volume of his *Natural History of Fossils*, which eventually appeared in 1757, with a subscription list of ninety-eight. He experienced considerable difficulty in generating subscriptions, and claimed to have incurred a financial loss of nearly £200.[35] As with so many of da Costa's projects, the promised and much vaunted second part failed to appear. His later substantial publication, *Historia Naturalis Testaceorum Britanniæ* (1778), was a beautifully produced and well-illustrated catalogue of shells containing a wealth of scientific detail, but, despite a slightly longer list of subscribers, which included sixteen Jews, it too was a failure financially. Yet both works enhanced his standing among fellow philosophers and patrons.

On a number of occasions da Costa was entertained by wealthy and noble landowners who sought his advice on local fossils and mineral deposits or on the contents of their natural history cabinets. For example, through the good offices of the President of the Royal Society, Martin Folkes, he was invited to

32 Thomas Percival to da Costa, 19 Sept. 1765, EMdC, vii. 193.
33 Da Costa to William Borlase, 21 Sept. 1749, 20 Feb. 1750, EMdC, ii. 33 and 47.
34 Da Costa to I. M. Belisario, 10 July 1766, EMdC, i. 206.
35 Da Costa, *Natural History of Fossils*; Da Costa to J. A. Schlosser, 29 Mar. 1762, EMdC, ix. 137–8.

Goodwood to give scientific advice to the Duke of Richmond, 'the best family in the Universe'.

[H]e commands me, [wrote Folkes . . .] to invite you down, if your affairs will permit. . . . The Duke being the most humane and the best man living, you need be in no difficulty about your eating, here being all sorts of fish, and every day the greatest variety of what you may feed on without breach of the Law of Moses, unless the lobsters of Chichester should be a temptation, by which a weaker man may be seduced.[36]

Da Costa pursued many projects for deriving income and status from his enthusiasm for natural history. In this endeavour he was ultimately unsuccessful, and he died in poverty in 1791.

Both comparisons and contrasts can be drawn between da Costa's career as a trader in fossils, shells, and minerals, and that of the more successful Peter Collinson, who became the foremost importer of botanical specimens from North America. The son of a successful woollen draper, Collinson took over his father's business in Gracechurch Street, at the hub of Quaker London. Like da Costa, he developed an early interest in natural history and was soon in contact with a number of leading naturalists, including William Derham, Hans Sloane, and the geologist John Woodward. Sloane, who was elected President of the Royal Society in 1727, became Collinson's main scientific patron. A doctor and botanist who had travelled widely, Sloane helped to revivify both the Royal Society and the Society of Antiquaries. Like da Costa, Collinson joined both Societies. Sloane often employed Collinson as his shipping agent, and frequently turned to him for useful information, specimens of plants, unusual natural objects, and even curious antiquities. For example, after a hoard of ancient, probably Roman, weapons was discovered on the Isle of Wight, Collinson negotiated their display at the Society of Antiquaries and then arranged for duplicates to be donated to Sloane's museum.[37] Other letters show Collinson conveying books, animals (including a beaver and a goat with extraordinary genitals), shells, and the hand and arm of a 'Maremaid' from Brazil. He even introduced Sloane to 'the Great Emperour of China and his Mandarines. I doubt not but they will meet with a Reception Becoming their Quallitye.'[38] Sloane nominated Collinson as one of the trustees for his magnificent scientific collections which, after his death in 1753, became the basis for the British Museum. As Collinson noted,

[36] Martin Folkes to da Costa, 9 and 28 Aug. 1747, in Nichols, iv. 635–7. On Folkes the atheist, see Rousseau and Haycock, 'Voices calling for reform'.

[37] Collinson to Hans Sloane, 20 Apr. 1737, Sloane MS 4055, fol. 98, BL. See also MacGregor, 'Prehistoric and Romano-British antiquities'.

[38] Collinson to Hans Sloane, n.d., Sloane MS 4058, fol. 154, BL.

'I was one of the Few Friends, that by His [Sloane's] Will was desired to attend Obsequies, which was very Grand, & Magnificent.'[39]

Despite their friendship and mutual interest in science and antiquities, the correspondence indicates the social distance that divided the two men. Collinson referred to Sloane as 'my Dear Patron & Friend', and in a deferential tone thanked him for various favours, including the gift of duplicate East Indian shells from Sloane's impressive collection. Particularly revealing is the following passage: 'I am heartily Sorry I happnd to be so Engaged w^{n} you was so kind to Call on Mee but I hope you'l please to Consider Mee a Trades Man in Hurry of Buisness w^{ch} prevented Mee paying the Respect I woud a done.' He then requested Sloane to visit him again soon, tempting him with '50 Bottles of Curious Creatures in Spirits & severall other Curiosities'.[40] Collinson's letters indicate not only a lack of formal education, but also his social position—'a Trades Man in Hurry of Buisness'. A mutual interest in science and antiquities enabled him to rub shoulders with the titled President of the Royal Society. E. G. Swem has rightly insisted that Collinson should be viewed first and foremost as a merchant involved in his day-to-day drapery business. Many of his letters on scientific subjects were written during odd minutes snatched during business hours and subject to frequent interruptions.[41]

In importing exotic plants from North America, Collinson developed business contacts principally through the Quaker network. These contacts, especially John Bartram, initially enabled him to obtain unusual seeds and plants for his own use. 'At first it was not thought that sending [specimens] over [to England] would prove a trade[,] but with the demand the price was fixed at £5 5s. 0d a box.'[42] By the mid-1730s he had developed a flourishing business with extensive contacts on both sides of the Atlantic and criss-crossing much of Europe. Collinson played a key role in providing British collectors with exotics from abroad, especially from North America, and introduced nearly 200 new plant species into Britain.[43] Although this trade proved lucrative, the shipment of plants and seeds was fraught with difficulties. The merchandise had to be carefully packed, and not a few shipments were lost through organic decay or by the invasion of rodents during the long journey. Ships and their valuable cargoes were also sometimes lost at sea or seized by unfriendly nations; since the Spanish allegedly displayed little interest in natural history, they were likely to jettison overboard any

39 Collinson to C. J. Trew, 18 Jan. 1753, PCLS.
40 Collinson to H. Sloane, n.d., Sloane MS 4058, fol. 166, BL.
41 Swem, 'Brothers of the spade', 25, 157.
42 Brett-James, *Life of Collinson*, 52; Fothergill, 'Memoir of Collinson'.
43 Dillwyn, *Hortus Collinsonianus*.

specimens they captured.[44] Collinson supplied plants and seeds to many gardens, including the Royal Gardens at Kew and the Apothecaries' Gardens at Chelsea. Among his customers were numerous members of the gentry and nobility, including Sloane and Lord Petre, a young Catholic who owned a thousand acres at Thorndon Hall, Essex, and who also planned the landscape garden at the Duke of Norfolk's estate at Worksop. Many of the North American trees and shrubs used by Petre had been obtained from John Bartram, with Collinson acting as intermediary. In 1740 Petre planted at Thorndon Hall 10,000 trees and shrubs from North America which 'mixed with about twenty thousand Europeans, and some Asians, make a very beautiful appearance;—great art and skill being shown in consulting every one's particular growth, and the well blending of the variety of greens'. Petre's untimely death in 1742 robbed Collinson of his most ardent client. 'If he had Lived', wrote Collinson, 'all round Him would have been America in England.'[45]

Thus the leading traders in scientific specimens during the mid-eighteenth century included a Jew and a Quaker. The few surviving letters between the two men indicate a close friendship. For example, the kindly Quaker wrote: 'I am much concern'd for your long confinement [in gaol. I]s there no hopes of your Liberty, that it may be soon, is the wish of your Old Friend.' On another occasion Collinson purchased from a third party a financial note worth £10 written by da Costa, in order to prevent it from falling into the wrong hands. (Da Costa may have been involved in some shady business transactions or have lost money through gambling.[46]) They also sometimes worked together. For example, letters addressed to one of them often contained information or even an enclosure for the other. Again, during his travels on the continent, da Costa fulfilled Collinson's request to visit the Dutch naturalist Johan Frederic Gronovius and to convey back to England a sample of roots that Gronovius had procured. Collinson was also impressed, in somewhat un-Quakerly fashion, by da Costa's ability to persuade collectors to part with their specimens: 'thou art the archest Wagg alive & hast the best success in talking people out of their Christian names I ever knew'.[47]

Although da Costa was generally well liked by fellow scientists and gained a reputation as an able naturalist, he was unsuccessful in business and spent two periods in gaol. Fothergill described him as 'oft necessitous', adding: 'I knew not what credit to give to his request. This made me more slow in advancing

[44] Collinson to H. L. D. du Monceau, 6 Mar. 1763, PCLS. Lettsom, *Hortus Uptonensis*, 3–14.

[45] Chambers, *Planters of the English Landscape Garden*, 102–19; Collinson to B. Smithurst, 9 Sept. 1742, PCLS.

[46] Collinson to da Costa, n.d. [June 1754] and 20 Aug. 1766, EMdC, iii. 64 and 76.

[47] Collinson to da Costa, 26 Sept. 1748, EMdC, iii. 60: Cantor, 'Rise and fall of Emanuel Mendes da Costa'.

money.'[48] It is unclear whether his financial situation was exacerbated by a predilection for gambling, but he clearly experienced considerable difficulty in maintaining a respectable standard of living. By contrast, Collinson's trading activities contributed significantly to his wealth and social respectability. As Fothergill recalled, in conversation Collinson was 'chearful and usefully entertaining; which rendered his acquaintance much desired by those who had a relish for natural history'.[49] Thus he was at ease in the milieu of the Royal Society.

5.3 Travellers: James Backhouse and Moses Montefiore

When not in gaol, George Fox and many early Quakers travelled throughout England, and sometimes further afield, zealously spreading the word through public meetings. The first group of itinerant preachers, often called the 'Valiant Sixty', included Thomas Lawson (1630–91), who, having attended Cambridge University for about a year, joined the Quakers after hearing Fox preach. From the age of 21 he devoted his life to the Quaker cause, and after various travels, settled as a schoolmaster in Cumbria. His serious interest in botany dates from the mid-1670s, with a record of plants in the Furness area.

Probably with Fox's encouragement, Lawson subsequently set out in 1677 on a further journey for the purpose of meeting Quakers, preaching, and cementing Fox's blueprint for his religious organization. On this mission, however, Lawson combined botany with his Quaker objectives. Hence, prior to his departure, he compiled from available sources descriptive lists of the flora that he could expect to find in each English county. He was on the road for several months, first travelling south from Cumbria to Bristol, then by a circuitous route to London, before heading north to the Yorkshire coast, and finally turning west back to Cumbria. As he proceeded, he kept detailed notes of the plants he encountered, both those growing wild and those cultivated in gardens. During his travels Lawson was overwhelmed by the great variety of plants he saw for the first time. He also experienced some difficulty in classifying unusual plants and in identifying specimens from the written descriptions given by earlier naturalists.[50]

Travelling in the Quaker cause of Truth continued throughout the eighteenth century, and the rising evangelicalism of the early decades of the nineteenth century increased the zeal for pursuing missionary activities over-

48 Fothergill to John Morgan, 7 Dec. 1765, in Corner and Booth (eds.), *Chain of Friendship*, 250.

49 Fothergill, 'Memoir of Collinson', 266.

50 Whittaker, *Thomas Lawson*, 79–117.

seas. The nurseryman and botanist James Backhouse (1794–1869) provides a useful example, showing how travel in the cause of religion could be combined fruitfully with the pursuit of science, especially botany.[51] The son of a cloth manufacturer and banker of Darlington, Backhouse became an assistant in a 'Grocery, Drug, and Chemical business' run by two Darlington Friends. Although he intended to become a chemist, he was directed to outdoor activities, owing to the poor state of his health, and was soon drawn to botany. In this he received much encouragement from his family, which included several botanists of note. In 1816 James and his brother Thomas purchased an extensive and flourishing nursery in York. The magnitude and success of their enterprise can be gathered from their *Catalogue of Fruit and Forest-Trees; Evergreen and Deciduous Shrubs; Annual, Biennial, and Perennial Culinary, Officinal & Agricultural Plants* (1816), which listed approximately 3,000 items, each described by both its botanical and English names.[52] The Backhouses became leading lights among Yorkshire Quakers, James being appointed an elder at the early age of 20 and subsequently a minister.

After the death of his wife in 1827, Backhouse felt the call to travel abroad in the Quaker cause. Three years later he was granted permission by York Monthly Meeting 'to visit, in the love of the Gospel of our Lord Jesus Christ, The Inhabitants of the British Colonies and Settlements, in New Holland [Australia], Van Diemens Land [Tasmania], and South Africa, and to attend to such other religious duties as, in the course of his journey, he may be required to perform'. Certificates were issued by York Monthly Meeting, York Quarterly Meeting, and, in 1831, the Yearly Meeting. He and his companion George Washington Walker, from Newcastle, enjoyed extensive support from the Quaker community, who commended the travellers to God's protective care.[53] They sailed from London on a ship, appropriately named *Science*, in September 1831. The first of many dangers confronting the travellers was the sea voyage to Hobart accompanied by convicts and demobbed soldiers, who, being frequently inebriated, posed a danger to the whole company. Undeterred, the Quakers offered religious instruction to any interested crew members and passengers.

Backhouse's journal, which was published in 1843 under the title *A Narrative of a Visit to the Australian Colonies*, contains fascinating accounts of his travels: the people he met, his activities as a minister, the conditions of Australian convicts, the dangers of travel, the terrain he crossed, and the

[51] Biographical sources include *AM*, 1870, 6–14; Baker, 'James Backhouse'; S. Backhouse, *Memoir of James Backhouse*, 16–19, 142, 236; P. Davies, 'Backhouses and their scientific pursuits'.

[52] Backhouse and Backhouse, *Catalogue of Fruit and Forest-Trees.* A copy of this rare item is deposited in the Gray Herbarium, Harvard University.

[53] J. Backhouse, *Narrative of a Visit*, pp. i–ii.

botanical specimens he found. Soon after arriving in Tasmania, the Quaker travellers visited a prison ship in which 220 prisoners were incarcerated. It received a fairly positive evaluation, and the surgeon superintendent, Dr Martin, was praised for maintaining a firm but kindly regime. Backhouse took the opportunity to lecture the prisoners, advising them to 'confer with their own consciences' and to read their Bibles every day.[54] Other facilities were condemned. For example, Backhouse was clearly horrified by a 'Female Factory' he visited in New South Wales with 250 inmates.[55] He found violence everywhere, and was particularly critical of the soldiers and prison guards who controlled prisoners by beating them. In his reports Backhouse argued that, while some level of chastisement was necessary, the harsh regime of gaols, penitentiaries, and chain gangs was counterproductive. The evidence showed that far from quelling crime, a harsh penal regime dehumanized the inmates and left them no option but to commit further acts of violence.[56]

Even outside the penal system Backhouse frequently encountered drunkenness, debauchery, and violence. For example, he visited an inn where the inebriated landlord floored his wife with a punch; aborigines were attacked and lived in fear; babies of mixed race were put to death by their mothers. The litany of suffering covered nearly 600 pages. Whenever able to intervene, he preached the Quaker message and distributed religious tracts. He reported that even prisoners renowned for violence listened patiently and thoughtfully to his words of kindness and moral exhortation. The aborigines presented a specific difficulty, for although he was sure that they could receive the Christian message, 'their moral state is . . . of the lowest grade'.[57]

Backhouse's narrative moves effortlessly between cataloguing the degraded human inhabitants of Australia and Tasmania and descriptions of spectacular natural phenomena. As a botanist and nurseryman Backhouse possessed a keen eye, carefully describing plants, usually with the correct Latin names, and their habitats. To cite just two examples among many, when in Tasmania, he recorded: 'A laurel-like shrub of great beauty, with clusters of white blossoms, half an inch across, *Anopterus Glandulosus*, grows by the side of the Emu River, in shady places.' Again, after describing the reed that a young male aborigine wore through the cartilage of his nose, Backhouse described the various species of reed he encountered in the Bell River in New South Wales.[58]

While the religious and humanitarian aspects of Backhouse's travels were appreciated principally by his fellow Quakers, his obituarist in the *Annual Monitor* accurately summarized the significance of botany as a source of spiritual well-being for Backhouse during his demanding travels:

[54] J. Backhouse, *Narrative of a Visit*, 18–20. [55] Ibid. 301.
[56] J. Backhouse, *Narrative of a Visit*, Appendix F.
[57] Ibid. 315. [58] Ibid. 122, 318.

> Many a time must his knowledge of Natural History and a keen relish for the beautiful, have proved a source of relaxation and refreshment to his oppressed and wearied spirit, whilst passing through a land, where a profuse and brilliant Flora continually presented new forms of beauty to the eye; contrasting strangely and sadly with the dark shadow which, as the fruit of sin, too often rested, like a cloud, upon the moral world around him.[59]

His fellow botanists likewise held Backhouse in high esteem. For example, Joseph Dalton Hooker, the director of Kew Gardens, considered that Backhouse's travels in Australia were of great scientific importance for their contribution to our knowledge of the Australian flora.[60] The genus *Backhousia*, which includes the *Backhousia Citriodora* (lemon myrtle), bears his name.

Jews have often travelled either to escape persecution or, like the peddlers who travelled from town to town, in search of business. Sir Moses Montefiore (1784–1885), the most influential English Jew of the nineteenth century, travelled for neither of these reasons. Having made a fortune on the Stock Exchange, he retired in 1824 at the age of 40 and devoted the next sixty years to pursuing other business interests and engaging in a wide range of philanthropic activities. Impelled by a fascination with the events related in the Bible and with the prospect of visiting the historical home of the Jewish people, Montefiore and his wife commenced their first visit to Jerusalem in 1827. Travelling initially for pleasure, Montefiore increasingly became a roving diplomat who tried to intercede on behalf of the Jewish community in places where fellow Jews were under threat and where philanthropy was required.

Montefiore undertook several diplomatic missions. For example, in 1840 he travelled to Alexandria to intercede with the Pasha of Egypt on behalf of a group of Damascus Jews who had been imprisoned and tortured on a trumped-up murder charge with clear anti-Jewish overtones.[61] In 1846 he visited Russia in order to intercede with the Tsar, who had promulgated a decree that expelled Jews from rural areas near the German and Austrian borders. In 1859 he was at the Vatican in connection with the infamous 'Mortara case', which arose because a Jewish boy had been secretly baptized by his nurse. In 1863–4 he travelled to Morocco in order to intervene in the 'Safi affair', in which Jews were accused of murdering a Spanish customs official. In 1867 he was in Romania, where the powder-keg of anti-Semitism had been ignited and persecution was rampant. On many of these missions, such as his 1840 intercession in Alexandria, not only did he represent the

[59] *AM*, 1870, 6–14.
[60] S. Backhouse, *Memoir of James Backhouse*, 76.
[61] Parfitt, 'Year of the pride of Israel'.

Jewish community, but he also worked closely with the English government. He was a man of immense influence who had friends in high places.

The Jewish press frequently reported on Montefiore's travels, offering descriptions of places he had visited and of the Eastern Jewish communities that he had encountered. More extensive accounts appeared in his *Narrative of a Forty Days' Sojourn in the Holy Land* (1875), and in Lady Judith Montefiore's *Notes from a Private Journal of a Visit to Egypt and Palestine* (1836). While Montefiore's *Narrative* was primarily concerned with the depressed situation of the Jews whom he encountered and was of limited scientific interest, Lady Montefiore's *Private Journal* provided a brilliantly evocative travelogue interspersed with geographical information. The appendix to her book included several translated reports specifying the geography and political economy of the region.[62]

The most scientifically important work resulting from the Montefiores' travels was the *Narrative of a Journey to Morocco in 1863 and 1864* (1866) written by Sir Moses' Quaker physician and travelling companion Thomas Hodgkin (I). Hodgkin's *Narrative* contained not only records of the progress of Montefiore's humanitarian mission to save Jews imprisoned at Safi, but also a number of observations on the natural history, ethnology, and geology of the countries that the party visited. For example, Hodgkin offered a detailed account of the appearance and habits of the 'cow-bird' he encountered in Morocco, and also of the chalk-like limestone he studied at Smyrna, which also formed the topic of his paper at the 1864 BAAS meeting. His *Narrative* was illustrated by several of his pictures showing the terrain and the locations where the party stayed.[63] Of these his 'Tents of the wandering Arabs and Atlas Mountains' was of both geological and ethnological interest (Fig. 5.5).

5.4 Jewish Newtonians

An extensive literature exists on the responses made by British writers to the innovative ideas propounded by Isaac Newton in the various editions of his two monumental treatises, the *Philosophiae Naturalis Principia Mathematica* (1687) and the *Opticks* (1704).[64] These responses were frequently coloured, if

[62] J. Montefiore, *Notes from a Private Journal.*

[63] Hodgkin, *Narrative of a Journey to Morocco*; *idem*, 'On some superficial appearances'. On the relationship between Hodgkin and Montefiore see Kass, 'Friends and philanthropists'.

[64] E.g. Schofield, *Mechanism and Materialism*; Jacob, *Newtonians and the English Revolution*; L. Stewart, *Rise of Public Science.* For the influence of Jewish themes on Newton, see Goldish, *Judaism in the Theology of Sir Isaac Newton.*

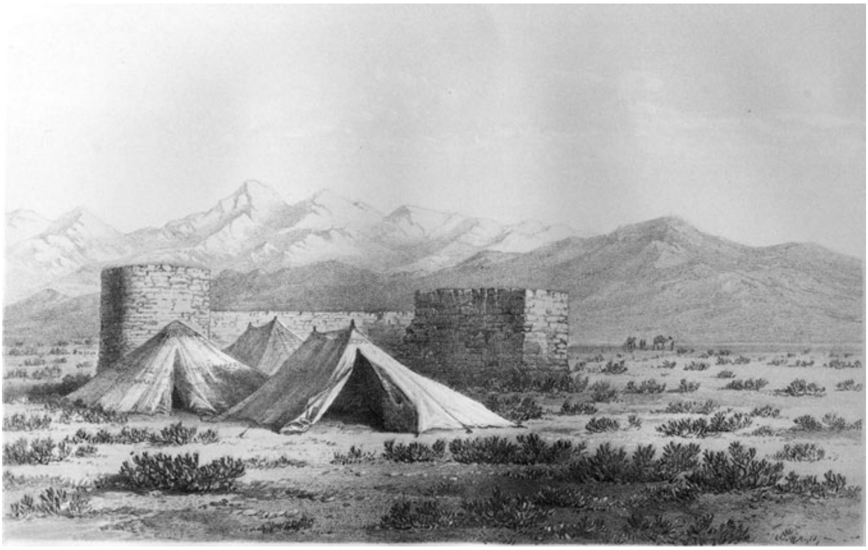


Fig. 5.5. Hodgkin's 'Tents of the wandering Arabs and Atlas Mountains'. From Thomas Hodgkin, *Narrative of a Journey to Morocco, in 1863 and 1864 . . . with Geological Annotations* (London: T. Cantley Newby, 1866), between pp. 96 and 97. Reproduced with the kind permission of Leeds University Library.

not determined, by religious considerations. For example, a number of eighteenth-century High Churchmen followed John Hutchinson's lead in rejecting Newton's natural philosophy because it was not founded on the Bible. Hutchinson instead propounded *Moses's Principia* (1724–7), an account of the physical universe derived (allegedly) from Torah.[65] Given the widespread interest in Newton's theories and the profusion of these religion-based commentaries, it is surprising that eighteenth-century Quakers paid scant attention to Newtonianism, not even writing to oppose it. Instead, as will be discussed in the next chapter, Quakers were drawn principally to botany and to the observational aspects of astronomy. John Dalton was one of the few Quakers who cited Newton's writings: for example, in analysing the physical behaviour of gases, he followed Newton's discussion in the 31st Query to the *Opticks* by treating a gas as a 'Newtonian' elastic fluid consisting of mutually repelling particles.[66] By contrast with the general indifference among practising Quakers, several ex-Quakers were avid Newtonians, including Benjamin Robins, who made significant contributions to the science of gunnery,

[65] Wilde, 'Hutchinsonianism'; *idem*, 'Matter and spirit'.
[66] Patterson, *John Dalton*.

and Thomas Young, whose optical researches and lectures at the Royal Institution (1801–3) display an intimate knowledge of Newtonian mechanics. In wholeheartedly embracing Newtonianism, Robins and Young may be seen as implicitly rejecting their Quaker backgrounds and aligning themselves with a natural philosophy that was widely endorsed by the liberal Anglican establishment.

Compared with this lack of interest in Newtonianism among practising Quakers, one Jewish writer was strongly attracted to Newton's scientific theories and, more generally, to the Newtonian world-view, while three others displayed some interest but cannot be deemed acolytes of Newton. One of this latter group was the *haham* of the Spanish and Portuguese community during the first quarter of the eighteenth century, David Nieto (1654–1728), who had not only studied medicine at the University of Padua but also developed a keen interest in contemporary developments in science and philosophy. As David Ruderman has argued, Nieto was familiar with the contemporary controversies between Christians and deists, and he sided against the deists by deploying from a Jewish perspective arguments based on natural theology. Indeed, he was keen to demonstrate that the rabbinical tradition had been sympathetic to science and reason, and that Jewish philosophy had always been open to employing empirical evidence and insights from science. Thus, in his discussions of the relationship between God and nature, and on the subject of divine providence, he drew on astronomy, on the theory of the four elements, and on the corpuscular theory of matter. Moreover, he supported the rather conventional view that while empirical knowledge was important, it was only partial and had to be supplemented by Revelation—a view that he considered to be sanctioned by rabbinical tradition. Despite endorsing a range of scientific issues, it is striking that he did not mention Newton by name, or dwell on any specifically Newtonian aspects of science. Thus, while he reflected some of the natural theological concerns of his day, it would not be appropriate to call him a Newtonian in anything but a weak sense.[67]

The second example is Mordechai Gumpel Schabner Levison (1741–97), who had studied with an eminent Talmudist in Berlin before enrolling in John Hunter's famous medical school in London in the early 1770s. In 1771 he published in London a Hebrew introduction to the sciences, in order to make fellow Jews aware of the strides that had been made in natural knowledge. This work included a fairly extensive account of Newtonian mechanics based on the laws of motion.[68] While in London he also penned two medical works

[67] Ruderman, *Jewish Thought*, 310–31.

[68] Ibid. 345–57, where Ruderman discusses Levison's work, esp. his *Ma'amar ha-Torah ve-ha-Hokhmah* (1771). See also Schoeps, 'La vie et l'oeuvre de Gumpertz Levison'.

that drew heavily on his medical training. In one of these—*Essay on the Blood* (1776)—he supported Hunter in a controversy over the vitality of the blood, arguing that the properties of the blood are reducible to chemical or mechanical processes. In insisting that life operates through mechanism, he was asserting the need to understand the actions of the blood in terms of its constituent particles and the forces operating between them. He therefore addressed the nature of solids, liquids, and 'vapours' by considering the forces of attraction and cohesion—key terms in Newton's vocabulary. Thus in solids the cohesive force is stronger than the gravitational one, whereas in liquids gravitational attraction predominates.[69]

During the eighteenth century Newtonians were divided over whether attraction was an underlying cause of phenomena or whether it was merely descriptive—describing the movement of bodies towards one another. Both interpretations could be justified by quotations from Newton, the latter by a passage added in the second (1713) edition of the *Principia* in which he stated that he had 'not been able to discover the cause of gravity from phenomena', but was not prepared to frame any hypothesis, 'whether metaphysical or physical, whether of occult qualities or mechanical', such hypotheses having 'no place in experimental philosophy'. Likewise, in his preface to the same edition, Roger Cotes, a disciple of Newton, argued that gravitation should not 'be called an occult cause of the celestial motions, because it is plain from the phenomena that such a power does really exist'.[70] For Levison this latter interpretation was the correct one. He understood 'attraction' to mean 'an effect, or the appearance of bodies with respect to their relative situation; which appearances are objects of sense'. He also dismissed the opposing interpretation: attraction is 'not the power or cause by which the attraction is performed', since that makes 'the cause itself ... occult'. Note his use of 'occult', which for many Newtonians indicated that such causes were beyond the limits of scientific enquiry. Those who appealed to 'occult' causes were therefore being unscientific.[71]

Thus far Levison appears to be committed to developing a Newtonian project. However, the main argument of his *Essay on the Blood* headed in a very different direction; one that owed little to Newton's writings. Rather than analysing the blood in terms of forces, he was far more concerned to demonstrate that a continual interchange occurred between the solid, fluid, and vaporous parts of animal bodies. To support this thesis he cited Aristotle. Again, in his section headed 'Of Action and Reaction' he was not concerned

[69] G. Levison, *Essay on the Blood*, 3–12.

[70] Cajori (ed.), *Sir Isaac Newton's Mathematical Principles of Natural Philosophy*, ii. 547; see also preface by Roger Cotes, i. p. xxviii.

[71] G. Levison, *Essay on the Blood*, 2–3.

with Newton's third law of motion, but rather with a 'great universal law of nature' which he interpreted as meaning that physiological organisms react to stimuli. Although motion was discussed throughout the remainder of his *Essay on the Blood*—he even considered that thinking involved the motion of the mind—his views were unrelated to Newton's theories of motion. Only in the preface and opening pages did Levison draw on Newton.

The third Jewish writer to engage Newton was Eliakim ben Abraham (otherwise Jacob Hart, 1756–1814), who was highly critical of certain kinds of science.[72] A prosperous jeweller and prominent member of the Ashkenazi community, Hart was immersed in the kabbalist tradition. He was also a Freemason, and may have trained as a rabbi. His views about science are clearly articulated in his *Milhamot Adonai* ('Wars of the Lord') published in 1794. For Hart, three major schools of science had not only corrupted Jewish tradition but had also impugned the sanctity of Torah. These were, in turn, Aristotelianism, Cartesianism, and Newtonianism. While dismissing Aristotelianism as obsolete, and Cartesianism as conducive to atheism, his opinion of Newton was rather more complex. He commended Newton's book on the prophecies of Daniel—a subject on which Hart subsequently wrote—and, like many contemporaries, he applauded Newton as the discoverer of nature's laws. Yet, after offering an abbreviated account of Newton's scientific advances, he criticized Newton's views and particularly their elaboration by Newton's deistical or atheistical followers.

Hart reserved severe disapproval for *A New Theory of the Earth* (1696), in which William Whiston had offered an account of how God had fashioned the earth using the (Newtonian) force of gravitation; thus, for example, the biblical Flood was explained by the gravitational attraction of a comet passing close to the earth. Although Whiston was a clergyman, albeit with Unitarian leanings, Hart considered that, in making gravitation the immediate cause of the earth's physical characteristics, he had excluded the role of God, as expounded in Genesis. However, Hart also sided with Robert Greene, an early eighteenth-century Cambridge cleric and author of two impenetrable works attacking Newton's natural philosophy. Hart appears to have strongly shared Greene's view that Newton's inability to assign a cause to gravitation made it an occult power of matter, and therefore philosophically problematic, since it implied a materialistic view of nature, which, in turn, played into the hands of the atheist. Although Hart drew on these two rather outmoded writers—despite there being many more sophisticated contemporaries to whom he could have turned—they served his purpose of warning against

[72] My discussion is based on Ruderman, *Jewish Enlightenment*, 188–201; Barnett and Brodetsky, 'Eliakim ben Abraham'.

the atheistical implications of Newtonianism. Hart's concerns arose in part from his commitment to kabbalism, which portrayed the physical world as an organic expression of the divine. But he was also prompted by the widespread fear of materialism and atheism at the time of the French Revolution. His *Milhamot Adonai* should therefore be read as one of many contemporary works that both defended religion against the atheistical philosophies of the French—epitomized by Descartes—and argued that science should be purged of all materialistic connotations.[73]

By contrast, the early eighteenth-century Portuguese-educated, *converso* physician Jacob de Castro Sarmento (1692–1762) provides an example of an enthusiastic and robust Jewish Newtonian. In 1737 he published a book with the revealing title *Theorica Verdadeira das Mares, Conforme à Philosophia do Incomparavel Cavalhero Isaac Newton* ('The True Theory of the Seas, Conforming to the Philosophy of the Incomparable Sir Isaac Newton'). Here he described Newton as 'immortal', adding that Newton possessed an 'illustrious character, most perfect and complete, having the moral values of humanity, friendship, generosity, humility and modesty'. The title-page of the work was graced by a Latin translation of Pope's couplet celebrating the great man and four lines from Halley's ode in praise of Newton. Before discussing the tides, Sarmento devoted a number of pages to a hagiographical account of Newton's life and a discussion of his impressive scientific achievements in both the *Principia* and *Opticks*. Only then did he engage Newton's explanation of the tides. As Newton argued in the *Principia*, while the water composing the sea is attracted by the earth's gravitational attraction, the tides result from the gravitational attractive influence of both the sun and the moon. From a knowledge of the solar and lunar motions, the forces operating on the water can be calculated, and the tidal motions predicted.[74] Sarmento's *Theorica* contained a competent discussion of Newton's analysis of tidal motion together with empirical evidence derived from a number of respectable sources.

To further locate Sarmento in the circle of Newton's scientific admirers, it should be noted that his dedicatory letter states that, after completing the treatise, 'my good friend and associate' Jean Theophilus Desaguliers invented a mechanical instrument for demonstrating 'the variations of the sea and its phenomena'. This equipment, which Desaguliers had displayed at Bath before an audience of nobles, was based on the principles enunciated in Sarmento's book. Desaguliers was the foremost science lecturer of the period and a committed follower of Newton, whose views he propagated and defended.

[73] See, e.g., Adams, *Lectures on Natural and Experimental Philosophy*, i. pp. vii–xiii.
[74] Cajori (ed.), *Newton's Mathematical Principles of Natural Philosophy*, ii. 478–84.

Sarmento's name also appears on the subscription lists of two works that lauded Newton's achievements, Henry Pemberton's *View of Sir Isaac Newton's Philosophy* (1728) and Colin Maclaurin's *Account of Sir Isaac Newton's Philosophy* (1748). As Matt Goldish has written: 'No Jewish scientist of the early modern period shows himself more informed [about Newton's science] or truly useful [in spreading Newtonianism—in this case to a Portuguese readership] than Sarmento.' But, as Goldish also argues, Sarmento's *Theorica* marks his conversion to deism and his increasing estrangement from the Sephardi community, from which he finally resigned in 1748. Ironically, his commitment to Newtonianism helped undermine the Jewish identity he first realized after coming under Nieto's influence as a *converso* a quarter of a century earlier.[75]

The examples of Sarmento and Levison illustrate Ruderman's argument that eighteenth-century Jews were prone to assimilate to the cultural currents fashionable in England. Sarmento in particular found Newton's ideas so enlightening that he abandoned Judaism in favour of deism. As Ruderman stresses, a number of other eighteenth-century Jews with intellectual interests were likewise drawn to deism, such as Abraham ben Naphtali Tang and Joshua van Oven.[76] Yet, like Christians, Jews could also be ambivalent about Enlightenment modes of thought, on the one hand welcoming the innovative science of Newton, while on the other considering that it promoted materialism and atheism. Writing at the time of the French Revolution, Hart reflected the widespread fear of atheism and materialism that threatened to engulf England. For him, traditional Judaism, founded on Torah, was also endangered by science when pursued from an atheistical perspective.

5.5 Cumbrian Quaker astronomers and meteorologists

A number of local scientific networks can be identified within the Quaker community, the most prominent linking Quaker astronomers and meteorologists living in Cumbria over a period of three or four generations. These Quakers were also connected by family ties. No comparable grouping can be found within Anglo-Jewry, the closest being the group of students who studied mathematics under Augustus de Morgan (see section 3.3.1). Yet, unlike these students of mathematics, Cumbrian Quakers were primarily observers of natural phenomena.

[75] My discussion of Sarmento is based on R. Barnett, 'Dr Jacob de Castro Sarmento'; Goldish, 'Newtonian, converso, and deist'.

[76] Ruderman, *Jewish Enlightenment*, 89–134.

The diary of Isaac Fletcher (1713–81) illustrates the life-style of an eighteenth-century Quaker yeoman with wide-ranging commercial interests who lived at Underwood, some four miles from Cockermouth. Possessing a lively curiosity about natural phenomena, he frequently recorded agricultural, botanical, and meteorological observations, sometimes in impressive detail. During a visit to London in 1760, he ordered from a well-known instrument maker 'an optical apperatus & the machine for viewing prints'. He also possessed a telescope (although it is not clear whether this was the aforementioned 'optical apperatus'), which he deployed on a number of occasions to make astronomical observations, principally of conjunctions. The most detailed astronomical reports in Fletcher's diary were of the 1761 transit of Venus across the sun's disk, and of the 1776 lunar eclipse. In order to record the transit, Fletcher commenced observation at about 4 a.m. Initially the sun was partially obscured by cloud, but as it rose higher in the sky, the cloud cleared, and the 'image of the sun & the planet Venus as a black dot [moving across the sun's disc] appeared very plain upon a white cloth put up for that purpose'.[77]

On this occasion Fletcher was accompanied by Elihu Robinson (1734–1807), a wealthy Quaker yeoman from nearby Eaglesfield, who shared his enthusiasm for studying natural phenomena. Robinson too appears to have been well-informed about recent scientific developments. When visiting London to attend the 1762 Yearly Meeting, he was introduced by Peter Collinson to a distinguished microscopist, visited the shop of a leading scientific instrument maker, and recorded the names of a number of unusual plants in Collinson's garden.[78] Together with John Fletcher (one of Isaac's sons), he formed a book club that served the Whitehaven and Cockermouth area. The members, principally Quakers, received from London regular packages containing books and magazines.[79] However, Robinson was also the early patron of John Dalton, whose scientific career he encouraged. A further connection between Dalton and the Fletcher family is provided by John Fletcher, who tutored Dalton at the Quaker school at Pardshaw Hall.[80]

Although Dalton is usually cited as the architect of the atomic theory, it should be remembered that his first extended foray into science was in the field of meteorology—Robinson's main area of interest—and his first publication was *Meteorological Observations and Essays* (1793). From 1787 onwards Dalton maintained a detailed and consistent meteorological register

[77] Winchester (ed.), *Diary of Isaac Fletcher*, 85, 104, 322. See also Thackray, *John Dalton*, 16, 43–8.

[78] Elihu Robinson's diaries, MS Box R3/1, LSF.

[79] Lonsdale, *Worthies of Cumberland*, 35.

[80] Thackray, *John Dalton*, 156–7.

of weather conditions at Kendal; he read his barometer three times each day: in the morning (between 6 and 8 a.m.), at noon, and in the evening (between 8 and 10 p.m.). In the first part of his published account, Dalton described his instruments and the results he obtained. He not only recorded a mass of data, but also produced numerical tables showing the average barometric pressure for each month throughout the year.[81]

Despite sharing Robinson's interest in meteorology, Dalton approached the subject from a very different perspective. The extant volumes of Robinson's manuscript journal contain notes on the weather for a number of years, beginning in 1779 (although it is likely that other pages, now missing, included earlier observations). As a farmer, Robinson noted weather conditions primarily for their relevance to agriculture. Thus excessive rainfall and snowfall were recorded, as was the terrible drought in 1798, which produced widespread food shortages. Alongside comments on the weather he often noted the prices of wheat, barley, apples, and potatoes at local markets, and sometimes also in London. Unlike Dalton's 1793 book, Robinson's diary did not contain a consistent record of meteorological conditions, but included sporadic barometric and thermometer measurements. Although Robinson has been described as 'the first of Cumberland's meteorologists',[82] his rather haphazard record of the weather disqualifies him from this title. Along with infrequent measurements, he usually noted the first 'Cuckow' of spring. Moreover, his record sometimes strayed far from meteorological matters; for example, there were occasional references to the comings and goings of fellow Quakers and to pressing political events. Thus, at the end of January 1798 he noted an interesting conjunction between the weather and politics: 'Very *gloomy* both in y^{e} Elementary & Political World! Threatened Invasion from France!'[83]

Dalton's book was not confined to meteorological observations, but also contained several essays, the most important and original discussing thunderstorms and the aurora borealis. One line of investigation particularly attracted his attention. Magnetic needles, he noted, were affected by an aurora, especially by the impressive illuminations of 13 October 1792. Hence, he argued, the aurora was a magnetic phenomenon produced by an 'electric light'. Using simple geometry, he determined the height of the auroral arch to be about 150 miles.[84] The list of subscribers is also noteworthy, since it reveals

[81] Dalton, *Meteorological Observations*.

[82] Lonsdale, *Worthies of Cumberland*, 35.

[83] Elihu Robinson's diaries, MS Box R3/7 and R3/8, LSF.

[84] Dalton, *Meteorological Observations*, 71, 175. See also *idem*, 'On the height of the aurora borealis'. This problem was also tackled by two subsequent Quakers, Robert Were Fox ('On the variable intensity of terrestrial magnetism') and Thomas William Backhouse ('Height of auroras').

the names of a number of other Cumbrian Quakers interested in meteorology, including John Fletcher, Elihu Robinson, and John Gough (of Kendal, who had coached Dalton in mathematics). Quakers living further afield included Joseph Gurney of Norwich, William Allen of London, and Robert Barclay of Clapham. The Quaker publisher and bookseller James Phillips, of Lombard Street, took twenty-five copies.

Inspired by Isaac Fletcher, later members of the Fletcher family continued to uphold the Quaker tradition in astronomy. John Wilson Fletcher, the son of John and grandson of Isaac, was a respected Quaker elder who lived at Tarn Bank, close to his family home at Greysouthen. A prosperous coal owner and landowner, Fletcher constructed an observatory at Tarn Bank in 1848 for his son, also named Isaac (1827–79) (Figs. 5.6 and 5.7). A visitor to the Fletcher residence in 1850 commented on his host's 'very good house, finely situated on rising ground, which commands an extensive view. There is a very well-planned observatory attached, and we had the gratification of viewing the moon and the planet Saturn through the instrument it contains.'[85] Although clearly impressed by the sight of the moon and of Saturn, this visitor may not have been aware that Fletcher's telescope was one of the finest instruments in private hands, and the subject of a paper in the *Monthly Notices of the Royal Astronomical Society*.[86] It is clear that, despite his youth, Isaac was well-informed about telescope design (probably because his cousin John Fletcher Miller had recently purchased a less satisfactory instrument) and had acquired a six-foot achromatic instrument from Thomas Cooke of York, the foremost optical instrument maker in Britain. As Fletcher wrote to Sir John Herschel in 1849, he had 'recently erected a very admirable equatorial [telescope] expressly for the purpose of pursueing the measurements of double stars . . . I have every reason to believe it to be well adapted for these very delicate researches.' Having outlined his project to examine binary stars, he invited any suggestions from the eminent astronomer.[87]

Elected to the Royal Astronomical Society in 1849 and to the Royal Society in 1855, Fletcher's certificate recorded him as an eminent 'observer of double stars and computer of their orbits; also as having equipped and worked an observatory which has advanced Astronomy'.[88] The several papers he contributed on double stars helped to open up this important field of research.

85 W. Miller to J. Miller, 19th day, 10th mo., 1850, in W. F. Miller, *Memorials of Hope Park*, 183.

86 Fletcher, 'Brief description'.

87 Isaac Fletcher to John F. W. Herschel, 25 Oct. 1849, Herschel Papers, MS HS.7.271, RSL.

88 Proposal form 674, Papers 1, Royal Astronomical Society Archives; Certificate EC/1850/16, RSL. See also C. May to J. Williams, 26 Feb. 1849, Miscellaneous Letters, Royal Astronomical Society Archives.

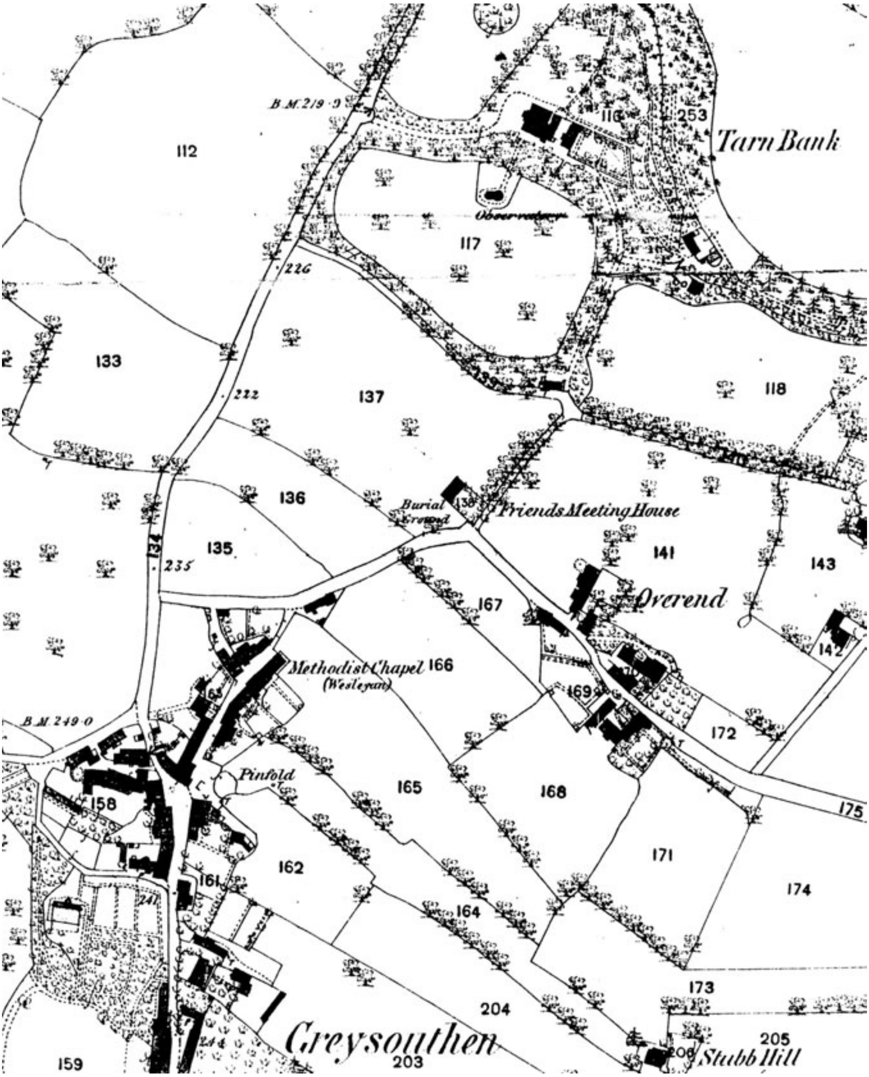


Fig. 5.6. Mid-Victorian map of the Greysouthen area, with Tarn Bank to the north. Isaac Fletcher's observatory is marked, just to the south of Tarn Bank. Notice also the Quaker meeting-house nearby. Reproduced with kind permission of the Cumbria Archive Service, Whitehaven.

Fig. 5.7. Isaac Fletcher's observatory at Tarn Bank. The observatory and the instrument, a six-foot Cooke achromatic reflector, are described in Fletcher, 'Brief description'. Author's photograph taken August 1997. Published with the permission of the present owner, Mr B. Walker.

In particular, his 1853 paper on double stars observed at Tarn Bank summarized data based on some 5,200 individual measurements.[89] However, his astronomical publications appear to have declined somewhat after the mid-1850s. Nevertheless, in 1858 he purchased from Cooke a more powerful telescope with a nine-inch objective lens, costing £400.[90] The demands of business, which prompted him to publish on the coal question, and increasingly of politics—he became MP for Cockermouth—appear to have diverted him from science.

One of the signatories to Fletcher's Royal Society certificate was his cousin, John Fletcher Miller (1816–56), who lived in Whitehaven, some fifteen miles away. Elected to the Royal Astronomical Society in 1849 and to the Royal Society in the following year, Miller had already achieved some renown among the scientific community for his research into the meteorology and climate of the Lake District. The son of a tanner, Miller attended the Quaker school at Kendal before returning to help run the family business. From the age of 15, and for the next twenty-three years, he maintained a detailed meteorological journal. Partly to combat ill health, he visited Australia and Chile during his early twenties, but continued his meticulous daily meteorological observations throughout his travels. Returning home, he embarked on a major project measuring the rainfall at a number of stations positioned at different altitudes throughout the Lake District. In the resulting publications he concluded that this mountainous region displayed tropical patterns of precipitation.[91]

Miller's journals must be among the most impressive nineteenth-century meteorological records. In his neat hand and with consummate care he recorded measurements made daily at Whitehaven.[92] As the sample double-page spread for October 1850 indicates, he recorded the barometric and thermometer readings at 3 p.m. and 10 p.m., took several measurements using thermometers of various types, and measured the daily rainfall and wind speed and direction (Fig. 5.8). Each monthly table was supplemented by notes, sometimes running to several pages, recording specific details of the weather, especially if some unusual phenomenon had occurred, such as heavy rainfall, a drought, or an aurora. Frequently, too, extracts were inserted from

[89] Fletcher, 'Results of micrometrical measures'. As the full title indicates, Fletcher (and also Miller) specified dates in terms of years and decimal parts thereof, thus avoiding the heathen names of the month.

[90] 'Thomas Cooke's Order Book, 1858–68', Borthwick Institute of Historical Research, University of York. I am grateful to Mrs A. J. Brech for supplying this information.

[91] J. F. Miller, 'On the meteorology of the English Lake District'.

[92] 'Meteorological observations' and 'Meteorological summaries', Papers of John Fletcher Miller, DH1/1–6 and DH2, Cumbria Record Office, Whitehaven.

newspapers or from the reports of other observers detailing a wide variety of meteorological occurrences throughout Britain and sometimes further afield. Indeed, Miller belonged to an extensive network of meteorologists. Thus we find in his log-books letters from Luke Howard (giving temperatures and rainfall at Ackworth for July 1846) and from Isaac Fletcher (on parhelia), and meteorological tables compiled by many other observers. The second volume concludes with the names and addresses of some 250 correspondents, mostly people with meteorological interests to whom Miller sent copies of his publications. Among these correspondents were several scientifically minded Quakers, including John Ford of York (who compiled meteorological data for the Yorkshire Philosophical Society), Luke Howard, Joseph John Gurney (Norwich), Samuel Gurney (London), Charles May (Ipswich), William West (Leeds), and J. J. Lister (Upton).

At the end of each year Miller summarized the data he had collected into tables showing monthly variations in temperature, pressure, rainfall, wind speed, etc. Moreover, with the passage of years and the extension of his work to include rainfall measurements throughout the Lake District, the comparative dimension achieved increasing importance. He also published these summaries as pamphlets that were distributed widely through his network of correspondents. Although his meteorological investigations demanded intensive labour (with, doubtless, the help of assistants at several locations), it is clear from these published reports that he received money from subscribers who helped to defray his expenses and also grants from the Royal Society.[93]

Like his cousin, Miller became an enthusiastic astronomer. Having purchased a good-quality telescope and other equipment from Thomas Cooke, in 1849–50, he constructed his own observatory with 'its elegant revolving conical roof' at Whitehaven abutting the family's tannery in Wellington Row (Fig. 5.9). As his obituarist (probably Fletcher) noted, Miller was a skilled observer, possessing 'excellent eye-sight, perseverance, and dexterity of manipulation', and he was also very knowledgeable in several other sciences.[94] Miller's beautifully written 'Astronomical observations' contains surprisingly few entries, but shows that he trained his instrument not only on double stars but also on Encke's comet, Saturn (to show its planets), the sun (to show a surprisingly large group of sunspots), and Mercury (to observe a transit). Dates were given throughout in the Quaker format, whereas in his meteorological work he combined Quaker and heathen terminology. As with the meteorological observations, Miller's astronomical records display his

93 Lonsdale, 'John Fletcher Miller'.

94 Ibid.; Obituary notice of John Fletcher Miller in *MNRAS*, 17 (1856–7), 99–100.

October.

1850 10th Mo.	Barometer. 3 P.M	Ther:	10 P.M	Ther:	Thermometers. Max:	Min:	Naked On Grass	On Wool	In Sun	Dry Bulb 9h	10h	3h	Wet B[ulb] 9h	10h
1	29.604	60	29.736	61	58.5	43	38	36	80.5	52.5	55.5	57.5	50	53
2	29.810	49	29.808	59	58	40	31	26.5	76	49	52	55	46	50
3	29.849	49	29.883	49	61	47	44	41	71	52	55	58	52.5	53
4	29.704	60	29.701	60	59	43	38	34	64	55.5	56.5	53	53	53
5	29.643	58	29.632	58	56.5	46	41	39.5	68	51.5	53.5	53	49	49
1st	29.404	57	29.124	59	57.5	47	40	38	64	50.5	52	52	48	49.5
7	29.130	56	29.172	56	58	49	48	47	56	51.5	52	49.5	49	50
8	29.616	59	29.721	60	57	50	47	46.5	70	51	52	56.5	49	50
9	29.940	52	30.040	57	53	42.5	37	33	72	46	48.5	51	44	45
10	29.964	56	30.028	56	53	36	31	26	75	46	48	51.5	42	44
11	30.212	55	30.400	56	50.5	41	35.5	33.5	65	44	46	49	40	41
12	30.400	56	30.361	57	51.5	36	30	26	67	44	46	49.5	39.5	42
1st	30.161	56	30.091	56.5	54	45	44	40.5	66	51	51.5	54	48.5	49
14	29.790	56	29.904	56.5	54.5	49	48.5	47	60	52.5	53	51.5	50	50
15	29.974	53.5	29.934	56	52	33.5	26	25	66	42	45	50	39	42
16	29.924	58	29.916	59	58	49	46.5	44.5	72	53	54.5	55	51	51.5
17	29.896	59	29.900	61	57.5	49	49.5	50	64	53	54	56.5	51.5	52
18	29.960	60	29.920	62	59.5	51	47	47	68	55	57	67	54	55.5
19	29.858	59	29.904	62	55	52	47.7	47.3	66	54	54.5	58	51	51.5
1st	29.972	60	30.000	56	52	46	42	40	72	47.5	48	50	44	44
21	30.188	56	30.276	55	49	36.5	33.5	26	61	43	45	46	39.5	41
22	29.860	53	29.420	54	50.5	32.5	28	23	50	40.5	44	45.5	38	41
23	29.280	55	29.352	54	47	41	39.5	37.5	59	44.5	45.5	45	41	43
24	29.380	60	29.582	52	47	34.5	27	20.5	57	39	41	46	37.5	39
25	29.630	49	29.670	57	45	35	29.3	26.5	77	39	41	44	37.5	38
26	29.814	52	29.862	52	45	32	28.3	25.3	56	36	39.5	44	34.5	37
1st	29.620	52	29.440	54	50	36	28	23	50	42.5	44	47.5	40.5	41
28	29.280	51	29.354	55	49.5	44.5	40.5	39	64	46	47.5	47	44	44
29	29.530	56	29.600	57	50	39.5	34	31.5	61	42	44	49	40	42
30	29.496	56	29.624	55	54	38	29.5	27	58	44	47.5	52.5	43	42
31	29.822	57	29.800	59	55.5	50.5	46.5	45.5	61	51.5	53	54	49.5	50
	29.764	56.0	29.746	56.9	53.50	42.38	37.86	35.16	65.7	47.45	49.30	51.06	45.00	46
	.074		.046											
	29.690		29.700											
	.014		.014											
	29.704		29.714											

Mean 47°.846

Corrected Mean 29.710

Dew Point.

9 a.m	42.36
10 a.m	43.23
3 p.m	43.95

Fig. 5.9. John Fletcher Miller's observatory in Wellington Row, Whitehaven; photograph taken 1904. From the Papers of John Fletcher Miller, Cumbria Record Office, Whitehaven. Reproduced with kind permission of the Cumbria Archive Service, Whitehaven.

meticulous attention to detail (Fig. 5.10). Many of his observations were printed either for distribution to colleagues or for inclusion in the local newspaper; thus in 1851 he issued reports on 'The solar eclipse' and on a 'Stupendous group of spots on the sun's disc'. The final entry in Miller's astronomical log dates from March 1854, more than two years before his death

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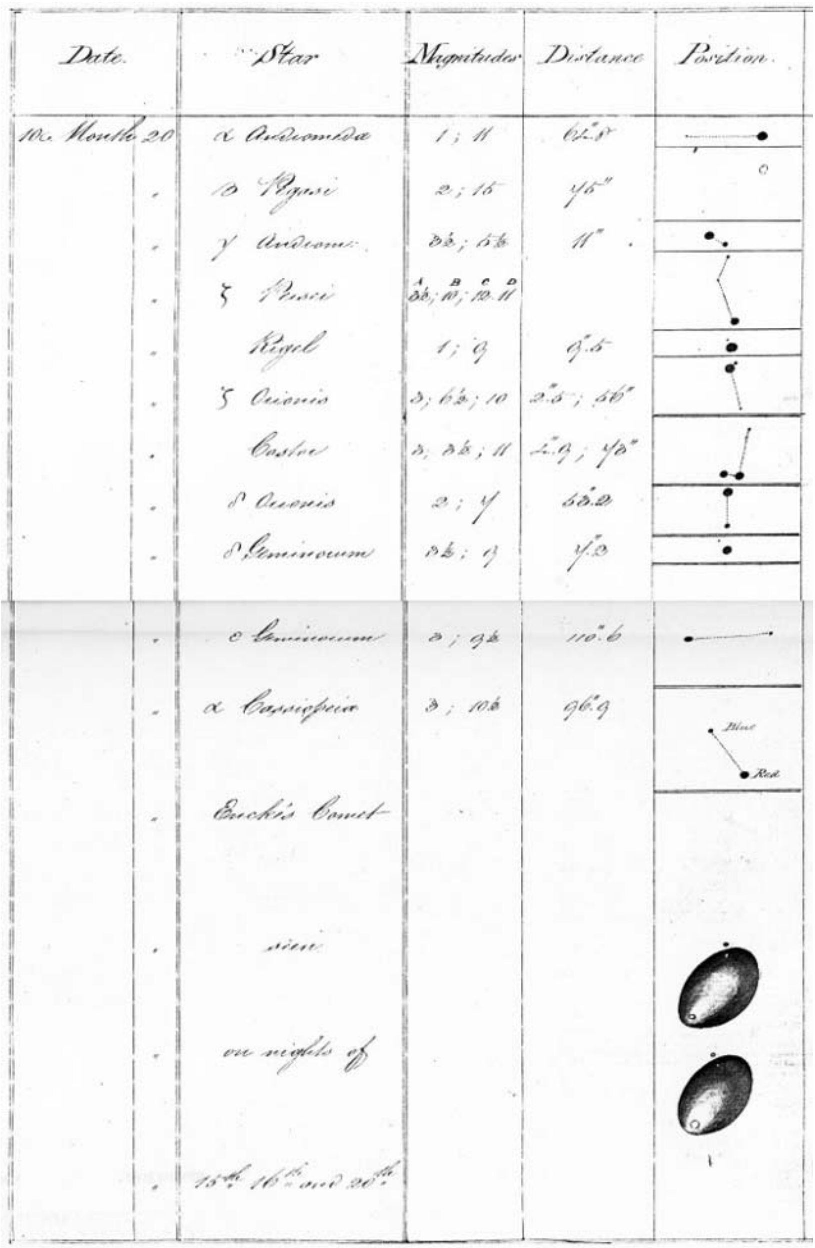
Fig. 5.8. John Fletcher Miller's meteorological journal, October 1850. This shows most of the left-hand page of a double-page spread. The main headings, from left to right are '1850 ye 10th Mo[nth]'; Barometer (3 p.m.; Ther[mometer]; 10 p.m.; Ther[mometer]); Thermometers (Max[imum]; Min[imum]; Naked (On Grass; On Wool; In Sun)); Dry Bulb [Thermometer] (9 h[our]; 10 h[our]; 3 h[our]); Wet Bulb [Thermometer] (9 h[our]; 10 h[our]; 3 h[our]); Evaporation Gauge; Pluviometers [Rain Guage] (Garden; Steeple); Winds (a.m.; p.m.); Force [of wind]; Lunation. The average values are given at the bottom of this page, and the average dew point calculated. Note that although the heading is October, the month is given in Quaker form—10th mo.—as the heading for the first column. Also the Sabbath is denominated 'S'. Papers of John Fletcher Miller, MS DH1/43, Cumbria Record Office, Whitehaven. Reproduced with kind permission of the Cumbria Archive Service, Whitehaven.



Date.	Star	Magnitudes	Distance	Position.
10. Month 20	α Andromeda	1 ; 11	62.8	
.	β Pegasi	2 ; 15	45"	
.	γ Androm.	3½ ; 5½	11"	
.	ζ Pisci	A 3½ ; B 10 ; C 10 D 11		
.	Rigel	1 ; 9	9.5	
.	ζ Orionis	3 ; 6½ ; 10	2.5 ; 56"	
.	Castor	3 ; 3½ ; 11	2.9 ; 48"	
.	δ Orionis	2 ; 7	53.2	
.	δ Geminorum	3½ ; 9	7.2	
.	ε Geminorum	3 ; 9½	110.6	
.	α Cassiopeia	3 ; 10½	96.9	Blue Red
.	Encke's Comet			
.	seen			
.	on nights of			
.	15th 16th and 20th			

Fig. 5.10. Entries in John Fletcher Miller's astronomical journal. From the Papers of John Fletcher Miller, MS DH15, Cumbria Record Office, Whitehaven. Reproduced with kind permission of the Cumbria Archive Service, Whitehaven.

in July 1856.[95] Although he was interred in Whitehaven Friends' burial ground, he is recorded as a non-member, and must therefore have either resigned his membership or been disowned.[96]

Although Cumbria became a major locus for Quaker astronomers and meteorologists, a sprinkling of Quakers in other parts of the country contributed to these subjects, including William Allen,[97] Charles May,[98] Isaac Brown, Joseph Gurney Barclay,[99] Joseph Beck, and Thomas William Backhouse,[100] who were all members of the Royal Astronomical Society. Luke Howard, who devised the nomenclature for cloud types, was doubtless the best-known Quaker meteorologist.[101] However, while some Quakers contributed energetically to the science of meteorology, the subject also evoked wider interest among the general Quaker community, as the meteorological tables published in the *Friend* and in other Quaker periodicals indicate. By contrast, in the Anglo-Jewish community of the late eighteenth and early nineteenth centuries interest in either observational astronomy or meteorology was virtually non-existent.[102] The contrast between the extensive participation of Quakers and the absence of Jews in these two major observational sciences is significant and will be discussed in later chapters.

5.6 Engineers and entrepreneurs: the Samuda Brothers and Charles May

It is difficult to make a clear division between science and technology, and although much technological innovation in the eighteenth and nineteenth centuries owed relatively little to science, the participation of Quakers and Jews in areas where science, technology, and industry intersected must be

[95] 'Astronomical observations', Papers of John Fletcher Miller, DH15, Cumbria Record Office, Whitehaven.

[96] Information kindly supplied by Edward Milligan.

[97] Allen, a pharmaceutical chemist, frequently travelled throughout Britain and Europe on diplomatic or philanthropic missions. He also compiled tables of stellar positions, including some double stars, which he published in 1815 under the title *A Companion to the Transit Instrument*.

[98] See sect. 5.6.

[99] See obituary notice of Joseph Gurney Barclay in *MNRAS*, 59 (1898–9), 218–19; J. G. Barclay, *Astronomical Observations*.

[100] See T. W. Backhouse, *Publications of West Hendon House Observatory*; Journals of Thomas William Backhouse, MSS V65/1–36, University of Durham Archives.

[101] Luke Howard's principal work was *Climate of London*. On Howard see also Scott, *Luke Howard*.

[102] The main exceptions are the eccentric Lazarus Cohen (author of *New System of Astronomy*) and Solomon Moses Drach (*Mathematical Essays*). Drach and David Salomons were Fellows of the Royal Astronomical Society.

acknowledged. The literature on Quaker contributions to engineering and to technology-based industries is extensive; for example, Arthur Raistrick has discussed their innovations especially in the mining and iron industries.[103] Although the nineteenth century has not been researched so thoroughly, there exist a number of studies of individual Quakers and Quaker-owned businesses that were entrepreneurial and technically innovative.[104] By contrast, with the exception of work on the industrial chemist Ludwig Mond,[105] Anglo-Jewish engineers have received little attention. Yet, while numbers are admittedly small compared with the list of inventive Quakers, a few Jews were at the forefront of technological innovation during the nineteenth century. Nathan Defries, the gas engineer who supplied the illuminations at the wedding of the Prince of Wales, as well as lighting many institutions and private buildings, deserves particular mention.[106] However, the emphasis here will be on the railway technologies developed during the crucial middle decades of the century. While both Quakers and Jews invested heavily in railway expansion, this section will focus on Quaker and Jewish railway engineers.

Railway historians have concentrated on the development of the steam locomotive, whose manifest success has cast a shadow over a rival method of traction that in the 1840s was widely considered a viable alternative. This was the atmospheric railway, which included two—possibly three—Jews among its main promoters. The atmospheric railway worked on a simple principle. If a piston is placed in a tube and the air pumped in at one end, the piston will be propelled towards the other end, owing to the difference in pressure. Imagine this now on a large scale, with the piston attached to a carriage running on rails and filled with passengers; it too will be propelled along the track by air pressure. To implement this technology, a stationary steam-engine is required to compress the air, which is then pumped into the pipe placed between the two rails. The compressed air will then cause the carriage to move along the rails. (Rather than compressing the air, some systems withdrew the air, causing a partial vacuum.)

One of the first to champion this means of propulsion was Henry Pinkus, who is described as 'an American living in London', but whose name strongly suggests that he was Jewish or of Jewish extraction.[107] Since about 1825, Pinkus had been developing machines using atmospheric pressure for the traction of barges, but only in 1835 did he issue a prospectus for the 'National Pneumatic Railway Association'. Despite receiving the endorsement of no less an author-

[103] I. Grubb, *Quakerism and Industry*; Raistrick, *Quakers in Science and Industry.*
[104] Walvin, *Quakers.*
[105] J. M. Cohen, *Life of Ludwig Mond.*
[106] See frequent references to him and his products in the *JC* and sect. 4.5 and 4.6.2.
[107] Hadfield, *Atmospheric Railways.*

ity than Michael Faraday, Pinkus's proposals attracted little attention. However, in 1840 he published *The New Agrarian System; and the Pneumatic-Atmospheric and Gaso-Pneumatic Railway, Common Road and Canal Transit*, in which he argued that atmospheric traction was vastly superior to the steam locomotive, not only for farm work but also for drawing barges on canals and propelling carriages on railways. There were, he claimed, several clear advantages: atmospheric traction systems were cheaper to construct, cheaper to maintain, capable of higher speeds, and considerably safer. Since many serious accidents resulted from the explosion of boilers on steam locomotives, the distancing of the steam-engine from the carriages in which passengers travelled was a distinct benefit. Also, since the carriages were connected to a fixed pipe between the rails, collisions and derailments were minimized.[108] Pinkus also provided calculations showing that the atmospheric engine was considerably more cost-effective than its rival. It was an attractive business proposition, and in his book he offered landed proprietors licences to install this efficient form of engine for agricultural and mining purposes.

Although Pinkus soon faded from the history of atmospheric engines, the Samuda brothers—Jacob (1813–44) and Joseph (1813–85)—played a prominent role. Born into a family of Sephardi merchants, they developed marine engines during the 1830s. Teaming up with Samuel Clegg, another engineer, they pioneered the development of the atmospheric railway during the early 1840s. Initial tests were carried out using track extending three-quarters of a mile at Wormwood Scrubs, and by the autumn of 1845 a five-mile track was laid between Norwood and Croydon, with a vacuum tube of fifteen inches diameter. According to one contemporary report, speeds of seventy-five miles per hour were achieved, and the system even worked efficiently in propelling carriages up relatively steep inclines which had often defeated steam locomotives (Fig. 5.11).[109] But the Samudas' most impressive enterprise was the line between Kingstown and Dalkey, near Dublin, which (its proponents claimed) resulted in a cheap, safe, and efficient railway system. As the *Voice of Jacob* trumpeted:

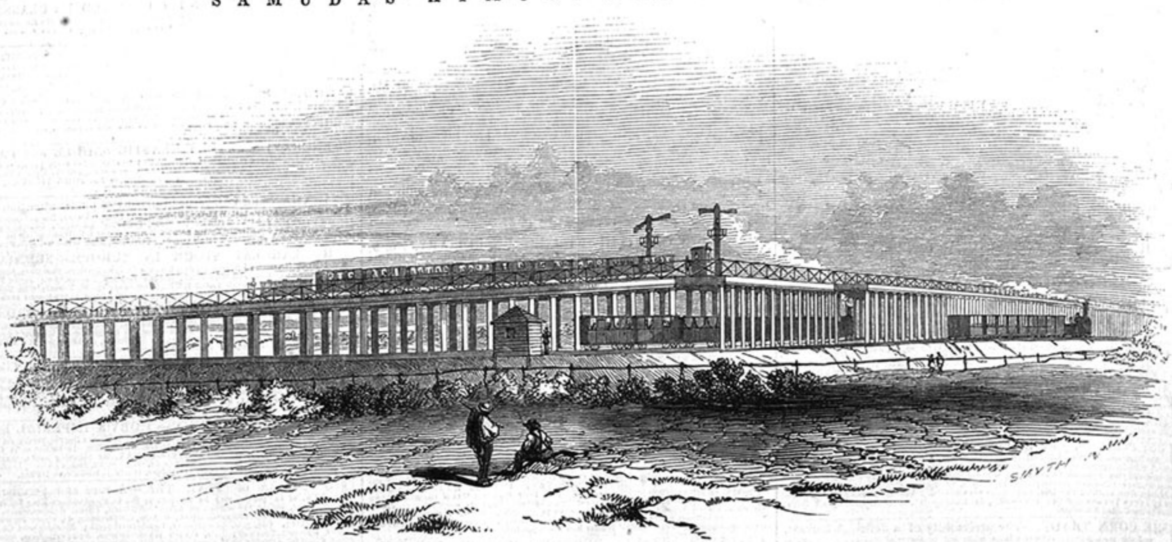
> *Scientific and Philanthropic triumph.*—Apart from our satisfaction at the complete success of the atmospheric, or, as it may be called, *safety* principle,—a propelling power on railways, invented and patented by Messrs. Clegg and Samuda, and now for the first time in full operation near Dublin,—we find additional gratification in the circumstance that the Messrs. Samuda are Jews.—Vide the newspaper reports.[110]

[108] Pinkus, *New Agrarian System*, 40–1.

[109] *Illustrated London News*, 11 Oct. 1845, 240. Part reprinted in Cowan and Cowan, *Victorian Jews*, 88–9.

[110] *VoJ*, 1 Sept. 1843, 229.

SAMUDA'S ATMOSPHERIC RAILWAY.



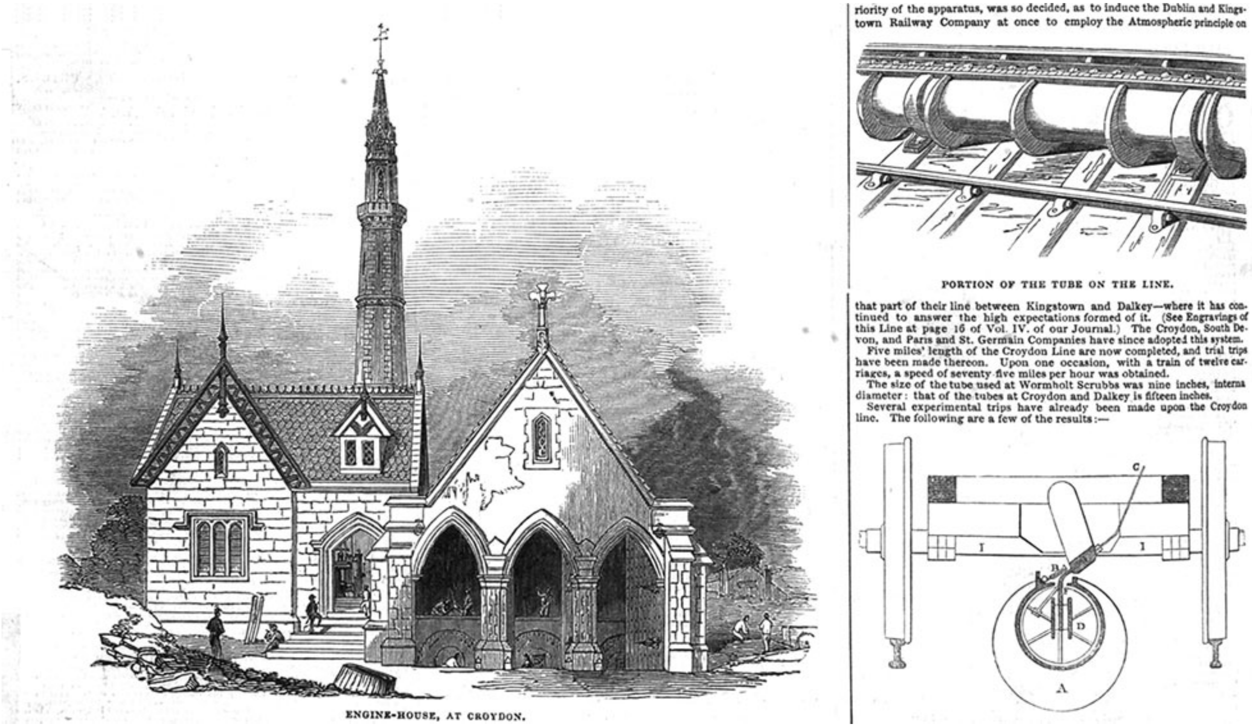
VIADUCT ON THE CROYDON ATMOSPHERIC RAILWAY, CROSSING THE DOVER AND BRIGHTON LINES, BETWEEN NORWOOD AND CROYDON.

We resume our Illustrations of the various methods of Amospheric Traction with that invented by Messrs. Clegg and Samuda, which may be thus generally described.

A large tube is laid down in the centre of a line of rails. This tube has an opening at the top, which is closed by a valve, formed of a leather strap, covered with short plates of ron above and below. Now, the strap being broader than the plates, it is pressed against the top of the pipe by a succession of long rods, screwed down with hook bolts, and thus forming a hinge. On the side on which the valve opens is a groove, which is filled with a composition of wax and tallow. It is evident that when the valve is raised, there will be space enough for a bent plate of iron to pass into the tube.

heated, to prevent the composition adhering to it. The pipe is then ready to be exhausted for another train.

The Atmospheric Railway was first experimented, some years since, at Wormholt Scrubbs, where a line of three quarters of a mile in length was laid down, at the expense of the Patentees. The success of the experiments on this line, in spite of the novelty of the invention, and consequent infe-



ENGINE-HOUSE, AT CROYDON.

riority of the apparatus, was so decided, as to induce the Dublin and Kingstown Railway Company at once to employ the Atmospheric principle on

PORTION OF THE TUBE ON THE LINE.

that part of their line between Kingstown and Dalkey—where it has continued to answer the high expectations formed of it. (See Engravings of this Line at page 16 of Vol. IV. of our Journal.) The Croydon, South Devon, and Paris and St. Germain Companies have since adopted this system.

Five miles' length of the Croydon Line are now completed, and trial trips have been made thereon. Upon one occasion, with a train of twelve carriages, a speed of seventy-five miles per hour was obtained.

The size of the tube used at Wormholt Scrubbs was nine inches, interna diameter: that of the tubes at Croydon and Dalkey is fifteen inches.

Several experimental trips have already been made upon the Croydon line. The following are a few of the results:—

Fig. 5.11. The Samudas' atmospheric railway reported in the *Illustrated London News*, 11 October 1845, 240. The top illustration shows a train on the Croydon Atmospheric Railway crossing the viaduct over the Dover and Brighton lines, where two trains pulled by steam-engines can be seen. The lower left illustration shows the engine house at Croydon, while the illustrations on the right, the tube that sits between the two rails and, below, a cross-section of the tube with the valve located between the carriage wheels. Reproduced with the kind permission of Leeds University Library.

Concerted attempts were made by the Samudas and their friends, including John Lewis Ricardo, MP, and the Jewish financier Hananal De Castro, to convince railway companies to adopt the atmospheric system of traction. To assist in their cause, Clegg and Samuda were successful in petitioning parliament to convene a Select Committee to assess the technology. Faced with expert witnesses who were divided on the issue—Isambard Kingdom Brunel keenly supported the system, while Robert Stevenson opposed it—the Committee's report was a moderate endorsement of atmospheric railways.[111] Moreover, Peel spoke warmly in parliament of the system and of the 'ingenious men who were entitled to the discovery, [being] two brothers of the Jewish persuasion'.[112] Yet, despite these powerful advocates, most railway companies opted for the alternative system of traction. Although its proponents claimed that it possessed many advantages, the atmospheric system encountered several major problems. For example, the vacuum in the pipe proved difficult to maintain, and the valve sealing the pipe (through which the bar connecting the piston and the carriage passed) was inefficient. Joseph later became a prominent shipbuilder and engineer, the Samuda shipyard producing a large number of warships and merchantmen, even royal yachts. It has been claimed that the firm of Samuda Brothers, being at the forefront of technological innovation, exemplified 'the rise, progress, and development of iron steam-ship construction'. Samuda entered parliament as a Liberal in 1865, and served as MP for the densely Jewish constituency of Tower Hamlets from 1868 to 1880. However, at some time in his adult life he appears to have severed his connection with the Sephardi community.[113]

Quakers too made distinctive contributions to the development of railways. As Edward Milligan has shown, they invested massively in railways, built them, and maintained them. The great Bradshaw of timetable fame was a Quaker, as was the 'inventor' of the railway ticket.[114] Milligan also discusses 'Ransomes & May' of Ipswich, a firm of Quaker iron-founders established in 1789 by Robert Ransome, who specialized in agricultural machinery and developed new types of plough, including one with interchangeable parts—a significant innovation that greatly enhanced the firm's reputation. Over the years this family firm prospered, expanded, and diversified its products. In 1836 it was joined by Charles May (1801–60), a young Quaker who had been trained as an apothecary. Aware of the proliferation of railways and of the significant profits that could be made, he foresaw a considerable demand for the iron chairs and

[111] *Report from the Select Committee of Atmospheric Railways.*

[112] Quoted by Hadfield, *Atmospheric Railways*, 45.

[113] *Engineer*, 59 (1885), 338; 87 (1899), 82; *Minutes of the Proceedings of the Institution of Civil Engineers*, 81 (1885), 334–7.

[114] Milligan, *Quakers & Railways.*

fastenings that secured the rails. He therefore undertook responsibility for the railway aspect of the firm's business and patented a form of chair for fastening the track. This proved highly profitable, and Ransomes soon produced fastenings for many thousands of miles of track being laid both in Britain and abroad. By the mid-century the company's railway-related sales far outstripped its turnover for agricultural machinery. After the partnership was dissolved in the early 1850s, May moved to London as a consulting engineer.

In 1854 he was elected to the Royal Society, his certificate stating that he was 'the Inventor of recognized improvements in the construction of [the] permanent way of Railways' that were widely employed in Britain, on the Continent, and in India. However, his contributions to astronomy, a subject that had interested him from an early age, were listed ahead of his contributions to railway engineering. The certificate stated that he had constructed several telescopes and 'a very elegant and spacious' private observatory at his Ipswich home. While at Ransomes, May had undertaken major engineering projects, including the construction for the Astronomer Royal, George Airy, of two 'magnificent instruments'—a transit circle and an altazimuth—that were used at the Royal Greenwich Observatory. These were described as being 'justly regarded by all competent judges as models of engineering perfection, and they have inaugurated a new phase in astronomical-instrument making'.[115]

Both May and Joseph Samuda were respected members of the Institute of Civil Engineers, May serving on its Council for a number of years. Samuda, who was a powerful and well-informed speaker on engineering topics was also co-founder of the Institution of Naval Architects and its first Treasurer. Samuel Smiles could readily have written heroic biographies of these two successful Victorian engineers.

5.7 Industry and science: Robert Were Fox

Two questions pertinent to the present study are raised by the significant role played by Quakers in such industries as mining, iron founding, wire making, and brewing (until the evangelical turn of the early nineteenth century favoured teetotallers). Did their industrial activities impact on their science? Conversely, did they apply scientific knowledge to industry? The example of Robert Were Fox (1789–1877) from Cornwall will be used to investigate these questions. Fox, a highly respected Quaker elder, was active in a number of social and philanthropic movements, such as the anti-slavery campaign. His

[115] Ibid. 22; Obituary in *MNRAS*, 21 (1860–1), 101–2; Grace and Phillips, *Ransomes of Ipswich*, 2–3.

forebears had accumulated extensive commercial interests in the Falmouth area, especially in shipping and in tin and copper mining. With their wealth they purchased attractive houses, first Grove Hill, later at Penjerrick. One visitor in 1865 dilated not only on the 'magnificent pictures, rare china, and a rich collection of animals' at Fox's home, but also on the 'beauty of his gardens, which have justly been compared to those of the Hesperides'.[116] Like many accomplished and affluent Quakers, Fox was an enthusiastic botanist and horticulturalist, the temperate Cornish climate enabling him to grow and develop many exotic species.

Despite his extensive botanical interests, Fox did not publish on natural history. Instead, the vast majority of his sixty scientific publications engaged topics that related to his industrial and commercial interests. For example, in his first sustained scientific investigation he examined the operation of the steam-engine, which was used extensively in the Cornish mines, especially for drainage. The patent he and a colleague subsequently took out for improving steam-engines was intended to save on fuel costs. But his main research was directed to the earth and, as his biographer recorded, 'not a single branch of science connected with mining escaped his attention'.[117] These researches can be conveniently divided into several overlapping topics.

In several papers, from 1819 onwards, Fox engaged a problem raised by contemporary geological theory. Around the turn of the century, a major controversy had developed about whether fire or water was the principal agent fashioning the earth's geological structure. By the early 1820s, the consensus of geological opinion was that the earth's strata had been causally affected by heat, a view that cohered with Joseph Fourier's argument for a cooling earth. Yet, during this process of cooling, the earth had been subject to a number of major cataclysms; indeed, during the late 1820s a leading French geologist had correlated the geological evidence with the theory of a central source of heat and concluded that the earth had undergone twelve periods of mountain building. Opposing such speculative theories in his *Principles of Geology* (1830–3), Charles Lyell insisted on the principle of actuality—only currently operating forces could be evoked—and argued that the earth is a steady-state system.[118] Although these disputes over geological theory provided a contemporary context for Fox's work, he was not primarily interested in theory building. In a paper of 1827 he reported the results of extensive observations he had made in seventeen tin and copper mines in Cornwall and Devon. In so doing, he confirmed the well-known fact, predicted by the

[116] J. H. Collins, *Catalogue of the Works of R. W. Fox*, 5.
[117] Ibid. 2.
[118] Lawrence, 'Reappraisal of Lyell's place'.

igneous hypothesis, that when descending a mine shaft, the temperature will increase. While he recognized that his work possessed implications for geological theory, he had become increasingly aware that on descending a mine, the rate of increase of temperature depended not only on distance from the surface but also on the types of rock encountered and on the disposition of springs. With an eye to prospecting for minerals and to any potential economic advantage, he sought to determine the relationship between temperature and the mine's mineral content. Moreover, he was beginning to speculate on the role of electricity in the earth's economy.[119]

Fox's attention was also directed increasingly to the existence of mineral veins that passed through the ambient rock and were exposed in mine shafts and galleries. The cause of these veins and their physical characteristics became pressing concerns that he researched in a long series of experiments performed in local mines. His papers show that he was soon convinced that these veins were produced by minerals seeping into fissures in the rock. Yet the geological fissures were not original, but had been produced over a long period of time. As fissures extended to a considerable depth, the water they contained traversed a great range of temperature, being very hot at lower levels and cool near the earth's surface. Since the water that circulated in the fissures carried minerals in solution, and since the water cooled as it rose, the minerals became deposited in the fissures, thus forming mineral veins.

However, Fox's research was also directed to another physical force that was responsible for the production of metallic veins. Aware of recent developments in electricity, such as the thermoelectric effect discovered by Seebeck in 1821, and with advice from Faraday, he carried out a number of underground electrical experiments that fill his most extensive publications. For example, with the aid of long lengths of copper wire he measured the electrical characteristics between pairs of veins, using a sensitive galvanometer. His investigations indicated an abundance of electrical action, but his results could not be reduced to any simple laws, since veins were not uniform but differed widely in their physical and chemical characteristics. For example, they varied considerably in cross-section, in direction, and in their chemical composition. Again, a single vein might split into smaller veins, which might then recombine. As the mass of data yielded little consistency, he considered that they undermined all the hypotheses that had been proposed to account for the origin of veins. He therefore looked for a more functional account of veins, stressing the role of 'design' and their 'connection with other phænomena of our globe'. A close analogy appeared to exist between geological configuration and the electrical properties of the earth. Moreover, he was

[119] R. W. Fox, 'Some further observations on the temperature of mines'.

aware of an intimate connection between terrestrial electricity, magnetism, and the earth's heat, since they all increased in intensity as one descended a mine—that is, moved towards the centre of the earth.[120]

Likewise, in his investigation of terrestrial magnetism he was always aware that he was experimenting on a global force that was intimately connected with other forces that traverse the earth. In one paper he therefore urged the pursuit of the 'extensive', 'interesting and important' relationships between terrestrial magnetism and 'other natural phenomena', particularly electrical currents. Likewise, in an 1827 letter to Faraday, he speculated: 'Heat, Light, & electricity appear to have strong analogies & possibly a greater degree of identity than has been supposed.'[121] He viewed the earth as the nexus of force, and electricity as the most powerful and fundamental force affecting all activity. Moreover, in 1836 he speculated that electricity 'is inherent in all matter in some modified form; so that, should the Hand that produced it, suspend its operation for one moment, animal and vegetable life would be universally extinguished'.[122]

Despite Fox's commitment to the scientific study of the earth, he accepted that our knowledge of earth history is limited. In one paper he also raised some objections to the view that the spheroidal shape of the earth had resulted from its axial spin during its cooling and solidification. Such a mechanical explanation did not accord with geological evidence; in particular, the stratification of rocks was not parallel to the equator, as the hypothesis would suggest. Indeed, although the laws of nature can be known, 'we cannot find laws to apply to the *original* organization of the earth, or the things which it contains'. As an evangelical, Fox could thereby prevent science from impinging on the account of creation, the domain of Revelation; while we may study the earth, its early history remains unknowable. Adopting a methodological position that also appealed to other Quakers (see section 6.2), he commended both the collection of observational data and the drawing of inferences supported by experience and analogy. However, he warned against speculating 'about questions which probably are, and ever will be, out of our reach'.[123] Moreover, in line with Quaker values, he was, as one obituarist stated, '[a]n economist of time, his scientific pursuits were not allowed to interfere with his [religious] duties towards his family and fellowmen'.[124]

[120] R. W. Fox, 'On the electro-magnetic properties of metalliferous veins'.

[121] R. W. Fox, 'On the variable intensity of terrestrial magnetism'; Fox to Michael Faraday, 18th day, 6th mo., 1834, in F. A. J. L. James (ed.), *Correspondence of Michael Faraday*, ii. 194–5.

[122] R. W. Fox, 'On mineral veins', 133.

[123] R. W. Fox, 'Some facts'.

It is clear from the above discussion that Fox's entrepreneurial interests were highly germane to the scientific projects he pursued. Moreover, his science possessed practical applications. Nevertheless, his only direct contribution to mining was a wedge that could be employed for blasting rocks. In one of his papers he did, however, suggest that electromagnetic devices would be of use to 'the practical miner' in determining the richness and disposition of ore-bearing veins.[125] He also made improvements to scientific apparatus such as the dipping needle, the galvanometer, and the magnetic balance. Of these, Fox's dipping needle was extensively used by navigators, such as James Ross the Antarctic explorer, in order to readily determine the strength of the earth's magnetic field at any geographical position. Another example of concern with praxis was his commitment to the Royal Cornwall Polytechnic Society—'to encourage the useful arts and to elicit the ingenuity and inventive powers of the young'—which he helped to establish in 1833.

Yet, while utilitarian factors played some role in directing Fox's science, it is important to recognize that his research was also impelled by religious aesthetics, a curiosity to understand God's creation and an engagement with the problems of contemporary science. Unlike some of his Quaker contemporaries, Fox was very receptive to the contemporary flux of ideas, and he was deeply involved in both local and national organizations, including the BAAS and the Royal Society, to which he was elected in 1848. He maintained close friendships with some of the leading thinkers of the age, including John Stuart Mill and Samuel Taylor Coleridge. Thus, while commercial motives played a part, Fox's zeal for science cannot be explained purely by his mining interests; nor was it directed solely to industrial advance.

The example of the Quaker meteorologist Luke Howard is introduced here to illustrate that the relationship between technology and science could be even more distant. In furnishing Goethe with a short autobiography in 1822, Howard outlined his activities as a manufacturing chemist and addressed the question of why he had not published on chemistry (his research instead having been directed to meteorology). 'C'est notre *metier*,' he insisted, 'we have to *live* by the practice of Chemistry as an art, and not by exhibiting it as a science.' He also complained that his interest in chemistry had declined, as the subject had become increasingly 'betrothed to the Mathematics'—that is, dominated by sophisticated scientific theories expressed through mathematical relationships. By contrast, meteorology was not yet a well-developed science, and he found it attractive precisely because, as God had created an ordered universe, there existed the possibility of discovering order within a mass of apparently incoherent data.[126] He approached meteorology not as a chemist but as a devout, evangelical Quaker.

5.8 Science/technical educators: Priscilla Wakefield and Ellis Davidson

It is widely believed that throughout its history the Society of Friends has accorded equality to women. This is said to be confirmed by the example of Elizabeth Fry, the prison reformer, and by the prominence of women among both the First Publishers of Truth and later travelling preachers. However, although Women's Meetings gave women some power and autonomy within the Quaker movement, several recent writers have argued that in a number of significant respects the position of women often fell far short of equality. Despite women playing a more visible role within the formal Quaker structures than did their counterparts in many other religious groups, they were generally hampered by conventional notions of gender, and rarely achieved significant public positions, except as preachers or philanthropists.[127]

Few eighteenth- or nineteenth-century women of any religious persuasion were engaged in science. Yet, beginning late in the eighteenth century, a small number of women wrote introductory science books directed particularly at young readers. The production of such educational works provided one of the few entrées to science and to authorship for women. Doubtless the best-known early example is Jane Marcet, of Huguenot descent, who wrote *Conversations on Chemistry* (1806) and several other popular science works.[128] The writings of a Quaker contemporary, Priscilla Wakefield (1751–1832), have also aroused much recent interest, and her *Mental Improvement: Or, the Beauties and Wonders of Nature and Art* (1794–7) has recently been reprinted.[129] While Marcet gained access to the scientific élite through her husband, a physician and FRS, Wakefield had no connection with the scientific establishment. She grew up in Stamford Hill in a close, moneyed family, which seems to have adopted a rather relaxed attitude towards the decorum deemed appropriate to Quakerism. Her mother, Catherine (née Barclay), is said to have frequently attended the theatre, while her father, Daniel Bell, was a keen

[124] 'The late Robert Were Fox, F.R.S.', Backhouse Papers 244, University of Durham Archives. Reprinted from the *West Briton*, 26 July 1877.

[125] R. W. Fox, 'On the electro-magnetic properties of metalliferous veins', 400.

[126] Scott, *Luke Howard*, 4, 6; Howard, *Climate of London*.

[127] Mortimer, 'Quaker women'; Holton and Allen, 'Offices and services'; Lunn, '"You have lost your opportunity"'.

fox-hunter and amateur naturalist. Having married Edward Wakefield, a London merchant and banker, in 1771, Priscilla subsequently bore three children. Like many other Quakers of the period, she participated extensively in philanthropic ventures, including founding a School of Industry for girls, and she helped to instigate the savings bank movement.[130] Moreover, during a period of two decades she published more than a dozen works directed mainly to juveniles. Several of these engaged contemporary science, including her *Introduction to Botany* (1796), which passed through twelve editions over the ensuing century.[131] While the book found its way into many non-Quaker homes, it strongly conveyed both Quaker and upper-middle-class values.

Wakefield's *Botany* is cast in the form of twenty-seven letters written by Felicia to her sister Constance, who is away from home. Since a governess is mentioned, the sisters clearly represent a comfortable moneyed family, like the Bells and the Wakefields. Felicia writes to her sister about botany and describes the plants she has examined with her instructress, Mrs Woodbine.[132] Despite the technical content of many of the letters, the author generates a relaxed atmosphere by deploying a fictional correspondence between the sisters, with Felicia frequently adding personal comments on the subjects under discussion. Wakefield thus strove to present her subject empathetically to middle-class female readers.[133]

Natural theology featured prominently in many of Wakefield's books for young readers. Indeed, in her preface to her *Botany* she urged the study of botany as 'the most familiar means of introducing suitable ideas of the attributes of the Divine Being, by exemplifying them in the order and harmony of visible creation'. For young people who could not be expected to understand abstruse theological disquisitions, the 'structure of a feather or a flower' was particularly appropriate for impressing on their minds God's power and wisdom. Moreover, as Felicia told her sister, 'persons of true taste and observation . . . clearly perceive the traces of infinite Wisdom and Intelligence, in the structure of every leaf and blossom'.[134] Such design arguments were typical of the period, and were not confined to Quakers. However, their

[128] Marcet, *Conversations on Chemistry*. See also D. Knight, 'Accomplishment or dogma'; Lindee, 'American career'.

[129] Wakefield, *Mental Improvement*. See also Shteir, *Cultivating Women*, 83–9; *idem*, 'Elegant recreations?'

[130] Shteir's introduction to *Mental Improvement*, pp. xiv–xv; Anderson, *Friends and Relations*, 142–70.

[131] Comparable texts are Hack, *Harry Beaufoy*, and the several scientific works by Mary Roberts (1788–1864), most of which were written after she had dissociated herself from the Quaker movement. I am grateful to Donald Opitz for information about Roberts.

[132] One of the few explicit references to Quaker mothers encouraging their children to study nature appeared in the biography of the young William Cadbury of Birmingham, who collected birds' eggs and butterflies on his walks, but particularly cultivated ferns. During his childhood

use in these personal letters and the appeal to immediate experience is, as we shall see repeatedly, a modality particularly favoured by Quaker writers.

Some of the social values underlying Wakefield's *Botany* also indicate Quaker norms that cohered with the expectations of the book's potential upper-middle-class readership. Thus, although Felicia accepted that the study of botany is both beneficial to health and interesting, she insisted that it is not a frivolous amusement but an 'innocent enjoyment'—a tellingly Quaker phrase—that requires perseverance and patience and helps train the mind and the eye.[135] Moreover, in her preface, Wakefield argued: 'May it [the study of botany] become a substitute for some of the trifling, not to say pernicious objects, that too frequently occupy the leisure of young ladies of fashionable manners, and by employing faculties rationally, act as an antidote to levity and idleness.'[136] Her great grandfather, Robert Barclay of Ury, author of the *Apology for the True Christian Divinity*, would have applauded her expression of this sentiment.

Wakefield's text is oriented towards the female student. She does not patronize the reader, but treats her as intelligent, sensitive, and keen to learn. Although she insists that the prospective botanist must be prepared to master the basic terminology, she emphasizes the enjoyment to be gained from the subject and its essential nobility. 'In the important business of forming the human mind', she writes, 'the inclination and pleasure of the pupil should be consulted: in order to render lessons effectual, they should please, and be sought rather as indulgencies, than avoided as laborious toil.'[137] Here, as elsewhere, Wakefield articulates a liberal conception of self-education in which the child is not forced to learn some alien subject but is self-motivated by the intrinsic challenge of botany.

The book's attraction is further enhanced by a large number of illustrations showing clearly the organic structures described by Felicia (Fig. 5.12). Wakefield also claimed that it was far cheaper than existing introductory texts, and believed that it filled a niche in the market that botanical writers had not adequately exploited. The initial letters provide a general description of the structure of plants, but Wakefield is suitably decorous in not alluding to their sexual functions. In the fifth letter she provides instructions on how to dissect flowers. Exploring a topic that demands some technical rigour she argues that a systematic method of plant classification has to be learnt, for otherwise 'Botany would be indeed a most fatiguing and almost unattainable science' if the student had only to memorize details of each plant type.[138] Urging the Linnaean system, Felicia proceeds to describe the twenty-four orders of plant based on the number of stamens and pistils they possess.

he often studied botany with his mother, and 'it was chiefly from her that he gained his love and knowledge of ferns and plants': H. C. Alexander, *Richard Cadbury*, 81–2.

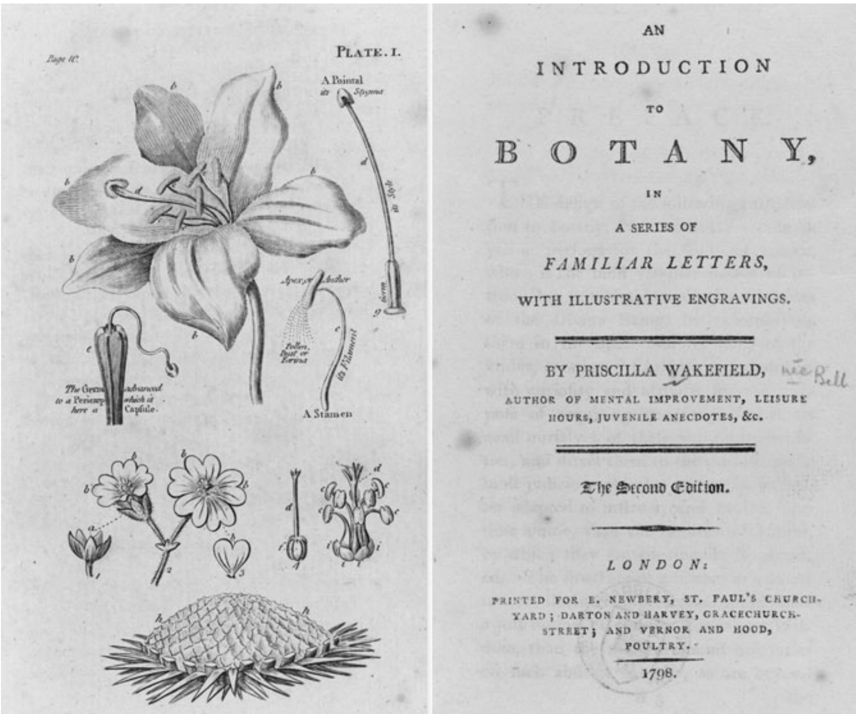


Fig. 5.12. Frontispiece and title-page of Priscilla Wakefield's *An Introduction to Botany, in a Series of Letters*, 2nd edn. (London: Printed for E. Newbury, Darton and Harvey, and Vernon and Hood, 1798). The illustrations in some later editions were coloured. The eighth (1818) and possibly other later editions contained a poem, 'The pleasures of botanical pursuits', by Sarah Hoare, who was also a Quaker. Reproduced with the kind permission of Leeds University Library.

There were no comparable scientific works written by Jewish women, the closest being Miriam Mendes Belisario's *Sabbath Evenings at Home* (1856), a series of conversations which we will encounter in section 8.3. However, during the closing decades of the nineteenth century, Jews and Quakers contributed to the development of both scientific and, particularly, technical education. For example, Silvanus Phillips Thompson wrote several introductory primers, including *Elementary Lessons in Electricity and Magnetism* (1881) and *Light Visible and Invisible* (1897), which was based on a series of lectures at the Royal Institution. Together with his Jewish colleague at Finsbury Technical College, Raphael Meldola, he was an enthusiastic advocate for making science central to technical education—the subject of his *Apprenticeship, Scientific & Unscientific* (1879). Their contemporary, Philip Magnus, a minister at the West London Reform Synagogue, became a leading educationalist, serving for many years as the Director of the Examinations Department of the City and Guilds of London Institute. Magnus was knighted for his services to the Royal Commission on Technical Education, which reported in 1884.[139] Far less well known is Ellis A. Davidson (1828–78), who was a tireless advocate of education for the working classes.

A native of Hull, Davidson attended the School of Art in South Kensington before gaining employment as a teacher at the Government School of Arts and Crafts at Chester in 1853. He is said to have reinvigorated the school, introduced many new courses, and attracted large numbers of students. In 1866 he was appointed Lecturer on Science and Art at the City Middle School, a position he held for six years before deciding to concentrate on his literary career. In great demand as a lecturer by both Jewish and non-Jewish organizations, he lectured to printers at Stationers' Hall, to the evangelical Association in Aid of the Deaf and Dumb, and to the Society of Arts (where he delivered lectures on industrial and scientific education). This 'prince of lecturers'—as he was described by the *Jewish World*[140]—also played a prominent role in the Jewish community. He lectured to the Jews' and General Literary and Scientific Institution and to various Jewish schools, and, from the late 1860s onwards, he helped to organize (with Michael Henry) and contributed to an annual series of lectures directed to Jewish working men and their families.[141] His lectures covered a wide range of artistic, scientific, and technological subjects. For example, in 1875 he delivered a lecture on 'Motion and locomotion' to Jewish working men. Starting with the zoophytes and working up to more complex creatures, he showed how motive power correspondingly increases. However, in discussing humankind, he reflected on our ability to use machines, from the simple mechanical devices known to the ancients to the steam-engine, which represented an outstanding tribute to human ingenuity. Davidson illustrated this lecture with a number of model machines.

This lecture and the thrust of many of his other writings reveal a concern not simply to display the advances made by science and technology and the skills required in executing technical drawings. He also repeatedly pondered the religious significance of our knowledge of nature and our ability to construct powerful machines, like the telegraph and the steam-engine. Thus his lecture on 'Motion and locomotion', which opened with a meditation on his recently deceased friend Michael Henry, ended with Davidson's reflections on nature—'the laws of Nature, [are] only another term for God's laws'—and

[133] Wakefield, *Introduction to Botany.*
[134] Ibid. pp. iii–iv, 42–3.
[135] Wakefield, *Introduction to Botany*, 3, 7.
[136] Ibid. p. v. [137] Ibid. p. iv. [138] Ibid. 26.

the covenant that God has made with humankind. By using our intelligence, we perform his will:

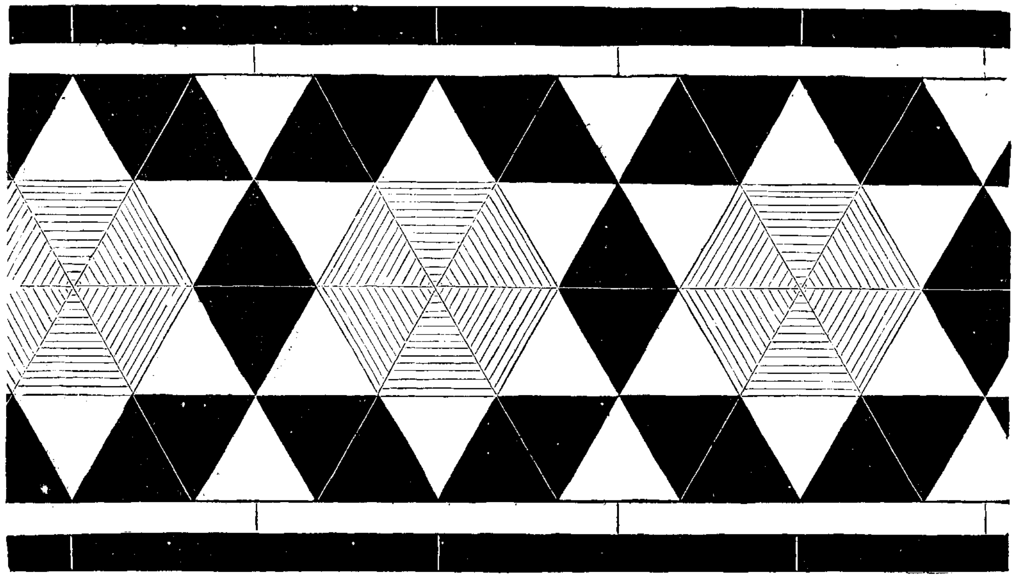
> He has given us the power to discover, to adapt, to manufacture—to use the great forces of Nature for thousands of purposes. . . . [W]e must, as we go on increasing our knowledge and improving our position, remember that we owe it all to Him—our Father, our Guide, our Rock.

To his audience of working men Davidson emphasized the nobility of labour, but he also insisted that they must 'read', 'examine', 'study', and 'reflect': through education, 'your mental power increases and . . . your position becomes more elevated'.[142] While he urged working-class Jews to study science and technology, he also sternly advocated the teaching of science at Jews' College and Jews' College School, suggesting that professors of science subjects be appointed and a laboratory and a museum constructed. A Jewish education, he insisted, must amount to more than Torah study: God's creation must also be studied, and, moreover, educated Jews must equip themselves with an adequate knowledge of science in order to refute confidently those who employed science to advance atheism.[143]

Between 1868 and his death in 1878, Davidson wrote nearly thirty popular texts, many of which were substantial treatises containing numerous illustrations, practical exercises, and sample examination questions (Fig. 5.13). They ranged from *Elements of Practical Perspective* (1870) to *The Boy Joiner and Model Maker* (1874) and *Pretty Arts for the Employment of Leisure Hours* (1879), which was directed to a female readership. Most of these titles were produced for the publisher Cassell, Petter, and Galpin, including several in the series of 'Cassell's Technical Manuals'. Yet the demands made on Davidson as a copywriter and illustrator affected his health, particularly his eyesight, and may have hastened his death.

Davidson possessed an extensive knowledge of Jewish subjects, served on the boards of a number of Jewish organizations, and occasionally contributed articles on religious issues to the *Jewish Chronicle*. (Abraham Benisch, the editor and a notable scholar, was his brother-in-law.) His main specifically Jewish publication was *The Bible Reader, an Abstract of the Holy Bible: Adapted for the Use of Jewish Schools and Families* (1877), which was 'sanctioned' by the Chief Rabbi, Nathan Marcus Adler, and the text checked by Adler's son Hermann, then minister at the Bayswater Synagogue. Following a summary of each passage selected from the Torah, Davidson added his own moral reflections, and also posed a number of questions to his young readers.

[139] Foden, *Philip Magnus*. At the very end of our period, Philip Hartog also embarked on an educational career.



DIAPER, OR UNIFORM SURFACE DECORATION.

Fig. 5.13. Of the many thousands of students who learnt geometrical techniques from this book, which was first published in 1868, few would have realized that Davidson's example of a diaper design incorporated the Star of David. Ellis A. Davidson, *Linear Drawing, Showing the Application of Practical Geometry to Trade and Manufactures* (London: Cassell, n.d.), 118.

Thus, after summarizing the first chapter of Genesis, Davidson asked: 'In the beginning what did God create?'; 'What was the state of the earth when first created?'; together with two dozen similar questions. His reflections on Genesis are particularly interesting, as they indicate Davidson's providentialist commitments. The world, he argued, was not merely created, but 'we are led to admire the wisdom of Almighty God . . . and His Divine mercy in surrounding us with all that is useful and beautiful'. All creatures—birds, fishes, and animals—'do the bidding of their Creator, and fulfil some purpose in creation'. Always keen to emphasize utility, Davidson noted that trees, plants, and minerals are 'used in building, in food, in medicine, and for thousands of other purposes'. Optimistically, he portrayed the physical universe as being under God's care; even the laws of nature are 'God's words'.[144] As this book carried the imprimatur of the Chief Rabbi and the text was verified by his son, it appears that they concurred with Davidson's providentialist gloss on Genesis.

Although Priscilla Wakefield and Ellis Davidson employed design arguments in their educational writings, they wrote very different kinds of books. Wakefield, the affluent Quaker, wrote for young middle-class women, whereas Davidson, the journeyman educator and pen-pusher, sought to enable the working classes to improve their situation through a religiously based education in science.

5.9 Social statisticians: John S. Rowntree and Joseph Jacobs

Both Quakers and Jews were intensely interested in their own communities. This interest manifested itself in many ways, ranging from support of philanthropic and communal institutions to maintaining records of membership. Given their greater exposure to science education, Quakers made more use of social statistics than did Anglo-Jewry. This contrast is reflected in the appearance of John Stephenson Rowntree's 1859 classic *Quakerism, Past and Present* more than three decades before Joseph Jacobs's study of the Jewish community. Yet these two analyses need to be understood in the broader context of the Victorian enthusiasm for data collection and statistical analysis, as exemplified by the ten-yearly census and, more specifically, by the religious census.[145] Not only were Jews and Quakers enumerated as part of the national picture; they also utilized statistics to address important questions about their own communities.

[140] *JW*, 6 Nov. 1874, 4.
[141] *JC*, 18 Jan. 1856, 454.

Rowntree (1834–1907) was not the first Quaker to use statistics. Indeed, from early in the movement's history, each Monthly Meeting was required to maintain records of births, marriages, and burials. The information was then forwarded to London, digested, and presented to the Yearly Meeting in order to provide an annual statistical overview of the membership.[146] In Quaker periodicals, statistics were widely employed in many different contexts, ranging from statistical analyses of the Austrian Empire and a statistical table showing the age of Quakers at death to a startling analysis of American whites, demonstrating that illiteracy was higher in the Southern slave-owning states than in the North.[147] Statistics were also a crucial consideration in social issues that exercised Quakers, such as working-class poverty, slavery, and the maltreatment of 'aborigines'. Anecdote clearly played an important role in reports on these subjects, but statistical evidence was particularly valued, since it carried far more weight, transcended the reports of individual observers, and added scientific credibility to an argument. Thus, in an historical account of the slave trade, the number of slaves transported from Africa in 1788 was cited against each trading nation, showing unequivocally that Britain was the principal culprit.[148]

The 1843 volume of the *Friend* even included a three-part series entitled 'Gleanings from statistics', which began with a quotation from Linnaeus: 'I acknowledge no authority save that of observation.' The author aptly described statistics as an 'instrument', like the telescope or microscope, which enabled social facts to be ascertained with confidence, so that policy could be firmly based and not left to the sway of opinion. He thus looked forward to the development of the 'Science of Mankind', its object being 'the improvement of the human species—and what means are more likely to advance this end, than searching diligently for the causes of that misery and disease which are unfortunately so abundant around us?' An analysis of mortality rates, for example, demonstrated that English cities were 'prejudicial to long life and good health'. In the concluding part of this series, the author reflected on the way in which social statistics, like other natural sciences, produced hitherto unknown facts illuminating 'some segment of the vast circle of creation'.[149]

Rowntree, who was a member of the famous grocery and chocolate-making clan, attended Bootham School before devoting himself to the family business and to a host of communal activities. According to Thomas Kennedy, his *Quakerism, Past and Present* was 'a work of seminal influence in the

[142] 'Mr Ellis A. Davidson's lecture on "Motion and locomotion" ', *JC*, 3 Dec. 1875, 564.
[143] *JC*, 22 Oct. 1875, 482.
[144] Davidson, *Bible Reader*, 1–7.
[145] Porter, *Rise of Statistical Thinking*.

transformation of British Friends'.[150] This book, written in his mid-twenties, helped establish Rowntree as one of the most important and influential Quakers of his generation. To appreciate the book's content, its context deserves consideration. In the early 1830s the Beacon controversy had impelled many Quakers towards evangelicalism and a greater involvement in the wider society, especially through philanthropy. As pointed out in section 2.1, although the movement was partially re-energized, there remained significant tensions between evangelicals and conservative Friends who clung to traditional Quaker views and practices, opposed innovation, and pursued a more spiritually inward-looking, quietist vision, emphasizing the Inner Light rather than the Bible. Yet, despite—if not because of—this infusion of evangelical zeal, by the mid-century the Quaker movement was losing significant numbers of members; its power and influence were on the decline, and its future was in doubt.

Radical steps were required to halt and reverse this decline. A prize essay competition was therefore announced in 1858, in order to determine the causes of the decline and to initiate an appropriate remedy. The winning essay was Rowntree's *Quakerism, Past and Present*, which offered a long-term statistical analysis of membership and identified a number of areas in which Quakerism had failed its original promise. His approach reflected the statistical formulation of the problem as expressed in the original prize essay advertisement, which drew attention to the fact that, 'notwithstanding the population of the United Kingdom has more than doubled itself in the last fifty years, the Society of Friends is less in number than at the beginning of the century'.[151] In the initial chapters of his essay Rowntree sought to demonstrate that George Fox and the early Quakers had bequeathed two very different legacies. One consisted of essential Christian beliefs, such as the salvation of the individual through Christ. But Quakerism also promulgated unnecessary survivals from its early history. For example, although in the context of his time Fox had clearly been justified in refusing to pay tithes, modern Friends were embarrassed by the constraint, which was no longer relevant. Again, while silent worship remained a valuable part of Quakerism, it had become a rigid tenet that inhibited other forms of worship. Rowntree argued that such vestigial aspects of Quaker practice were largely responsible for the sect's decline. Indeed, Quakerism had lost its way, because it was too strongly wedded to many inessential doctrines ordained simply by custom. Rigid discipline had taken over from sound good sense. Particularly open to question was the rule that Quakers who married out were to be disowned.

[146] E.g. Rowntree, 'Friends in Great Britain'.
[147] *Friend*, 1 (1843), 51–2, 134, 189–90.

In order to address the sect's decline, Rowntree compiled tables of births, marriages, and deaths over an extended period—in some cases spanning the period from the mid-seventeenth century to his own time. His competent analysis, which included such factors as emigration, showed clearly that not only had the total number of Quakers declined steadily since the late seventeenth century, but that in relation to the total British population, the fall was even more dramatic. Deaths exceeded births, and disownments far exceeded admissions. Thus, during 'the last one hundred and eighty years the population of the United Kingdom has trebled, but the Society of Friends has diminished nearly two-thirds'.[152] Of the many factors responsible for this decline, he was able to show that the loss of members through marrying out was particularly significant; about one-third of those who married had selected non-Quaker partners and were therefore lost to the Society.[153] Unless the matter was addressed urgently, Quakerism would soon become extinct.

While Rowntree was concerned to demonstrate his main demographical points by appealing to statistics, he was aware that qualitative change had also occurred. The decline in numbers correlated with a decline in piety, and, compared with the spiritual excitement among early Friends, Quakerism was now rather barren. He sought not only to reverse the numerical decline, but also to reinvigorate Quaker spirituality. The two were inseparable. Moreover, he was highly critical of many of the views supported by the conservative, the evangelical, and the Unitarian factions. Yet each group could find some consolation in his vision of Quakerism, which was firmly rooted in tradition, but more tolerant and inclusive. The Yearly Meeting subsequently adopted many of Rowntree's recommendations; for example, those who married out were allowed to remain within the fold.[154]

In contrast to the fairly frequent use of statistics by Quakers, the Jewish periodical press contained very little information in statistical form.[155] One of the few examples occurred soon after Nathan Marcus Adler was appointed Chief Rabbi of the Ashkenazi community in 1845. Wishing to ascertain the size and characteristics of the community he was to lead, Adler, who had received a sound general education on the Continent, circulated a questionnaire to all congregations.[156] Although this exercise provided a helpful snapshot of

[148] Ibid. 85–7.

[149] J. J. F., 'Gleanings from statistics', *Friend*, 1 (1843), 155–6, 177–8, 202–3.

[150] Kennedy, *British Quakerism*, 40.

[151] Rowntree, *Quakerism, Past and Present*, pp. v–vii.

[152] Rowntree, *Quakerism, Past and Present*, 163.

[153] Ibid. 153.

[154] Isichei, *Victorian Quakers*, 111–19; Kennedy, *British Quakerism*, 31–46.

[155] The community did, however, include a number of accomplished actuaries—see sect. 3.3.1. Among Jewish members of the Statistical Society of London (later the Royal Statistical Society) were Henry de Worms, Lewis Emanuel, Francis Henry Goldsmid, Lionel Louis Cohen,

Anglo-Jewry in 1845, it was not repeated until Joseph Jacobs's survey of the early 1880s.

Armed with a first class honours degree in the Moral Sciences from Cambridge, a period studying Jewish history and literature in Germany, and a year working in Francis Galton's Statistical Laboratory at University College London, Jacobs (1854–1916) possessed the skills necessary for a concerted sociological and anthropological analysis of the Jewish community. During the 1880s he wrote several papers on this subject, which were published in the *Journal of the Anthropological Institute* and the *Jewish Chronicle*. As with Rowntree, his researches were driven by social problems. The rationale for his research project was the massive influx of Jews that commenced in 1881 and raised the prospect of an anti-Semitic backlash in Britain. For Jacobs, science was the reliable road to truth, which, in turn, was the only antidote to the anti-Semite's poison. It was easy to demonstrate statistically that some assertions about Jews were patently false. For example, anti-Semites frequently claimed that Jews invariably made themselves rich by exploiting Christians. This claim was refuted by Jacobs's statistical analysis of several Jewish communities, showing that Jews were not necessarily richer than Christians; for example, in Prussia 6.46 per cent of the Jewish population consisted of paupers, a higher figure than for the total Prussian population.[157]

Particularly revealing is Jacobs's contribution to a long-running debate on whether Jews were particularly susceptible to infectious diseases. As Frank Felsenstein has noted, Jews have often been associated with the spread of disease; for example, the author of a 1753 tract predicted that if the Jewish Naturalization Act were passed, 'a Second Swarm of this Kind of Locusts' would 'come and settle in the Town, [and] we should have a Kind of Plague or Sickness as often as they have at *Constantinople*'.[158] In his study of the portrayal of Jews in the late nineteenth and early twentieth centuries, Sander Gilman cites a number of texts and illustrations in which Jews were depicted as effeminate, weak, and as carriers of disease. Alleging Jewish immorality and promiscuity, anti-Semites have thus singled out Jews as transmitters of syphilis and as a medical threat to the rest of the population.[159] Likewise, one late Victorian periodical attributed the spread of cholera to 'the Russian Jews . . . fleeing from the Muscovite Pharaoh'. Since these refugees heading for America must 'cross England from Grimsby to Liverpool' they will 'bring cholera with them' and 'no sanitary precautions will suffice' to prevent the

Joseph Cohen de Lissa, and Jacob Waley (who served on the Council and was one of the Honorary Secretaries at the time of his death).

[156] A. Newman (ed.), *Provincial Jewry*. See statistical summary in *JC*, 23 July 1847, 201, and also letter in *JC*, 6 Mar. 1846, 98–9.

disease from invading England.[160] Thus Jews were identified as responsible for spreading cholera.

In order to refute this pervasive slander, Anglo-Jewry seized on any counter-evidence. For example, during the cholera epidemic of the late 1840s, one correspondent in the Jewish press analysed the recent outbreak at Smyrna, which showed that the mortality rate was lower among Jews than among non-Jews. This important difference, he argued, was due to the Jewish sanitary laws. Thus, not only was there a scientifically founded response to the anti-Semite, but the laws of hygiene laid down in the Torah and extended by the rabbis were shown to be efficacious. Therefore they were as relevant as they had always been.[161] The official *Sanitary Report on Epidemic Cholera as it Prevailed in London in 1848/49* (1850) was also warmly welcomed, because it showed a much lower death rate among Jews than among the general population of London. Several social factors were identified. First, unlike other people living in reduced circumstances, poor Jewish families did not share the same room, and therefore avoided overcrowding. Moreover, they cleaned their living quarters annually—at *Pesach* (Passover)—often applying lime to walls. They led healthier lives, since they were not drunkards and, owing to the regulations of *kashrut*, avoided shellfish and meats of dubious provenance. Also, their generally better standard of health was linked to their observance of the Sabbath, which ensured a day of rest each week. The support of communal organizations that prevented poor Jews from suffering malnourishment was also efficacious. This official report was seen to imply that in matters of health Jews were more enlightened than their Christian neighbours.[162]

The relative immunity of Jews to cholera during the 1853 epidemic likewise led the editor of the *Hebrew Observer* to stress the advanced medical outlook of traditional Judaism, and therefore its superiority over Christianity. But he also considered that the epidemic should be understood as providential, not because God directed the disease against those who strayed from Judaism, but because those who followed the dictates of nature—such as living in a clean, airy environment and not in overcrowded lodgings—would guard themselves against cholera. Interestingly, he considered the fight against cholera to be both an individual and a communal responsibility. In repelling cholera, the community worked more closely together, with the Jewish poor becoming dependent on the 'administrative talent, science, and pecuniary resources' of the more wealthy members, who, in turn, reached out to the poor. Thus, far

[157] Jacobs, 'The comparative distribution of Jewish ability'; repr. in *idem*, *Studies in Jewish Statistics*.

[158] Felsenstein, *Anti-Semitic Stereotypes*, 125.

from decimating the community, cholera performed a divinely ordained service by strengthening communal bonds.[163]

When cholera returned in 1865, it rapidly carried off several poor Jews. The community's philanthropic institutions, but especially the Board of Guardians, were quick to respond, and, aided by some prompting from the Jewish press, donors rushed to support the various relief organizations. The Board's medical officers were severely stretched in tending the sick; a hall was used as a dispensary, large quantities of carbolic acid and Condy's fluid (a widely used disinfectant containing sodium manganate or permanganate) were distributed gratis, twenty-seven stand-pipes were erected to bring fresh water to areas inhabited by the Jewish poor, and a house was procured for the families of victims, in order to remove them from the locus of infection. Moreover, prayers were recited at several synagogues.[164] By the middle of October, the *Jewish Chronicle* was congratulating the community on having survived the epidemic with few fatalities. This success, it claimed, stemmed both from the quick and effective reaction of the Board of Guardians and from the efficacy of the 'Mosaic laws'. The editor praised the 'temperate habits and general temper of the Jewish poor, and . . . their dietary observances', but especially their low level of alcohol consumption and abstinence from shellfish and unkosher meat. Yet, despite adopting an optimistic tone, the editor was not sure whether Jews had fared as well as they had in earlier cholera epidemics. Far more destructive of the claim that dietary laws protected the Jewish community was the report in the following week's issue of the *Chronicle* that cholera was raging 'with great virulence among our coreligionists on the continent'. The outbreaks had been particularly severe in Marseilles, Trieste, and the Rhenish provinces. During the ensuing weeks, further reports were published of the high mortality rate in other Jewish communities, including the death in Moravia of five rabbis, one of whom was particularly famed for his piety.[165]

In January 1867 the *Jewish Chronicle* published a report of the meeting of the BAAS held in Nottingham a few months earlier, at which the eminent physician Benjamin Ward Richardson addressed the topic of longevity among the Anglo-Jewish community. Much to the community's delight, he found that Jews lived longer and were in better health than their Christian neighbours.[166] In later publications Richardson continued to proclaim the extraordinary longevity and superior health of 'this wonderful people'. For

[159] Gilman, *Jew's Body.*
[160] 'The progress of the world', *Review of Reviews*, 6 (1892), 215–22.
[161] *JC*, 10 Nov. 1848, 50.
[162] Grainger, *Sanitary Report*; *JC*, 30 Sept. 1853, 417.
[163] 'The cholera', *HO*, 23 Sept. 1853, 100.

example, in his *Diseases of Modern Life* (1876) he cited several examples of statistics that demonstrated the better health, longer life, and lower suicide rates among Jews. On the issue of cholera he offered no figures, but merely asserted that the 'Jews escape the great epidemics more readily than the other races with whom they live. Thus the mortality from cholera amongst them is so small that the very fact of its occurrence has been disputed.' Turning to the reasons why Jews displayed superior health, Richardson claimed that they avoided excessive amounts of alcohol and took great care of themselves and of each other. This conclusion cohered with one of Richardson's main theses: disease arises from bodily stress, but moderation encourages good health. In pursuing a healthy life-style, Jews had much to teach the Christian world. One particular aspect of Jewish culture also provided a fascinating and perhaps unexpected confirmation of Richardson's thesis. In pointing out that such nations as the ancient Greeks and Romans had emphasized physical prowess and military might, Richardson insisted that 'such exercise ensures premature decay and early death'. By contrast, Jews may have appeared weakly and not encouraged physical exercise, and yet, paradoxically, by not subjecting themselves to physical stress, they had lived longer and been healthier.[167]

In order to enhance its status and repel the charges of the anti-Semite, the Anglo-Jewish community wanted to appear healthier and more long-lived than their Christian neighbours. The support offered by Richardson provided the context for the brief discussion of these issues contained in a paper that Jacobs read to the Anthropological Institute in 1885. Adopting a distinctly sceptical tone, he doubted whether Jews could claim any superiority, 'considering the insanitary conditions of their lives in the past, and their weakly constitution in the present'. In many traditional ghettos Jews suffered extreme overcrowding, and thus a high level of disease. On the other hand, where Jews did possess a better health record than their non-Jewish neighbours, this was due to 'moral and social causes'. Jews tended not to pursue dangerous occupations, and were also not prone to alcoholism. Moreover, several features of family life conspired to improve health, such as the regular rest periods imposed at Sabbaths and festivals and the care taken of women. Applying a functional analysis to the Jewish population, Jacobs asserted that social arrangements within the community were primarily responsible for any superiority in health or longevity. By contrast, religious observance played a very minor role. From this perspective, he argued that the commandment to rest on the Sabbath was not framed in order to improve the health of the

[164] See *JC*, 27 July to 31 Aug. 1866.

Jewish people; rather, any improvement in their health was an accidental and unintended by-product of the 'Mosaic law'.

Jacobs's opposition to religious doctrine and practice emerged even more strongly when he addressed the question of whether the dietary laws aided health and longevity, a question that 'requires careful and unbiased examination'. In discussing the main issues of *kashrut*, he acknowledged that they codified common-sense precautions taken by people who inhabit hot climates. However, they were not particularly effective in bestowing health or in providing immunity from specific diseases. In particular, he dismissed recent claims that religious observances prevented Jews from succumbing to cholera and phthisis (pulmonary consumption). Citing several epidemics in which the Jewish population fared far worse than their non-Jewish neighbours, he showed that statistical evidence does not support such claims. For example, in the Smyrna epidemic in 1848, one in twenty-six Jews died, compared to one in forty Muslims, and an even lower proportion of Greeks, Catholics, and Armenians. Only in two cases—the 1834 epidemic in England and a recent one in Marseilles—did Jews fare better than their neighbours. Likewise, the statistics for phthisis were mostly unfavourable.[168]

Although Jacobs employed statistics to argue against the claim that immunity was due to the dietary laws, he was clearly motivated by other concerns. First, as a progressive Jew, he considered that the laws of *kashrut* were almost worthless, and were inconsistent with modern, rational Judaism. (His alignment with the Liberal Jewish movement will be discussed in section 9.2.) Second, Jacobs repeatedly emphasized the role of nature, as opposed to nurture, and he therefore insisted that Jews were not biologically different, and certainly not superior, but that they were basically very similar to other social groups. Any minor differences were therefore due to social factors, and not to heredity. Third, he clearly disapproved of the special pleading involved in the claim that Jews possessed, say, natural immunity from cholera. All three points underscored Jacobs's strategy in responding to the anti-Semite. He sought to demonstrate that Jews were not an alien race, but a social group that, although possessing some specific characteristics, was subject to the same causal laws as any other social group. As he stated at the outset, the traits and habits to be found among Jews were mostly 'due to social causes, and therefore cannot be regarded as primarily racial'.[169] Through science he could therefore dissolve the notion of a distinct Jewish race. In adopting this stance, he was also responding to Robert Knox (author of the notorious

[165] 'Cholera among the Jews', *JC*, 12 Oct. 1866, 4–5. See also *JC*, 19 Oct. 1866, 2; 14 Dec. 1866, 6; 21 Dec. 1866, 5.

Races of Men (1850)) and other anthropologists who had identified Jews as racially distinct, thereby providing a scientific justification for anti-Semitism. Ironically, in deploying the statistical methods of his mentor Francis Galton to challenge Knox's racial theory, Jacobs implicitly refuted Knox's assertion that Jews do not possess a 'scientific turn of mind'.[170] Instead, Jacobs was one of the small but rapidly increasing number of Jews who unquestionably displayed a 'scientific turn of mind'.

[166] *JC*, 11 Jan. 1867, 7. See also Ackerknecht, 'Sir Benjamin Ward Richardson'.

6
Quaker Attitudes and Practices

In this chapter we examine Quaker attitudes towards nature and the pursuit of science. Although earlier chapters addressed specific issues within this broader theme, our concern here is the relationship between Quaker belief and practice, on the one hand, and the ways in which Quakers conceptualized and pursued science, on the other. In particular, we shall concentrate on Quaker ways of knowing the physical world, especially their attitude towards empiricism and the deployment of hypotheses in science. This will lead, in the next chapter, to a close examination of Quaker responses to Darwin's theory of evolution, which, for the Victorians, generated the most controversial issues in the domain of science and religion. In these two chapters our discussion will be informed both by the religious beliefs maintained by Quakers and also by their social context, since Quaker views, including their views about science, were profoundly affected by the Dissenting position of Quakers within British society as well as by the historical changes that Quakerism underwent. Thus, for example, the account of Quaker responses to the theory of evolution will be related to the interplay between evangelical, moderate, and Unitarian factions within the Quaker movement during the closing decades of the nineteenth century.

We start by examining some early Quaker sources, not only for their intrinsic importance in characterizing Quaker attitudes to nature, but also because later Quakers were continually engaged in conversation with the founders of their movement. Thus, while seeking to preserve the continuity of their religious tradition, eighteenth- and nineteenth-century Quakers drew selectively on the writings and insights of Fox, Penn, Lawson, and others. It is precisely the continuity within Quakerism that justifies us in specifying a broadly defined Quaker approach to nature and to the pursuit of science. Yet that Quaker scientific tradition is sufficiently broad to encompass a range of views on such issues as the use of the reasoning faculties (over which individual Quakers adopted opposing positions). But it is also intended to contrast the later scientific tradition with the illuminist attitude to nature adopted by some early Quaker enthusiasts, one which was largely repudiated by the Quaker leadership by the end of the seventeenth century.

One last introductory comment: although most branches of Christianity place great emphasis on religious belief, Quakers emphasize the intimate relationship between 'faith and practice'. Reflecting their Puritan heritage, they accentuate the *vita activa*. (In this they are close to the Jewish viewpoint, which requires the performance of religious duties and rejects the unmitigated pursuit of the *vita contemplativa*.) Not that actions should be without prior thought; rather, thought should be in the service of action, be that activity the planting of a bed of geraniums or protesting against the slave trade. But for Quakers, all such actions should be performed in a state of religious awareness. In the ensuing discussion we shall likewise engage a mixture of interrelated beliefs and practices in respect to both Quakerism and science. While our concern is with how Quakers conceptualized a role for science, we will closely examine Quaker scientific practices. This exploration of practice—both religious and scientific—highlights a form of science–religion interaction that has rarely been studied thus far.[1]

6.1 The science of Dissent

Early Quakers forged views and values that they conceived to be truly Christian, but also ones that enabled them to separate themselves from the religious establishment. For example, as noted in section 3.1.1, early Quaker writers on education rejected the Aristotelian natural philosophy taught at the two ancient English universities. Thus the Quaker schoolmaster Thomas Lawson considered Aristotelianism and Platonism to be heathen philosophies that were totally opposed to Christianity and to the Christian understanding of God's creation. Although primitive Christians had rejected paganism, he considered that from the third and fourth centuries onwards heathenism had triumphed, and ungodly forms of learning had insinuated themselves into the schools and universities. Melanchthon, he reminded his readers, 'termed the Universities, houses of Lies'.[2] Thus far from being fonts of religion, Oxford and Cambridge were disseminating heathenism, and the seven liberal arts which they taught were corrupted by irreligious dogmas inherited from the Greeks. He repeatedly contrasted pagan forms of learning with the wonderful knowledge imparted by God through the Bible. 'I wonder', he wrote, 'at the great Blindness of [the] Schools, in so greatly magnifying [Aristotelian] Logick', since, by emphasizing logic, they 'oppose themselves to the Commands of the Apostle'.[3] In contrast to the 'Earthly, Sensual and Devilish' knowledge inherited from the pagans, especially Aristotle, the wisdom of

[1] Brooke and Cantor, *Reconstructing Nature*, 32–4.
[2] Lawson, *Dagon's Fall*, 63.
[3] Lawson, *Mite into the Treasury*, 14.

the Bible is 'pure, heavenly, [and] full of good fruits'.[4] God had imbued Adam with knowledge of all the arts and sciences—'the secret virtues of living Creatures, of Plants, of Stones, of Metals, and Minerals, he perfectly knew the influences of the supernal [heavenly] Bodies'. Fox likewise referred to Adam's 'innocency', and he, too, envisioned that in a state of grace we would achieve the wisdom 'in which Adam was before he fell, in which the admirable works of the creation, and the virtues thereof, may be known'.[5] Like many Puritans, these and other early Quakers considered that Adam had possessed a complete and true knowledge of creation, which was lost at the Fall and could only be recovered once a pure religious state had been regained.

The widespread belief among early Quakers that they possessed privileged access to the truths of creation manifested itself in many ways, but especially in medicine, where faith healing was practised. An example of the putative power of the spirit over the body is provided by the confident group of Quakers who congregated in Colchester in 1656 at the grave of the recently deceased James Parnell, expecting to witness his resurrection.[6] They were, however, disappointed. Fox likewise believed that he possessed the power to overcome illness, and kept a diary listing the cures he accomplished. One such case involved the London merchant James Claypoole, who suffered extreme discomfort from the stone. In a diary entry Fox relates that he

> went to him and spoke to him and was moved to lay my hand upon him and desired the Lord to rebuke his infirmity. And as I laid my hands upon him the Lord's power went through him. And his wife had faith and was sensible of the thing. And he presently fell off asleep and presently after his stone came from him like dirt and so then he was pretty well.[7]

In contrast to his conviction that true believers could cure the body by healing the soul, Fox chastised physicians for being 'out of the wisdom of God by which creatures were made, and so [they] knew not the virtues of the creatures'. He doubted their ability to treat patients effectively, and also complained that they only pretend to cure the body.[8] The perspective of Dissent demanded that Quakers practise a form of medicine very different from that delivered by university-trained physicians.

A number of early Quakers were also strongly attracted to two medical writers who not only exemplified the Christian understanding of the creation

[4] Ibid. 39–40.

[5] Nickalls (ed.), *Journal of George Fox*, 27.

[6] Coudert, 'Henry More', 46–7; Macfarlane (ed.), *Diary of Ralph Josselin*, 367. See also Cadbury, *George Fox's 'Book of Miracles'*, 20, 145. This volume contains some fascinating material on the cures effected by Fox and other early Quakers. See also Harley, 'Forsaking the physician'.

[7] Cadbury, *George Fox's 'Book of Miracles'*, 129.

[8] Nickalls (ed.), *Journal of George Fox*, 28.

and of curative medicines but were also staunch opponents of the medical establishment. Johannes Baptista van Helmont and his son Francis Mercury van Helmont were noted iatrochemists—they deployed chemical substances as medical remedies—and followed Paracelsus, the famous healer who was celebrated for treating his poor patients gratis (unlike university-trained physicians who were alleged to charge fat fees that only the wealthy could afford). Thus Lawson frequently quoted passages from the elder van Helmont's *Oriatrike or Physick Refined* (1662). In turn, the younger van Helmont expressed his admiration for Quaker practices and their devotion to primitive Christian virtues: 'Monsieur Van Hellmont', noted a contemporary, 'is growne a very religious Churchman; hee goes every Sunday to the Quakers meetings.' It is not clear whether he formally joined the Friends.[9]

During the 1670s van Helmont paid several visits to Ragley Hall, Warwickshire, the home of Lord Edward and Lady Anne Conway. Lady Anne also attracted a number of Quakers, including William Penn, George Fox, George Keith, Isaac Penington, and Edward Haistwell, and employed Quaker women as her maids. However, her chagrined husband, who held Quakers in low esteem, was appalled by this new domestic arrangement: 'all the women about my wife and most of the rest are Quakers, and Mons. Van Helmont is governour of that flock, an unpleasing sort of people, silent, sullen, and of a removed conversation'.[10] Yet Anne was not only attracted to the religious values espoused by Quakers; as a long-term invalid she was particularly impressed by the way Quakers had borne their sufferings with great fortitude, and she considered that in confronting her own illness, she gained strength from the company of those who had suffered nobly and selflessly.[11] While van Helmont plied her with medicines for her piercing headaches, she identified with the visiting Quakers, many of whom had endured long periods of imprisonment. Van Helmont and the Quakers who attended Anne were in agreement on significant religious, philosophical, and medical issues. In particular, they considered that the practice of medicine was not directed solely to curing physical ills; instead, healing operated on both the body and the spirit. Another significant point of accord was the Quaker doctrine of the Inner Light, which cohered well with the Helmontian notion of the soul. Likewise, they were all committed to a belief in the goodness of the creation and in the divine origin of both religious and scientific wisdom.[12] Although

9 Anne Conway to Henry Moore, 29 Nov. 1675, in Nicholson and Hutton (eds.), *Conway Letters*, 407–9.

10 Edward Conway to George Rawdon, 28 Dec. 1677, in Nicholson and Hutton (eds.), *Conway Letters*, 439–41.

11 Ibid. 412.

12 Elmer, 'Medicine, science and the Quakers'.

Fox was later to question van Helmont's theories, many Quakers were attracted to Helmontian natural philosophy as a truly Christian science, and one that opposed what they believed to be the heathen view of nature taught at the ancient universities—that is, Aristotelian natural philosophy, but increasingly permeated by the new learning.

A further instructive example is provided by the Bristol apothecary Charles Marshall, who travelled extensively in the Quaker cause. In 1670 he published a small tract entitled *A Plain and Candid Relation of the Nature, Use, and Dose of Several Approved Medicines*, in which he recommended several medicines including *spiritus mundus*, *spiritus sedativus*, *aqua ruba*, solar tincture, and expulsive cordial. Like other druggists, he had little respect for the socially superior physicians, whom he portrayed as selfish and primarily concerned with stealing wealthy patients from one another. He also charged these physicians with 'the ruine of many' patients. Likewise, he claimed that Galenic medicine (which had traditionally been taught at the universities but was becoming increasingly outmoded) was far more dangerous than the iatrochemical cures that he prescribed. In contrast to the 'fine and plausible discourse' of his opponents, Marshall spun his own narrative, which appealed to the values of simplicity and naturalness. He proposed 'to tread the antient path of the simplicity of Nature'.[13] A few years later a number of leading Quakers signed a testimonial supporting Marshall and his medicines:

> The Consideration of the Natural, as well as the Spiritual Benefits that God in his Wisdom and Goodness, through the variety of gifts he has afforded amongst his People, whereby have made mutual Helps and Comforts one unto another, . . . [move us to recommend] some *Medicines* prepared by our Friend Charles Marshall, that we by long experience have known to be safe and harmless, and through the blessing of God made effectual for our own and others Relief . . .[14]

In gaining this imprimatur from his fellow Quakers, Marshall had clearly succeeded in dispensing remedies that addressed both the 'Natural' and the 'Spiritual'.

The early Quaker engagement with science should not be seen solely in terms of opposition to those views propagated by the English universities and the articulation of an alternative Christian natural philosophy. Quaker Dissent also encompassed a number of specific beliefs and practices that were generally commensurate with the study of nature. One of these is utility. For example, as noted in section 3.1.1, Thomas Lawson recommended the

[13] Marshall, *Plain and Candid Relation*, 5–7.

[14] 'Dear Friends, all unto whom this may come . . .', Testimonial recommending Charles Marshall's medicines dated 2nd day, 8th mo., 1681, with a codicil added on the 17th, vol. N/28b, LSF.

study of nature, especially those subjects that were useful, such as 'Gardening, Agriculture, . . . Navigation, . . . Chyrurgery, . . . [and the] Propagation of Plants'—to cite just a few examples from his long list.[15] The theme of utility also appeared in the writings of a number of other Quakers, but was particularly marked among those who travelled to the New World and faced the challenge of building communities in a virgin land. William Penn, for example, depicted America as rivalling the splendour of the Garden of Eden. The abundant natural products of America were for man's use:

> the soyle [is] good, the springs [are] many & delightfull. [T]he fruits[,] roots[,] corne and flesh, as good as I have comonly eaten in Europe, I may say of most of them better. Strawberr's ripe in the woods in Aprill, and in the Last Month [May], Peas, beans, Cherrys & milberrys. Much black walnutt, Chestnutt, Cyprus, or white Cedar and mulberry are here. The sorts of fish in these parts are excellent and numerous . . . Mineral here is [in?] great store . . . Vines are here in Abundance every where, some may be as bigg in the body as a mans Thigh.

This letter, written to John Aubrey some two years after Penn arrived in Pennsylvania, also attests to his enthusiasm for the moral value to be derived from studying nature:

> It is even one Step to Heaven to returne to nature, and Though I Love that proportion should be observed in all things, yett a naturall Knowledge, or the Science of things from Sense and a carefull observation and argumentation thereon, reinstates men, and gives them some possession of themselves againe. . . . I Love That Inquiry should be modest and peaceable; virtues, that have strong charmes upon the wiser and honester part of the mistaken world.[16]

Although Penn was one of the very few early Quakers to have taken an interest in the kinds of science pursued by the Royal Society, many contemporary Friends considered that nature was a source of spiritual awakening. For example, the young Charles Marshall, disillusioned by the sterility of conventional religion, spent much time alone 'in the fields and woods, and by the springs of water, which I delighted to lie by and drink of'.[17] Fox also turned his back on the clergy, and headed for 'the orchard or the fields, with my Bible by myself'.[18] For both Marshall and Fox the countryside provided not only solitude and a contrast with the bankrupt religion propagated by other denominations, but also a place to commune with God. The open

[15] Lawson, *Mite into the Treasury*, 41.

[16] William Penn to John Aubrey, 13th day, 4th mo., 1683, in Dunn and Dunn (eds.), *Papers of William Penn*, ii. 394–6. On Penn's interest in botany and horticulture see R. M. M. Hunt, *William Penn*.

[17] Marshall, *Journal*, 2.

[18] Nickalls (ed.), *Journal of George Fox*, 7.

countryside, surrounded by the wealth of God's bounty, was the spiritual antithesis of the Established Churches whose sterile practices stifled religion.

In Fox's *Journal*, topographical descriptions often served spiritual purposes. Thus he was 'moved by the Lord' to climb Pendle Hill. Having gained the high ground, he experienced God's presence and was shown the surrounding villages where he was destined to spread Truth. While descending, 'I found a spring of water and refreshed myself, for I had eaten little and drunk little for several days.'[19] In this remarkable journal entry, which invites parallels with Moses receiving the Law on Mount Sinai, there is a close interplay between the natural environment and the spiritual: climbing Pendle Hill brought Fox closer to God; it raised him above other men and determined his destiny to teach them the true religion; he was refreshed both physically and spiritually by the living waters. Nature provided early Quakers (among others) with a wealth of words and images that were serviceable in preaching their message.

Like many contemporaries, particularly Puritans, early Quakers often turned to the biblical account of creation to articulate their understanding of spiritual realities. For example, as its title suggests, Francis Howgill's *The Invisible Things of God Brought to Light by the Revelation of the Eternal Spirit who was an Ey-Witness of the Wonders of the Lord in the Beginning* (1659) was predicated on Romans 1: 20: 'For the invisible things of him from the creation of the world are clearly seen, being understood by the things that are made, even his eternal power and Godhead.' In this book Howgill charted the biblical history of the world, starting with the creation, followed by its subsequent defilement during the Fall, and finally man's salvation through encompassing a pure and undefiled Christianity. But he was not concerned with analysing the structure of the physical world, but rather with comprehending the meaning of the biblical narrative, especially the creation. Thus, in reflecting on the doctrine of the Inner Light, he insisted that in order to achieve salvation, we must cease contemplating 'earthly knowledge'. Instead, he urged the reader to recognize that the kingdom of God lies within. Yet, in articulating the realm of the spirit, he repeatedly evoked one aspect of the physical world: he conceived that the light of the sun bears a close analogy to the spiritual light.[20]

Nature study was also frequently identified by Quakers as an activity that was acceptable to Quaker conscience. In his influential *Apology for the True Christian Divinity* (1678), Robert Barclay prescribed Quaker behavioural norms, and specified those activities to be eschewed by the sober-minded Friend. Basing his advice on several biblical passages, Barclay argued that the

[19] Ibid. 104. [20] Howgill, *Invisible Things of God.*

use of flattering titles, kneeling, bowing, or uncovering the head to any man, swearing oaths, and making war were all proscribed activities. Also prohibited as inimical to religious piety were dancing, attending comedies, and playing games of dice and cards. Instead, a Quaker should perform all necessary activities—such as working, eating, and drinking—in a constant state of awareness of God's blessing. Barclay did, however, allow a Quaker some opportunity for

> innocent divertisements which may sufficiently serve for relaxation of the mind, such as for *friends to visit one another; to hear and read history; to speak soberly of the present or past transactions; to follow after gardening; to use geometrical and mathematical experiments*, and such other things of this nature.[21]

Gardening and natural history were activities that generally appealed to Quakers. More interesting, Barclay specified 'geometrical and mathematical experiments' as appropriate activities, which would not have been familiar to many contemporary Quakers, most of whom would not have possessed the necessary knowledge or apparatus. All these 'divertisements' were useful and sober, not futile and frivolous. They were therefore in harmony with Quaker mores.

While some of the attitudes espoused by seventeenth-century Quakers were retained by later Friends, others were not. In particular, although Quakers continued to cite the Bible in their discussions of the physical world, by the early eighteenth century they rarely turned to the Bible in order to understand the creation, but instead sought to comprehend through the senses the observable world that God had created. Moreover, the belief in faith healing declined, and Quakers in increasing numbers undertook training in regular (i.e. conventional) medicine at the universities of Padua, Leiden, and later Edinburgh. Some Quakers even joined the Royal Society, which in 1668 Penington had chastised as irreligious. Such changes parallel the decline in the sect's radical ethos and the emergence by the early eighteenth century of Quakerism as a middle-class, family-oriented sect that, while emphasizing its religious separateness from the wider community, was increasingly deemed to be socially respectable, trustworthy, and hard-working.[22] In line with this social change, Quakers largely abandoned their oppositional stance to those forms of science that had been earlier dismissed as heathen. Yet they engaged in science selectively, participating principally in those branches, such as botany and observational astronomy, that cohered with their own values, while eschewing other areas like Newtonianism. Likewise, as we shall see, they

[21] R. Barclay, *Apology*, 540–2 (emphases in original); Henrey, *British Botanical and Horticultural Literature*, 310–11.

[22] Vann, *Social Development of English Quakerism*.

pursued science by methods that were commensurate with Quaker beliefs and practices. Moreover, the active pursuit of such sciences as botany and astronomy increasingly provided a domain where the church–sect divide did not operate. Scientific societies therefore provided one of the few forums in which Quakers could emerge from their own community and encounter non-Quakers, even Anglicans, on relatively neutral territory.

6.2 The Inner Light and the study of nature

Confined to his bed at his Sudbury home during an extended illness, Jonathan Grubb (1808–94) spent long hours observing his garden, a nearby river, and the distant meadows. It was, he claimed,

> no small alleviation to my sufferings to have the Book of Nature open before me—to watch the change of the seasons, and the coming and going of the feathered tribes. And what a fund of innocent enjoyment does this contemplation of Nature's works afford! Who but the Christian can truly enjoy them?[23]

For Grubb, as for many Victorians, sermons were to be found in stones, and the natural world overflowed with religious meaning. Moreover, in contemplating God's creation, he discovered a spiritual power that aided his recovery. But the most telling phrase in this passage is 'innocent enjoyment', which at first sight may appear difficult to reconcile with the sober nature of Quakerism. Yet innocence connotes a morally acceptable quality and one that was often contrasted with viciousness and self-aggrandizement. Quakers likewise pursued 'innocent trades', such as horticulture, as opposed to the manufacture of weapons. The word 'enjoyment' also deserves comment, since many conventional forms of enjoyment, including card-games, excessive drinking, and even reading popular novels, were proscribed by strict Quakers. While keeping evil at arm's length and rejecting time-wasting activities, they insisted that their leisure-time activities be sober and directed to higher purposes. In this section we explore the ways in which the observational sciences fulfilled this role.

A prominent feature of the church–sect dichotomy must first be established. In rejecting a professional ministry, Quakers advocated a priesthood of all believers based on the doctrine of the Inner Light or 'Light Within'—the belief that each individual possesses a divine spark that enables intimate communion with God. Especially during the sect's early history, opponents of Quakerism considered this doctrine subversive of the Established Church

[23] J. Grubb, 'Ornithological notes'.

and a threat to social order, since it encouraged a form of individualism that challenged the authority of the clergy, the aristocracy, and the magistrates. But the Light Within also possesses significant implications for the ways in which Quakers understood themselves, their interaction with others, and their relationship to the physical world. Most importantly, it places a premium on direct experience, not only spiritual experience but also the experience of observing various parts of God's creation, ranging from plants to planets, and from pigs to pigeons. Experience of the physical and of the spiritual often merged. Indeed, as Grubb noted when surveying the contents of his garden, observing the Book of Nature was an intense spiritual experience. 'May we not regard flowers as a visible expression of God's love to man, and our appreciation of them be a sincere, yet humble[,] reciprocation of that love?', asked one Quaker rhetorically.[24] The naturalist George Stewardson Brady likewise advocated the study of natural history, because, in contrast to the 'din and tumult of Salvation Armies' and the spiritual intoxication produced by attending revivalist meetings, nature worked quietly and effectively on the soul, initiating changes that were both deeper and more long-lasting.[25] The study of nature—God's creation—was viewed as a thoroughly Quakerly activity.

Most of the Quakers who pursued science focused on those sciences that prioritized the observation of God's creation, principally in the areas of astronomy and botany. Wealthy Quakers who held prominent and demanding positions in business or industry often turned to these sciences as an acceptable and enjoyable recreation. For example, the pharmaceutical chemist William Allen (1770–1843), who lived in Stoke Newington, was one of several Friends who built well-equipped observatories at their homes. When not involved in his pharmaceutical business, the Royal Society, lecturing at Guy's Hospital, or any of his many other activities, Allen retired to his observatory in search of peace and spiritual solace at the end of a busy day. Astronomy was his 'favourite recreation'—his re-creation. His diary contains many astronomical entries, one of which reads: 'The evening being fine, I treated myself with going into my observatory, and had some beautiful observations.' Although a form of relaxation, astronomy was also for Allen a higher and more spiritually satisfying activity than working as a manufacturing pharmacist. Likewise, he rounded off his course of astronomical lectures to students at Guy's Hospital by showing them that 'the sustaining hand of God is still necessary [in the universe], and the present order and

[24] Procter, 'Thoughts on flowers', 584.
[25] Brady, 'Modern spirit', 63, 78.

harmony which he has enabled us to understand and admire [in the astronomical system], is wholly dependent upon his will'.[26]

Writing to an American correspondent, Peter Collinson related the effect that both astronomy and botany exerted on him, leading to a sublime appreciation of the Creator: 'With a Pious Mind filled with admiration I contemplate the Glorious Constellations above, and the Wonders of the Vegetable Tribes below. I have an Assemblage of Rare Plants from all quarters, the Industrious collection of forty years.'[27] Likewise, the surgeon Jonathan Hutchinson expressed his affection for botany in the following terms: 'Botany is really a knowledge of the works of the Deity in plant life: what plants are, and how they have become so; and is full of the beautiful and wonderful.'[28] Nature walks in the countryside, being both instructive and morally elevating, were also favourite activities for many Quakers, especially on Sunday afternoons. Thus the young William Frederick Miller (1834–1918) of Edinburgh first became interested 'in our common wayside wild-flowers' from taking 'First-Day [Sunday] walks' with his father and two Quaker medical students who often visited the Miller residence.[29] A country walk, asserted one Quaker, results in our feelings being 'soothed and comforted, our [religious] faith a little strengthened'.[30]

Another area where the Inner Light was relevant to the practice of science was in the deployment of design arguments. These arguments, which were frequently used by writers from across the religious spectrum, typically begin by identifying observable signs of design in the physical world, such as the well-adjusted structure of the eye or the beautifully symmetrical configuration of the petals of flowers. From these observations is inferred the operation of a divine designer. Although historians have tended to view these arguments as conventional, and therefore potentially uninteresting, they deserve close attention, since they were open to many different modes of expression. Thus, in contrast to most Anglican writers, Quakers rarely appealed to the power of reason in inferring the existence and attributes of the Designer from the beauty and harmony manifest in plants and animals. Indeed, many Quakers, especially evangelicals, were sceptical about using reason in the domain of religion.

For Quakers, all experience is illuminated, as it were, by this Inner Light. Thus, when a flower is observed, perception is not restricted to seeing the

[26] [W. Allen], *Life of William Allen*, i. 68 (entry for 20th day, 1st mo., 1804), and iii. 97 (entry for 26th day, 12th mo., 1832).

[27] Collinson to Codwallader Colden, 25 Feb. 1764, PCLS.

[28] H. Hutchinson, *Jonathan Hutchinson*, 145.

[29] W. F. Miller, 'Reminiscences'.

[30] Procter, 'Thoughts on flowers', 585.

physical properties of the flower, such as its shape and colour, but the observer also appreciates its beauty, and is thereby led to a consciousness of its Creator. The connection between observed object and the Creator/Designer is forged by the Inner Light, thus raising the experience of a physical object to a more spiritual plane. An example of this process is to be found in a 1729 letter by Collinson to Thomas Story, a respected preacher, who had recently retired in order to tend his garden in Carlisle after many years travelling in the Quaker cause. As an importer of exotic plants from North America, Collinson acknowledged that when he examined such impressive botanical specimens, 'my Soul is fil[le]d with Adoration to our Great Creator for his Goodness[,] Mercy & Blessings to Mankind'.[31] For Collinson this was not a rational inference but rather an appreciation of the divine in all creation. Another example appears in the first part of a series of articles on astronomy published in 1843–4 in the newly founded periodical the *Friend*. Having introduced to his readers a variety of astronomical bodies, the author (H. R.) asserted that among all natural objects the stars are the 'most calculated to awaken and inspire emotions of admiration and reverence . . . [and] to raise our conceptions of the immensity and magnificence of the universe'. Contemplating the stars provided a transcendent experience, and one that 'will not fail to raise our views and conceptions of the greatness of the Deity'.[32] Thus, like many other Quakers, Collinson and H. R. adopted a highly experiential appreciation of divine design. As the comparison with the Anglo-Jewish community will make all the more apparent, Quakers made extensive use of design arguments, which, in turn, indicates the centrality of experience in their philosophy.

The importance of experience in religion is also illustrated by a frequently cited passage in George Fox's *Journal*. The context is relevant, since immediately prior to making this connection he criticized the ordained clergy, who, having been educated at Oxford and Cambridge universities, were unfit to minister to others. He then alluded to those generally 'called the most experienced people'; however, these people could 'not speak to my [spiritual] condition'. Although the text is difficult to interpret, Fox appears to be implying that these same Oxford- and Cambridge-educated clergymen, though widely read, were spiritually emasculated and unable to address his religious needs. When he eschewed these clergymen and their sham claims to authority, a mysterious voice pronounced: 'There is one, even Christ Jesus, that can speak to thy condition.' Overjoyed at the realization that pure knowledge can come only from God and from Christ, Fox asserted: 'And

[31] Collinson to Thomas Story, 4th day, 6th mo., 1729, MS vol. 337, fol. 33, LSF.
[32] H. R., 'Astronomy', *Friend*, 2 (1844), 17–19.

this I knew experimentally.'[33] If we understand Fox to be basing Quakerism on experiment, in the modern sense of the term, then he would be linking religion directly with the method of science. However, that would be an anachronistic interpretation, as the modern notion of experiment was just beginning to emerge in the mid-seventeenth century. Instead, the phrase can best be rendered thus: 'And this I knew experientially.' Fox's insight was not gained by reading books or by consulting well-read, university-trained clerics who considered themselves authorities in matters of religion. Rather, spiritual knowledge, although ultimately from a divine source, was known from personal experience. Fox therefore perceived spiritual Truth through the exercise of the Inner Light. In this sense Quakerism can be characterized as an 'experimental religion'.

This emphasis on the direct experience of nature via the Inner Light had a number of implications for the Quaker practice of science. Most importantly, until the very end of the nineteenth century, Quakers pursued principally the more empirical branches of science, such as botany, zoology, meteorology, and the observational aspects of astronomy. Prior to Arthur Stanley Eddington, who entered Owen's College Manchester in 1898, mathematics and the more theoretical domains of astronomy and physics were almost totally ignored by practising Quakers, the principal exceptions being Dalton and Silvanus Phillips Thompson.[34] Although Quakers were often competent at these practical aspects of mathematics, which were essential for their business ventures and financial transactions, they were not inclined (and often unable) to apply mathematics, and especially algebraic formalism, to the analysis of natural phenomena. Moreover, as Dissenters, their antipathy towards mathematical physics was further strengthened by its close association with dry rational argument and with the ungodly University of Cambridge. Since mathematics can be understood as an artificial language that stands between nature and the observer, this anti-mathematical stance coheres with the strongly empiricist attitude to nature adopted by Quakers, who emphasized direct experience of nature.

The prevalent Quaker attitude towards scientific hypotheses can also be interpreted within the framework of religious sectarianism and the Inner Light. Placing great emphasis on the individual's ability to gain religious knowledge and to make spiritual progress, Quakers repeatedly rejected any ready-made religious system, especially any creed, such as the Thirty-Nine Articles of Faith promulgated by the Anglican Church. This anti-credal stance

[33] Nickalls (ed.), *Journal of George Fox*, 29–30.

[34] Joseph Jackson Lister (1786–1869), who developed achromatic lenses for microscopes, made use of geometrical procedures in his 'On some properties in achromatic objective lenses', but the paper contains no mathematical formulae.

manifested itself in science as a deep-rooted scepticism towards speculative hypotheses which purported to provide systematic accounts of natural phenomena. For example, in his *Essay on Instinct* (1824), Thomas Hancock (I), an Edinburgh-trained physician, strongly contrasted his own attitude towards empiricism with the prevalent use of hypotheses by contemporary scientists. Drawing on arguments developed by the Scottish school of common-sense philosophy about the limits of knowledge, he asserted that we should follow 'the plain and simple path of observation, which may lead to profitable results . . . [but we should] avoid the giddy heights of speculation, where the mind is too much disposed to look down upon the laborious inquirer, and to indulge in vain conceits of superior intelligence'.[35] Empiricism was the scientific method of the humble Quaker who looked unflinchingly at God's creation; commitment to a speculative system of hypotheses implied dogmatism, arrogance, and an undue restriction on scientific activity.

Such attitudes can be traced back to Fox and other early Quakers, such as Thomas Lawson, who rejected Aristotelianism.[36] However, while Lawson praised the writings of the elder van Helmont, Fox became increasingly concerned that some Quakers had uncritically adopted the natural philosophy of Francis Mercury van Helmont as their creed. In 1683 he penned a memorandum requesting Friends to examine two recently published books by van Helmont, so 'that ffriends may be caution'd and Truth Cleared'. In drawing attention to several issues for further discussion, he was clearly troubled over whether van Helmont's writings were truly Christian. In particular, he reacted against van Helmont's claim to have produced a true system, since he, like many other Quakers, considered that any systematic natural philosophy was likely to undermine a simple Christian faith. Moreover, even if van Helmont had produced a natural philosophical system, Fox anxiously questioned whether such systems were adequately based on a Christian understanding: 'whether they are Learned by ye Holy Ghost, or unclean Ghost'. The outcome of Fox's investigation into van Helmont's views remains uncertain, but by framing these questions for discussion by the Second-day's Morning Meeting he expressed his suspicion of authoritarian systems of scientific knowledge.[37]

Early Quakerism included a group who called themselves 'Seekers'. The importance of seeking is also captured by a passage written in 1656 urging Friends not to be dogmatic, even about the 'advices' circulated by Yearly Meetings, since all such advice should 'be fulfilled in the Spirit, not in the

[35] Hancock, *Essay on Instinct*, 4.
[36] Lawson, *Mite into the Treasury*, 10.
[37] 'Memorandum from George Fox to the Second-day's Morning Meeting', 19th day, 11th mo., 1683, MS Portfolio 10/3, LSF.

letter; for the letter killeth, but the spirit giveth life'. This passage was later cited by Eddington in his 1929 Swarthmore Lecture, in which he urged that the 'spirit of seeking' was equally necessary in both science and religion; indeed, the scientist should refuse 'to regard any kind of creed as its [science's] goal'.[38] Quakers, he insisted, should be seekers, not systematizers. While accepting that hypotheses are useful in science, he considered that they are merely temporary expedients on which the scientist should not rely too heavily. Although Eddington's Swarthmore Lecture falls outside our time period, his gloss on the Seekers reflected the prevalent Quaker attitude to knowledge acquisition.

The emphasis on the Inner Light empowering each individual also implied an antipathy towards mundane authority, especially the authority wielded by both the Catholic and the Established Churches and exercised through their clergy. Quakers repeatedly sought to undermine these religious authorities, which they portrayed as corrupt; instead, they sought to empower those who were moved by the Inner Light.[39] In a not dissimilar manner, Quaker scientists repudiated authoritarianism in science, as wielded by established scientific authorities, including such eminent individuals as Isaac Newton, and organizations like the Royal Society and the Linnaean Society. Thus Henry Doubleday (1808–75), the Epping lepidopterist, wrote to a correspondent: 'Every person has clearly a right to his own opinions, and I think nothing does more injury to science than one person assuming a kind of dictatorship and expecting everyone to bow to his decision.'[40] If we substitute the word 'religion' for 'science', this quotation reads like a typical entry in a Quaker advice book. We also find Doubleday's close friend Edward Newman complaining bitterly in an editorial preface to the *Phytologist*:

> There is a scientific power in this country far above the reach of truth,—a power which refuses to acknowledge the worth of all that does not emanate from itself. It is the bane of science; the great stumbling block in the student's path; the bitter blast that warps energy, genius, and originality in its icy embrace.... [H]ow few in this country pause to enquire into worth or truth. The only query is whether the author belongs to the clique that arrogates to itself the privilege of dispensing scientific reputation.[41]

As Newman recognized, the pursuit of Truth—the foremost aim for Quakers in all aspects of life—is inhibited by the system of power and patronage that operated in the scientific community. Although he was not elected to the

[38] Eddington, *Science and the Unseen World*, 53–6. The quotation from 1656, which is based on 2 Cor. 3: 6, is cited in the preface to the current edition of *Quaker Faith & Practice*, sect. 1.01.

[39] Bauman, *Let Our Words be Few*, 32–5.

[40] Henry Doubleday to T. C. Heysham, *c.*1831, in Mays, *Henry Doubleday*, 29.

[41] *Phytologist*, 2 (1846), p. xi.

Royal Society, and was scorned by its more sophisticated members, he in turn resented their arrogance and their attempt to manipulate science.

The preface to an early nineteenth-century work on architecture contains some interesting epistemological reflections that apply to scientific knowledge. Joseph Woods (1776–1864), who was also a skilled botanist, insisted that architects should view a number of buildings and reflect on which appeared beautiful; the architect should then strive to determine the causes of beauty. Woods continued:

> A person who thus criticizes every fine building which he sees, without vanity or presumption, [but] with a sincere desire to find out what is excellent, and to understand, and fully enter into, the reasons for any admiration which has been generally bestowed upon it by others, yet at the same time not blindly following authority, but bringing everything to the test of his own feelings and judgment, will form to himself a habit, profitable not only when applied to architecture, and the other fine arts, but in every subject on which the human understanding is exercised.[42]

Although architecture was the subject of this reflection, this passage encapsulates several key elements of the Quaker attitude towards science: to be critical, but not arrogant; to appreciate the views of others, but not to bow before authority; and, most importantly, to assess every experience by one's 'own feelings and judgment'.

While Quakers were united in championing empiricism, there was no consensus on another crucial issue, the role of reason. Evangelicals in particular allowed only a very limited domain to reason, since it could easily become a source of worldly attachment and intellectual pride. Thus, while Hancock acknowledged in his *Essay on Instinct* that reason had enabled humankind to discover the laws of the physical universe, he also stressed its imperfections and limitations, and he described the reasoning faculty as 'fluctuating, weak and fallible'.[43] Even those Quakers who accepted a far more robust role for reason nevertheless insisted that its power is—and should be—limited. Thus, in an earlier philosophical work, another Edinburgh-trained physician, Robert Courthope Sims, argued that 'the conclusions of reason, however beautiful and useful in their proper places, are altogether insufficient for the sole guide of the conscience'.[44]

Writing in the *Friends' Quarterly Examiner* in 1875, Silvanus Phillips Thompson likewise argued that reason has its limits and is inappropriate when probing certain aspects of nature, which instead remain a source of

[42] Woods, *Letters of an Architect*, p. v. Woods published several papers in Newman's *Phytologist*, including 'Notes on a botanical excursion'.

[43] Hancock, *Essay on Instinct*, 191.

[44] Sims, *Essay on the Nature and Constitution of Man*, 69.

fascination and convince us of the mystery of creation. While fully acknowledging that the march of the intellect had enabled many of nature's secrets to be understood, Thompson insisted that the scientist is continually assailed by 'wonder and mystery'. Taking examples from the histories of optics, atomism, and evolutionary biology, he argued that with each progressive step, further problems arise which, in turn, require solution. Thus, far from scientific progress putting an end to mystery, new depths are encountered which fill the scientist with a sense of awe. Moreover, although we can never 'find out God', 'true reverence . . . grows ever as our knowledge [of nature] grows'.[45] In articulating this position, Thompson successfully combined two traditional but somewhat antithetical attitudes by insisting that reason is a crucial tool for understanding nature, but one that is never sufficient, since it must be complemented by religious faith. Quakers like Thompson, and later Eddington,[46] considered that no matter how far science advanced, God's creation remains ultimately mysterious and wonderful.

Thompson's later writings, especially his lecture on *The Methods of Physical Science* (1877) and his *The Quest for Truth* (1915), shed further light on his views about scientific method. They are worth examining because, as a physicist, he was necessarily engaged in high-level theory, and also because his analysis offered several further points of contact between science and Quakerism that earlier Friends had often espoused, although rarely discussed in as much detail. His 1877 lecture at University College, Bristol, was an endorsement of the importance of empiricism. Drawing on the writings of William Gilbert, Bacon, Newton, Faraday, and others, he offered a sophisticated version of the scientific method, which, he claimed, starts

> from observations and experiment, draws inferences, generalises the inferences and produces laws of experience; proves these by deductive application in which resort is again had to the test of experiment and observation; frames theories to account for the laws, and again deductively applies them, until uniform correspondence of observation with theoretical requirement confirms the truth of the whole.

While acknowledging the importance of laws (and indeed theories) in contemporary physics, he insisted that the whole structure of science had to be firmly based on experiment and observation. He was ambivalent about the use of hypotheses; while he recognized their importance in connecting 'known facts' and conceded that even erroneous hypotheses can aid the development of science, he warned scientists of the danger of mistakenly believing their pet hypotheses to be truths about nature. Dogmatism had no

[45] S. P. Thompson, 'Mystery of nature'; *idem*, *Methods of Physical Science*, 30.
[46] Eddington, *Nature of the Physical World*, ch. 15.

place in either science or religion. When discussing the use of mathematics in physics, Thompson was strangely reticent, and he expressed a clear distaste for algebraic formalism and a preference for using geometrical, and especially graphical, methods, which he considered not only to make conceptual relationships more easily visualizable, but also mimicked physical processes more clearly.[47] Thus while Thompson offered a view of science that engaged the complexities of Victorian physics, he maintained many of the traditional Quaker attitudes towards science.

Thompson's reflections on science were extended in his 1915 Swarthmore Lecture, *The Quest for Truth*, in which he focused on the role of the Inner Light in the search for Truth across a number of areas. In the case of scientists, the Inner Light operated through their intuitions—when, for example, a hard-won solution to a scientific problem appeared correct. He portrayed the scientist's intuitive sense as bearing a close similarity to the power of the imagination (in contrast to the application of reason). At the heart of the scientific method, argued Thompson, was the necessity for scientists to exercise their critical faculties. He warned that they should not take refuge in opinions that they want to accept, but instead subject all opinions to critical scrutiny by the rigorous methods of science. He therefore championed a form of 'constructive scepticism', not only in science, but also in all other activities, religion included.[48] For Thompson this was the specifically Quaker way of knowing, and he cautioned against ready-made religious systems, suggesting that, as with science, progress arises from piecemeal increments resulting from the activities of many minds.[49] What is so striking is that these prescriptions for Truth seeking—so important to Quakers—apply equally in the domains of religion and of science.

6.3 Dangers posed by science

'I was sent to turn people from darkness to the light, that they might receive Christ Jesus.'[50] Thus Fox conceived of his mission, and subsequent Quakers have likewise understood their aim to be moral and spiritual enhancement. As Friends were reminded by the 1861 Yearly Meeting—to take one example among many—'Fervent are our desires that we may be indeed a spiritually-

[47] S. P. Thompson, *Methods of Physical Science*.

[48] S. P. Thompson, *Quest for Truth*, 40, 46. The term 'Constructive scepticism' is discussed in Fisch, *Rational Rabbis*. See also Eddington's 1929 Swarthmore Lecture, *Science and the Unseen World*, 53–6.

[49] S. P. Thompson, *Quest for Truth*, 126.

[50] Nickalls (ed.), *Journal of George Fox*, 34.

minded people; cherishing that inward retiredness and spirit of prayer in which the voice of the Heavenly Shepherd may be distinctly heard.'[51] Yet this 'spiritually-minded people' also engaged in such relatively secular activities as business and science. In order not to lose sight of their religious goals, they were, however, repeatedly warned that while they should be *in* this world, they should not be *of* the world. If Friends paid too much attention to science, business ventures, or indeed any mundane activity, then they ran the danger of compromising their religious fidelity. The books of advice, containing the guidance disseminated by Yearly Meetings, repeatedly identified a number of challenges faced by Quakers who engaged in business. Some of these 'advices' specified the norms of Quakerly conduct; for example, they were urged not to maintain sloppy records, but to keep their account-books in good order, and they were also warned against financial speculations, which might result in debt. Moreover, preoccupation with business and financial activities should not become so demanding that it led to neglect of religious practices and duties. Quakers were therefore advised to maintain these activities in their rightful, that is, subordinate, place.[52] Although the books of *Minutes and Advices* make no explicit reference to the practice of science, the same general warning against over-indulgence applied. Quakers recognized that, as with business, they ran the risk of becoming so engrossed in science as to neglect religion.

Some early Quakers adopted a particularly severe line. As noted in section 4.1, Isaac Penington criticized the Royal Society for pursuing natural knowledge at the expense of religion. He therefore advised Fellows to transcend nature in order to 'know and partake of the true wisdom, and feel union with God'.[53] Even one of the few scientifically able early Quakers, the botanist Thomas Lawson, made a similar point a few years later when he insisted that '[s]ound knowledge relates primarily to God, secondarily to the knowledge of the Creation, and of the useful and necessary imployments'.[54] By placing natural knowledge far below the divine, and insisting that it should be preserved in that subsidiary role, Penington and Lawson were expressing a view that was to recur many times during the next two and a half centuries, although often with different emphases.

An extreme example is provided by the mid-eighteenth-century quietist John Rutty (1698–1775), who was continually tormented by his worry that his spiritual quest would be undermined by his scientific activities, which included an extensive study of the influence of weather conditions on disease.

[51] *Extracts from the Minutes and Advices*, 4th edn., 37–8.
[52] *Extracts from the Minutes and Advices*, 2nd edn., 195–200.
[53] Penington, *Some Things Relating to Religion*, 3.
[54] Lawson, *Dagon's Fall*, 71–2.

Since science is a worldly activity, it must not, he insisted, usurp the place of religion. Natural knowledge, he asserted, 'is but dung, compared to the spiritual'. In another entry he cried out: 'Lord, slay the inordinate love of natural studies! the rather as thou hast said, "No man can serve two masters;" and, surely, natural studies have had pre-eminence [in my life].'[55] In accordance with this sentiment, he often portrayed knowledge of the physical world as utterly vain. Moreover, unlike spiritual Truth, scientific knowledge was necessarily imperfect. Such severe self-chastisement would seem to require Rutty to forsake science altogether. However, far from rejecting science, he sought ways of pursuing it that would strengthen, not undermine, his state of grace. For Rutty, science was a form of labour, and thus could not be avoided; it had to be pursued, but in the appropriate frame of mind. Hence in one diary entry he dwelt on the 'strong allurements of natural science' that provide a source of grace when pursued without 'spiritual pride and ostentation'. Only if practised with simplicity and humility could science become spiritually acceptable. But Rutty also conceived his enduring pursuit of scientific projects as divinely ordained. In one entry he expressed great satisfaction at making progress in his researches, adding: 'God has enabled me to perfect the Treatise on Milk [published in 1762]: and here ended the labours of twenty-five years of my faithful servant, whom God reward, and give me to prepare for the approaching end of my own labours: for surely God speaketh in this event.'[56] Thus God had spared him in order to enable him to fulfil this scientific project, and its completion provided an occasion to celebrate God's goodness and mercy.

In contrast to the quietist Rutty, William Allen was carried on a wave of evangelicalism. Yet his diary likewise contains several entries warning against over-indulgence in science and citing its potential to displace religion. Thus, when he first joined the Plough Court pharmacy, his mentor Joseph Gurney Bevan 'was ever watchful lest the allurements of science should beguile his [Allen's] heart from love of God, or adherence to the simple truths of the gospel'. A few years later he was cautioned by Mary Sterry, an elderly member of the local Preparatory Meeting, who warned

> lest my ardent desire for knowledge, even with laudable intention of benefiting mankind, should eclipse the lustre of that inestimable gift, which she believed was bestowed upon me. Her discourse was delivered with great affection, and enforced with energy. O! could I believe that I should ever attain—that I should struggle

[55] Rutty, *Spiritual Diary*, 16 (entry for 7th day, 3rd mo., 1755) and 37 (entry for 24th day, 7th mo., 1755).

[56] Ibid. 187 (entry for 26th day, 7th mo., 1761) and 218 (entry for 17th day, 7th mo., 1762). The work referred to is Rutty, *Analysis of Milk*.

through the briars and thorns, how would my soul rejoice! But the sickening prospect of those who have failed by the way, and the humiliating sense of my own weakness and unworthyness, at times almost weigh me down.[57]

Although both Gurney and Sterry proffered advice, Allen was also fully aware of the dangers posed by his enthusiasm for science. Early in 1794 he wrote: 'I am persuaded that it is the intention of the beneficent Creator that the conveniences, &c. of this life should be enjoyed, yet kept in subordination. Beware, lest chemistry and natural philosophy usurp the highest seat of thy heart.' Over the next few years, pharmacy, chemistry, natural philosophy, and botany featured prominently in Allen's bulging diary, as did his many philanthropic activities, religious observances, and duties. In a diary entry for 1803 he triumphantly reported: 'Made temporals give way to spirituals, in putting off my lecture [to students at Guy's Hospital] this morning, on account of the Quarterly Meeting, and was glad I did.'[58] When he reached middle age, Allen, like many other successful Quaker businessmen, withdrew from his business commitments and devoted his time to Quaker matters, both at home and abroad. He also paid less attention to science and, in 1826, even relinquished his lectures at Guy's Hospital.

Testimonies provide a particularly interesting, if highly conventionalized, source for investigating Quaker self-images. These biographical sketches often charted the spiritual growth of the deceased and provided the living with examples of Quaker virtue. Little attention was usually paid to the deceased's mundane activities, except when a religious moral could be drawn. A particularly poignant example of the danger posed by science is provided by the testimony of John Barlow (1815–56), who trained in veterinary medicine at Edinburgh and embarked on a research career. His veterinary researches were, however, cut short at the age of 40 by a crippling pain in the spine. During his final months he reflected on his short life and regretted that he had not made better use of his spiritual gifts and devoted himself whole-heartedly to Quaker service.

I have dearly loved science and my [secular] profession and have followed it with a too exclusive devotion—have perhaps made it somewhat of an idol ... Pecuniary success has not been my point of ambition; the *snare* has been in an over ardent desire for the advancement of science, and perhaps some corresponding care for scientific reputation.

57 [W. Allen], *Life of William Allen*, i. 3, 24–5. The latter entry is dated 18th day, 1st mo., 1795.

58 [W. Allen], *Life of William Allen*, 23 (entry for 22nd day, 1st mo., 1794) and 63 (entry for 29th day, 3rd mo., 1803).

Science proved a seductive mistress, not only because of Barlow's fascination with research and his commitment to it, but also because he found himself subtly drawn into the mores of the competitive scientific community. The publication of his testimony by the Friends' Tract Society in 1889 may have been intended as a warning to other Quakers that the pursuit of science, if carried to excess, will be to the detriment of religion.[59]

Science could also occasionally infringe other Quaker norms, and even the relatively peaceful pursuit of natural history could stir the Quaker conscience. Most Quakers repudiated field sports, much beloved by the social and ecclesiastical establishment, and some even urged that living specimens should not be harmed or killed in the pursuit of science. Thus James Hack Tuke recalled his youthful enthusiasm for ornithology, but also his father's earnest warning—'Only observe though!'—forbidding him either to shoot birds or to take their eggs.[60] Ecological issues were also broached by George Stewardson Brady in his presidential address to members of the Tyneside Naturalists' Field Club in 1871. Cautioning his audience against engaging in the wanton destruction of plants and animals, he urged the naturalist to take only as many specimens as were required, otherwise

> he is acting to the detriment of Science, and trespassing on the enjoyment of his fellow-naturalists, not only now, but possibly to future generations. There is really more pleasure to be gained from the quiet contemplation of natural objects in their proper haunts than from obtaining forcible possession of them.[61]

Another normative issue was raised in one of the earliest references to gardens and gardening. In the 1705 minutes of the Leinster Provincial Meeting—equivalent to an English Quarterly Meeting—some members expressed concern about the danger of possessing 'too great superfluity of plants and too great nicety of gardens'. A resolution was passed requiring that 'all Friends in planting gardens do it in a lowly mind, and keep to plainness and the serviceable part, rather admiring the Wonderful hand of Providence in causing such variety of unnecessary things to grow for the use of man, than seeking to please the curious mind'. In the same year a minute of a Half-Year's Meeting recorded that 'all Friends are desired as they have occasion to make gardens to make them plain or rather plant or set such profitable things as

[59] [Anon.], *Memoir of John Barlow*, 6–7. See also Martin Barry's similar concern: 'Martin Barry', *AM*, 1856, 13–18; [Anon.], 'Memoir of the late Martin Barry'. Also relevant are Rutty, *Spiritual Diary*, 6, 11, 48, 72, 113; Ash, *Retrospect of My Life*, 9–11; 'Edward Ash', *AM*, 1875, 198–209; 'Thomas Hancock', *AM*, 1850, 43–65; Binns, 'Our attitude towards science'.

[60] E. Fry, *James Hack Tuke*, 11. The young Tukes nevertheless admitted that they sometimes collected birds' eggs.

[61] Brady, 'Address'. See also *idem*, 'Bird'; W. Bennett, 'Development of the organ of destructiveness'.

may be of service'.[62] These fascinating records emphasize two acceptable uses of gardens; they were to be prized for their utilitarian value, especially in producing food, and as impressive evidence of God's handiwork. The advice that gardening should not be a source of pleasure for 'the curious mind' coheres with the recurrent warnings against engaging in speculative thought. These quotations also draw attention to the oft-repeated requirement that Quakers should value plainness in all aspects of their lives; just as brightly coloured clothing must be avoided (in favour of plainness of apparel), so Quakers should not grow plants for their outward splendour and in order to impress their neighbours. It is not known why Irish Quakers in 1705 were concerned to moderate their enthusiasm for gardens and gardening; presumably one or more of their number had indulged in conspicuous consumption by planting lavish gardens, thus transgressing strict Quakerly mores.

In this chapter traditional Quaker attitudes to a range of scientific issues have been reviewed. Yet the study of nature was generally considered an earnest and morally acceptable activity for Quakers. Thus science was encouraged, provided that it was not pursued so enthusiastically as to compromise religious fidelity. While there existed a generally positive attitude towards science, the Quaker belief system—and especially the commitment to the Inner Light—favoured certain sciences and scientific methods. Thus Quakers tended to pursue observational science, such as botany and astronomy, rather than physics. Moreover, they championed an *ad hominem* form of empiricism, rejected ready-made scientific systems, and treated speculative hypotheses with caution.

[62] Braithwaite, *Second Period of Quakerism*, 510; Brett-James, *Life of Peter Collinson*, 42; Henrey, *British Botanical and Horticultural Literature*, 311. Henrey quotes from the Braithwaite MSS, LSF.

7
Quaker Responses to Evolution

At the outset it should be noted that the intellectual environment of Britain changed significantly around the middle of the nineteenth century. For most Christian writers earlier in the century considered that science represented no major threat to religion; instead, it was generally viewed as a major resource for Christian apologetics. For example, design arguments were utilized to justify belief in God and his attributes.[1] Science was generally encouraged for religious purposes, and even those evangelicals who emphasized Revelation over natural religion frequently deployed design arguments as an aid to Christian piety. However, although the first sustained threat from atheism arose with the French Revolution, the relationship between science and religion came increasingly under strain, and sometimes manifested direct conflict. By the 1860s an increasing number of Christians perceived science as a threat, and not as a buttress to religion. Such works as the anonymously published *Vestiges of the Natural History of Creation* (1844) and Darwin's *On the Origin of Species* (1859) were condemned for spreading irreligion. In the escalating 'warfare' between science and religion, many of the main salvos were fired during the 1870s, especially in the prominent battle ignited by John Tyndall's presidential address to the British Association's annual meeting held in Belfast in 1874. As Frank Turner has argued, 'no single incident in the conflict of religion and science raised so much furore'.[2] Moreover, as Turner has emphasized, science did not only pose an intellectual challenge, but Huxley, Tyndall, and other 'scientific naturalists' sought to displace the clergy from their pedestals and to advance the standing of scientists.[3] In response to these challenges, some Christians branded certain aspects of science as atheistical, while others still found ways of bridging science—even evolution—and Christianity.[4]

Darwin's *Origin of Species* was published at a critical moment in British Quaker history. During the late 1850s Quakers recognized that their Society was in danger of terminal decay, since membership was declining significantly, as was the power and influence of the Quaker community. As Thomas

[1] See, e.g., Brooke, *Science and Religion*.
[2] F. Turner, *Contesting Cultural Authority*, 196; Lightman, 'Scientists as materialists'.
[3] F. Turner, 'Victorian conflict between science and religion'.
[4] Brooke, 'Darwin and Victorian Christianity'.

Kennedy has noted, the Society of Friends was in a state of 'spiritual torpor and social isolation'.[5] Radical steps were required if Quakerism were to be rescued. Thus one concerned member initiated a prize competition for essays that would address this pressing problem. That approximately 150 entries were received is indicative of the widespread concern about the movement's fate. The judges—three eminent non-Quakers—announced their decision in August 1859, and the two successful essays were soon published and avidly discussed. In his winning entry (discussed in section 5.9) John Stephenson Rowntree provided a long-term statistical analysis of membership and identified a number of ways in which Quakerism had failed its original promise. He identified problems with both the belief system and the movement's structural organization, and was particularly critical of the emphasis on the indwelling Spirit which, he claimed, had led to such problems as the neglect of prayer and the lack of instruction for the young. Likewise, he believed that the rigidity of the Society's organization had resulted in many being ejected owing to infringements of its rules, especially marrying out. He therefore suggested that new rules be adopted on intermarriage and on certain other topics.[6]

Although many of Rowntree's proposals were adopted at the 1860 Yearly Meeting, the prescription offered by the other prize-winner should also be noted. Thomas Hancock (II), an Anglican clergyman, argued that Quakerism had run its natural course, and that it should merge with mainstream Anglicanism, which, he claimed, had retained its evangelical zeal and vitality.[7] Hence, just when the first readers were opening their copies of the *Origin* in the closing weeks of 1859, Quakers were contemplating their ailing Society and discussing in sombre tones the possible remedies. This was not the best time to take a calm, measured view of a scientific text causing consternation in the outside world, but rather a time to turn inward and contemplate the changes that were necessary to revitalize the Quaker community, or even abandon the project initiated by Fox two centuries earlier.

7.1 Quaker assessments of evolution

These preoccupations, together with the continuing insularity of the Quaker community, help to explain the lack of immediate response to Darwin's theory in the Quaker periodical press. Although the *British Friend* paid little attention to science, the more evangelical *Friend* often carried articles,

[5] Kennedy, *British Quakerism*, 14.
[6] Rowntree, *Quakerism, Past and Present.*
[7] Hancock, *Peculium.*

reviews, and comments on scientific topics. Initially edited by Charles Gilpin, in 1858 Alfred Bennett (1833–1902) became both its proprietor and its editor, a position he held for the next nine years. As an accomplished botanist and subsequently lecturer in botany at St Thomas's Hospital and Bedford College, he initiated the 'Science' and 'Natural History' columns as separate and regular features, the latter conducted by Edward Newman, the author and editor of many works on natural history. Newman, who was critical of Darwin's theory, was largely responsible for its lack of support by the *Friend*. Moreover, after the mid-1860s science was accorded far less attention, the 'Science' and 'Natural History' columns no longer being regular features, although meteorological records continued to be published. This apparent loss of interest in science coincided with F. Bowyer Kitto taking over as editor from Bennett at the beginning of 1867. The influence exerted by the editor and by Newman (who was Bennett's mentor in scientific matters) over what was published, should caution us against attributing views expressed in the *Friend* to the whole Quaker community.[8]

A third periodical, the *Friends' Quarterly Examiner; a Religious, Social & Miscellaneous Review*, commenced publication in 1867, and was devoted to substantial signed articles. Its editor, William Colson Westlake, a corn merchant from Southampton, welcomed contributions from all sections of the Quaker community. However, in creating this new forum, Westlake insisted that, in order to be healthy, Quakerism must cast off 'that which . . . has lost its life and greenness'. Instead, Quakers should adopt 'those means which each generation requires for its peculiar condition. The body that can thus reform itself from within, is neither lifeless nor decaying.'[9] This call for reform from within was echoed by many of the contributors, who viewed the new journal as an appropriate place to present and discuss innovative ideas. Although the *Friends' Quarterly Examiner* post-dates the *Origin of Species* by several years, during its first three decades it contained a significant number of articles on science in general, and Darwinism in particular, many of which offered positive assessments of evolution.

Even more enthusiastic about both science and evolution was a short-lived monthly, the *Manchester Friend* (1871–3), which was founded by a group of disaffected Friends who had been investigated by the Yearly Meeting during the preceding decade. Led by David Duncan and Joseph B. Forster, and influenced by the Hicksite movement among American Quakers, they opposed both the intellectually repressive evangelicalism within the Society and the authoritarianism of the Yearly Meeting, which sought to suppress the

[8] Ellegård, *Darwin and the General Reader*, 21.
[9] [W. C. Westlake], 'Past year', 8. The circulation was 1,200 in 1869: *FQE*, 3 (1869), 2.

Manchester rebels in a heavy-handed manner. As the *Friend* and the *British Friend* supported the Yearly Meeting in its actions against the Manchester radicals, the *Manchester Friend* was rendered necessary 'by the increasing desire of many Friends for more liberty of thought and expression amongst each other than is at present possible in the columns either of the *British Friend* or [the] *Friend*'. Knowledge, argued the editor, should be the foundation of religious faith.[10]

These periodicals reflect four different positions within Victorian Quakerism. In assessing responses to Darwin, we will be concerned principally with the ongoing struggle between the evangelicals, who controlled the Society, and their critics, who sought to reform the Society of Friends by giving more emphasis to the Inner Light and less to the Bible. Although the Manchester radicals were at the forefront of these reforms, many less strident voices within the Society increasingly sympathized with their position. Historians have tended to call these reformers 'moderates' or precursors of the liberal stance generally adopted by Quakers at the century's end. Adopting this nomenclature, we will compare and contrast the responses to Darwin by the evangelical and moderate wings of Quakerism, with some discussion of the radicals who either left the Society or assimilated to its moderate fringe.

A significantly different view of Quaker responses to evolution is obtained if we examine other bodies of contemporary literature; for example, if, instead of consulting the Quaker press, we look at what Quaker scientists were writing for fellow scientists. This contrasting perspective will be explored in section 7.2, where the responses to Darwin by various groupings of Quaker scientists will be discussed. Here we will also encounter the response of the *Natural History Journal*, the Quaker periodical devoted specifically to science.

7.1.1 *Evangelical reactions*

The 1830s witnessed the Beacon controversy and a swing towards evangelicalism. One of the key figures of the period was Joseph John Gurney, an affluent Norwich banker, who sought to reinvigorate the movement with evangelical zeal and initiate a more spiritually satisfying and outward-looking form of Quakerism. Without rejecting the doctrine of the Inner Light, he nevertheless envisaged that Quakerism should be firmly reoriented towards biblical Christianity.[11] Yet Gurney also possessed strong scientific interests. As a student, he had attended lectures on astronomy, physics, and chemistry, and was subsequently well-read in the scientific literature. Like many other

[10] *MF*, 1 (1872), 1; Isichei, *Victorian Quakers*, 25–32, 61–5; Kennedy, *British Quakerism*, 47–94.

[11] For a wider perspective on evangelicalism, see Hilton, *Age of Atonement*.

Christians, he particularly commended the study of nature because it displayed the handiwork of God. Moreover, he endorsed the view held by many Quakers that science and technology were crucial to the advancement of the human race, both in terms of intellectual progress and through man's ability to control the natural world.[12] Gurney's most public pronouncement on science came in his address to members of the Manchester Mechanics' Institute in 1832. While enthusing about the pursuit of science and its importance for improving the human condition, he repeatedly emphasized to his audience of working men the religious implications of scientific endeavour. Using design arguments, he sought to impress on his listeners the need to appreciate God as the author of nature. The pre-eminent use of science, he wrote, 'is to confirm our belief in the Creator and Supreme Ruler of the universe—to establish and enlarge our acquaintance with God'.

Gurney nevertheless insisted that by itself the study of nature was insufficient, and that Bible study was also necessary, since the 'religion of the Holy Scriptures will sweeten your sorrows, and sanctify your pleasures'. On the vexed question of the age of the earth, he simply reminded his Manchester audience that the 'beginning, which took place about six thousand years ago, is plainly recorded in Scripture'.[13] Two years later Gurney adopted a different position when, faced by evidence from the fossil record, he agreed with the Scottish evangelical Thomas Chalmers that the biblical narrative made no specific pronouncement about the date of creation. Hence creation could be allowed to pre-date the First Day by an epoch of unspecified length. In this way geology and Genesis could be reconciled.[14] Although Gurney offered two incompatible views on the age of the earth, he (like other evangelicals) considered the Bible to be the unerring repository of Truth, which could not be compromised by science.

The evangelicalism that had enlivened and split the Society of Friends in the 1830s subsequently became the orthodoxy. While Gurney possessed the intellectual breadth to engage many issues from an evangelical standpoint, science included, few mid-Victorian Quakers could emulate his achievement. Evangelicalism, initially seen as breaking the hold of conservative inward-looking quietists, now bred its own form of insularity. This dominant anti-intellectualism discouraged Quakers from engaging with the major intellectual trends affecting Victorian society at large. Although Quakers continued to be deeply involved in social issues, such as pacifism and the slave trade, writers in both the *Friend* and the *British Friend* evinced little

[12] Swift, *Joseph John Gurney*, 145–61.
[13] J. J. Gurney, *Substance of an Address*, 7, 8, 13.
[14] J. J. Gurney, *Reminiscences*, 35–7. On Chalmers's attitude to science, see Cairns, 'Thomas Chalmers's astronomical discourses'; C. Smith, 'From design to dissolution'.

interest in such demanding conceptual issues as the scientific naturalism endorsed by many leading Darwinians and the challenge to biblical scholarship thrown down by the authors of *Essays and Reviews* (1860). In their limited forays in that direction, most Quakers perceived areas of potential conflict from their comfortably assured position founded on their understanding of God's word. They often promoted a 'monster-barring' strategy by simply refusing to acknowledge this challenge to their beliefs or summarily dismissing the offending viewpoint.

This insularity affected attitudes to science, and is reflected in the treatment accorded to Darwin's *Origin* in the Quaker periodical press. Although the book was published late in 1859, the *British Friend* ignored it entirely, and the *Friend* first noticed it only in January 1861, when William Tallack singled out the *Origin* primarily for its impact. He noted that Darwin's views 'have not been endorsed by the majority of naturalists and comparative anatomists, and have occasioned alarm to some, as having a tendency to weaken the authority of Scripture', adding 'but this is particularly denied by' Darwin. In support of the latter claim, he cited a passage near the end of the *Origin* in which Darwin had alluded rather circumspectly to God's role as creator of life. In presenting Darwin as simultaneously threatening scriptural authority and evoking God as Creator, Tallack avoided either endorsing or rejecting the new theory.[15] Darwinism formed part of the uncongenial world beyond the purlieus of the Quaker community, and was best kept at bay.

The August 1861 issue of the *Friend* contained a far more extensive and overt critique of the *Origin* with the byline 'I. K.' However, this contributor did not review the *Origin* directly, but instead engaged Darwin's views through the recently published review of the third edition by Edward Newman in the *Zoologist*, which Newman edited. Although he thought highly of Darwin as a naturalist, Newman was ambivalent about the *Origin*, but he particularly chastised Darwin for lack of honesty in failing to confront the incompatibility between his theory and the biblical account of creation.[16] Taking his cue from Newman, I. K. pointed out that Darwin's argument about the descent of species implied that 'the history of creation so beautifully recorded in the Book of Genesis is altogether a fable'. However, the author then sought to distance himself from any theological critiques of evolution by arguing that naturalists should assess a scientific theory in terms of its

[15] *Friend*, 1 (1861), 10. Tallack, who later became prominent in the penal reform movement, had previously taught at Sidcot and Ackworth schools. After resigning his teaching posts, he turned his hand to a wide range of literary projects in the early 1860s, and was a frequent contributor to the *Friend*. See *AM*, 1909, 142–7, and F. A. Knight, *History of Sidcot School*, 115–16.

[16] E. Newman, review of 3rd edn. of the *Origin of Species* and three other works, *Zoologist*, 19 (1861), 7577–7611.

scientific credentials and ignore any religious implications. Newman's review in the *Zoologist* served I. K.'s purpose, since it contained arguments that appeared to refute the theory. One argument was that Darwin's theory purported to explain not only instances where many similar species were known to exist, but also where no extant evidence of previous forms had been found, as in the case of giraffes. That the theory should be so plastic as to be applicable in both situations indicated its *ad hoc* nature. Moreover, the second case—where no previous forms had been identified—should, claimed the critic, be interpreted as indicating a lack of supportive evidence for Darwin's theory. A further argument was that Darwin had failed to apply his theory to minerals, which I. K. (like Newman) considered to be so closely analogous to organic forms as to require an identical explanation. Only towards the end of the article, after I. K. had disposed of Darwin's theory on 'scientific' grounds, did he advise readers to become fully acquainted with the arguments countering evolution so that they could defend themselves against its vocal proponents. He was particularly concerned that the 'timid and wavering mind' should not be seduced by Darwin's theory and be led to question the 'perfect harmony' between science—'true science'—and revealed religion.[17]

Extracts from scientific papers published in other periodicals often appeared in Newman's 'Natural History' column, as did letters from his readers. In this way subscribers became acquainted with each other's scientific interests and with the ongoing researches within the wider natural history community. The subjects discussed in the second number for 1861 are not atypical: the sagacity of birds, the hedgehog, the habits of moorhens, and a report about snails eating fish. Newman's column rarely dealt with the conceptually demanding aspects of natural history, but confined itself principally to reporting observations of interest. Newman's closest engagement with Darwinism in the *Friend* occurred in an editorial intervention early in 1862, when he dismissed a report which suggested that species could be transformed artificially.[18] For Newman, the natural was God-given and normative.

Throughout the 1860s and 1870s evangelical Quakers became increasingly concerned about the implications of science, especially the apparent clash between the account of humankind given in Genesis and the various naturalistic explanations which received increasing attention in the scientific press. Thus Charles Lyell's *Antiquity of Man* was summarily dismissed in the February 1863 number of the *Friend*, because it 'will be employed by sceptics to

[17] I. K., 'The Origin of Species—(Zoologist, No. 231)', *Friend*, 1 (1861), 210–12. The same number contained, in its Natural History column, extracts from two letters to Darwin written by Gideon Lincecum of Texas dealing with the habits of Texan ants.

[18] *Friend*, 2 (1862), 13.

impugn the early chapters of Genesis'.[19] Eight years later, Darwin's *Descent of Man*, which contained an evolutionary account of humankind, was likewise rejected because 'we could not accept its conclusion'.[20] Likewise, John Tyndall's 1867 article arguing against miracles was contested by a reviewer who cited enthusiastically another work in which miracles had been defended as providing evidence that Christ was the Son of God. Moreover, when Tyndall's *Fragments of Science* was reviewed in 1871, the reviewer commended it as a clear exposition of science, but criticized Tyndall for holding an inadequate view of miracles.[21] Despite these 'monster-barring' responses, contributors to the *Friend* were not in total accord. The reviewer of another of Tyndall's books sided with him, and clearly approved of his 'want of charity... towards those who are unable to reconcile the teachings of science with those of revelation'. This is a particularly interesting comment, since the (anonymous) reviewer appears to deprecate any attempt to use Scripture to criticize science.[22]

The only extended response to evolution in the *Friend* was written by the ageing Edward Ash, who had been a fervent Gurneyite. Although his evangelical commitments had resulted in him leaving the Quakers in the 1850s in order to join the Congregationalists, he subsequently returned to the fold. In a letter of 1873 Ash delivered eight propositions explaining why Quakers should not be worried by Darwin's or any other theory of organic development. Interestingly, he accepted that animals, even humans, may have changed over time, and he also insisted that the Bible should not be used to judge scientific theories, which must be assessed on their own terms. However, he maintained that no current scientific theory was able to offer a (scientifically) satisfactory account of the development of species. This being so, argued Ash, rationality and prudence dictated that believers in the authority of Scripture should not be 'disturbed or shaken' by recent developments in science, including Darwin's theory.[23] What Ash offered was a stance that enabled evangelical Quakers to protect their beliefs from the incursion of science by keeping it at bay. It is not known whether Ash's formulation was generally accepted by readers of the *Friend*, but the failure of his article to evoke any published correspondence may indicate that his position was widely endorsed.

Throughout most of the 1870s and 1880s, the *Friend* paid scant attention to Darwinism and devoted minimal space to science subjects. A few natural history books were reviewed briefly, together with some excursions into biblical chronology. Only when the *Friend* became a weekly in the early

[19] *Friend*, 3 (1863), 65–6.
[20] *Friend*, 11 (1871), 178.
[21] *Friend*, 8 (1868), 66; 11 (1871), 248.
[22] *Friend*, 13 (1873), 42.
[23] Ibid. 197.

1890s, under the editorship of Henry Newman, did the 'Scientific Notes' column written by James Edmund Clark, a schoolmaster at Bootham, become a regular feature. However, Clark confined himself to factual reports of recent developments in science and technology, and avoided the disputed territory of science and religion.

In the period 1870–6 four contributors to the *Friends' Quarterly Examiner* sought to defuse the threat from science by drawing a sharp distinction between the facts and legitimate inferences of science, on the one hand, and those speculations that carry the scientist far beyond the firmly based and truly knowable. In applying this anti-hypothetical strategy, they, like Ash, ensured that their somewhat literal understanding of the Bible was not threatened. As William Tallack pointed out in an 1874 article, 'Christianity has nothing to dread from real Science—nothing to fear from *Positive* Philosophy—fairly, fully, broadly and *scientifically* carried out.' However, problems arose when scientists like Darwin and Tyndall pursued unrestrained speculations, especially in theorizing about the geological history of the earth or the evolution of species. Tallack's implication was clear: scientists should not speculate beyond the available evidence. Another contributor reiterated this point, esteeming those scientists, like Faraday, who, 'by exact and laborious experiment', had provided science with firm foundations, as opposed to those who employed illegitimate and empty hypotheses.[24] Like Ash, these authors clearly viewed science as a potentially dangerous force which must be kept in its proper place. This attitude appears to have been widely shared among evangelical Quakers during the third quarter of the nineteenth century. However, this defensive strategy was rarely deployed after 1876, possibly because with an increasing number of scientists publishing in support of evolution, it became more difficult to dismiss the theory as a mere hypothesis. More importantly, evangelicalism was on the wane.

The above evidence derived principally from the *Friend* can be supplemented by a number of other sources. For example, the history of Bootham School includes an anecdote relating to a pupil who, in 1865, read the *Origin* and became a convert to evolution.

> Some cautiously propounded questions showed him that his masters knew nothing about the matter.... When that boy's ideal, the Head[teacher], assured him with conviction that 'Our First parents were divinely-created noble creatures,' the secret student closed his lips, but not his mind.[25]

[24] Tallack, 'Christian positivism', 560; Midgley, 'Religion and science'; F. E. Fox, 'Science and religion'; Burgess, 'Causes of the conflict'. See also C. M. James, 'Of books and reading', 560–1.

[25] Pollard *et al.*, *Bootham School*, 75–6; see also *Natural History Journal and School Reporter*, 6 (1882), 136.

Like the schoolmasters in this anecdote, many evangelical Quakers closed their minds against the provocative ideas of evolution, simply affirming the truth of the Bible or resting satisfied with some convenient strategy to protect the biblical account of creation. Science, these evangelicals agreed, should be kept within strict limits, and scientists should not speculate beyond the evidence.

7.1.2 *Moderates and rebels*

In contrast to the evangelicals with their 'monster-barring' strategy, the moderates and dissidents tended to support evolution in the Quaker periodical press. Their defence of the theory should be understood not solely in terms of the theory's scientific credentials, but also as reflecting the contested nature of Quakerism during the closing decades of the nineteenth century. Radicals and moderates stressed the need for Quakerism to break out of its insular, evangelical mould and engage modern thought, which Darwin's theory symbolized. Moreover, when taken to mean progress and development in the organic realm, evolution cohered well with Quaker notions of social, moral, and spiritual progress. Like many contemporaries, these Quakers largely ignored the mechanism of natural selection but instead articulated a teleological and progressive notion of evolution.[26] By the century's end, evangelicalism had been ousted by a liberal, modernist form of Quakerism that easily encompassed evolution. Indeed, the proponents of innovation supported their cause by appealing to evolution in the organic world.

The late 1860s and early 1870s proved a crucial but fraught period in the slow emergence of a moderate brand of Quakerism, with the dominant evangelicalism provoking a range of responses. Most prominently, those with strong Unitarian leanings found themselves increasingly and often bitterly opposed to the evangelical majority. In the late 1860s, discipline broke down at the Hardshaw East Monthly Meeting, leading to a deep schism. Significantly, the epicentre of this rift was one of the new cultural organizations, the Manchester Friends' Institute, where a number of contentious topics were openly discussed, such as the controversial theological views propounded in *Essays and Reviews* (1860), and also possibly Darwinism. Some Quakers, including a number of weighty evangelicals from London, considered that the Institute posed a threat to Quakerism, and proposed that its activities should be curtailed. During the ensuing months the schism widened. Two of the leading dissidents, David Duncan and Joseph B. Forster, evoked the spirit of George Fox and Robert Barclay, who, they claimed, placed

[26] Bowler, *Non-Darwinian Revolution*, 47.

liberty and freedom of conscience far above strict adherence to the letter of Scripture. 'The worship of anything short of God, is idolatry', wrote Duncan, 'whether it be a golden calf or a modern Bible.' After various machinations involving local, Quarterly, and Yearly Meetings, some of these rationalists and Unitarians seceded in the early 1870s and formed their own church. In another conspicuous case, Edward Bennett (brother of Alfred) was disowned in 1873 for espousing Unitarian views.[27] While these radicals were separated from the Society, many of those with more moderate leanings remained connected with the main Quaker body, but often found themselves opposed to the leadership.

Under Forster's editorship, the *Manchester Friend* commenced publication during the final stages of struggle with the Yearly Meeting. During its two-year existence the *Manchester Friend* became the organ of a small number of radical and moderate Quakers, who, dissatisfied with the reigning evangelicalism, wanted the Society to return to the rational path associated with the writings of Penn and Barclay. Thus one contributor posited two traditions within Quakerism, one rationalist, the other more intuitive. Fox's writings had encouraged the latter strand, which resulted in the mysticism that currently dominated the Society. This 'essence of Mysticism', added the author, 'is the degradation of reason.... In degrading reason you degrade also its associate, truthfulness.... Theologians say religion begins with mystery, but we believe where religion ends, mystery begins.'[28] While extolling reason *per se*, many contributors to the *Manchester Friend* championed science as the most impressive product of reason. Huxley's writings were cited approvingly, and a number of modern, progressive scientific publications were enthusiastically reviewed, such as Max Müller's proposal for a science of religion, which would enable rationalists to discard those erroneous beliefs that all religions had inevitably accumulated during their history.[29]

In several articles evolution was advocated as one of the greatest achievements of the human intellect. The *Manchester Friend* therefore chastised the *British Friend* for dismissing Darwin's theory as a 'mere supposition... a chimera of the brain' and comparing it unfavourably with scriptural Truth. By contrast, added this Mancunian, 'Let us never dare to address the flood of God's knowledge, as Canute addressed the ocean, but rather rejoice in the dimmest rays of any candid scientific search, and trust that the revelation may

[27] F. Cooper, *Crisis in Manchester Meeting*. See Isichei, *Victorian Quakers*, 27, 61–5; Kennedy, *British Quakerism*, 47–94.

[28] Review by Jos. Atkinson, *MF*, 1 (1872), 136–9, 154–7, 168–70. In the second volume (1873) another contributor, writing under the pseudonym 'MYSTIC', argued with 'EXPERIMENTALIST' (viz. Atkinson) over the place of reason in Quakerism.

[29] *MF*, 1 (1872), 133–4.

grow ever brighter.'[30] Another contributor, the naturalist George Stewardson Brady, published his 'Thoughts suggested by Darwin's "Origin of species" ', in which he asserted that evolution applied not only to physical organisms but also to the human mind and spirit. Thus, he claimed, not only does human knowledge increase, but also our spirituality (a theme which, as we shall see, appealed greatly to moderate Quakers). Moreover, in reflecting on the notion of continuity and citing Darwin's account of the intellectual backwardness and lack of religion among the Fuegeans whom Darwin had encountered during his travels in South America, Brady suggested that such animals as dogs were higher on the evolutionary scale than were these most degraded of humans.[31]

A few years earlier, Brady had written a short anonymous essay in the 'Liberty' series published by F. Bowyer Kitto and entitled *Lumen Siccum [Arid Light]: An Essay on the Exercise of the Intellect in Matters of Religious Belief*, in which he criticized the many Friends who failed to recognize those 'current[s] of modern thought in science and literature' that threatened long-cherished Quaker beliefs and traditions. The Society, he argued, should not stubbornly ignore these developments, but should honestly confront the difficulties they raised. Quakerism had become too enmeshed in its own dogmas, and particularly in 'the mischievous dogma of one unerring and infallible Book'. Evoking what he saw as the rich tradition within Quakerism that encouraged freedom of conscience, he encouraged his fellow Quakers to use their reasoning faculties fully and to embrace science, which he declared was God's special gift to humankind.[32] Unlike Duncan and Forster, Brady remained a Quaker, albeit an outspoken one.

In contrast to the *Friend* and the *British Friend*, the *Friends' Quarterly Examiner* carried a number of articles dealing with the links between science and religion, and paid considerable attention to both Darwinism and John Tyndall's widely discussed 1874 Belfast Address.[33] While the short-lived *Manchester Friend* sought to alter the direction of British Quakerism, throughout an extended period a number of contributors to the *Friends' Quarterly Examiner* added their voices to the chorus for change. As E. B. Bronner has noted, this periodical became the moderates' main channel

[30] Ibid. 3.

[31] Brady, 'Thoughts suggested by Darwin's "Origin of species" '.

[32] [Brady], *Lumen Siccum*. This work does not appear to have been reviewed in either the *Friend* or the *British Friend*.

[33] Tyndall would probably have been known to many Quakers, because he had previously taught at Queenwood College, which was run by a Quaker, George Edmundson. Although not a Quaker school, many Quakers had supported the liberal educational aims of Queenwood, which was sometimes advertised in the *Friend*. See Brock, 'Queenwood College revisited', in Brock's *Science for All*; E. T. Bennett, 'John Tyndall'.

of publication.[34] Although, as noted above, the *Friends' Quarterly Examiner* carried four articles between 1870 and 1876 written by evangelicals wishing to preserve the integrity of Scripture by demarcating the boundary between science and religion, an increasing number of contributors enthusiastically welcomed science in general, and Darwinism in particular. Thus, in an article entitled 'The harmony of Christianity and science' (1870), Richard Westlake deplored the recent attack on science by the Dean of Carlisle, offering instead an irenic message that he considered more appropriate for Quakers. Far from castigating scientists and seeking to limit their researches, he even urged the extension of science to the discovery of laws governing the moral and spiritual domains.[35] Although Westlake's conciliatory approach made no attempt to engage the full thrust of Darwin's argument, he was appalled by the damaging controversies generated by Darwin's book. Likewise, an American writing in the *Friends' Quarterly Examiner* advised fellow Quakers not to become embroiled in the current warfare between science and religion, but rather to 'see if in all this chaos of conflict there are not some elements of possible concord'. This was the only appropriate position for Quaker pacifists.[36]

An increasing number of contributors also argued that Friends must not interpret the Bible in a literal and inflexible manner, but that greater weight should be given to the doctrine of the Inner Light. For example, the first issue of the *Friends' Quarterly Examiner* carried a dialogue written by the historian Thomas Hodgkin (II, 1836–1913), in which the protagonists reflected on William Grove's presidential address delivered before the 1866 meeting of the BAAS. Grove's theme had been 'Continuity', which was taken to specify the relation between humankind and the rest of organic creation. Hodgkin used his interlocutors to express opposing positions, especially over the implications of Darwin's theory for religion. *Hugh* was greatly impressed by the intellectual brilliance and explanatory power of evolution. Even if the theory were applied to humankind, he asserted, it would carry no atheistical implications. Indeed, claimed *Hugh*,

> I can truly say for myself, personally, that though my feelings as to my Maker have undergone a change since I embraced the Darwinian theory, that change is not one that I can regret. I used to look upon his creative work as long since ended, and to feel myself as separated from Him accordingly by long æons of time. Now I can see that He has never ceased to create, that He is still creating . . . The result is, not that I for a moment feel the Creator of the Universe made less distinct, but that I feel its Upholder brought immeasurably nearer to me.

34 Bronner, 'Moderates in London Yearly Meeting'.
35 R. Westlake, 'Harmony of Christianity and science'.
36 Pinkham, 'Religion and science', 339.

By contrast, *Arthur*, was disturbed by Grove's address and expressed his concern that the Darwinians were peddling covert atheism. As the dialogue unfolded, *Hugh* demonstrated that *Arthur's* worries were groundless. However, it should be noted that *Arthur* did not exploit any potential conflict between Genesis and Darwin's account. Instead (like Hodgkin), he interpreted the Bible historically, claiming that it 'is really God's own story of creation, but told through an unscientific messenger to a half-barbarous people'. Interpreted in this way, the Genesis narrative had to be kept entirely separate from modern scientific theories.

Only towards the end of the dialogue did the two interlocutors converge on the issue that worried Hodgkin. In pursuing science, the scientist could easily forget God and drift involuntarily into atheism—a recurrent theme in Quaker writing. Such a stance, asserted *Hugh*, was especially likely to mislead the lower classes. The dialogue therefore concluded with *Hugh* reading aloud a passage from Bacon's famous aphorism about atheism: 'A little philosophy inclineth man's mind to atheism, but depth in science bringeth men's minds about to religion.' However successful modern science might prove, Hodgkin believed that it did not undermine religion; nevertheless he warned that Quakers should be prepared to counteract any tendency to involuntary atheism by actively pursuing their own spiritual path.[37] Hodgkin's use of the dialogue form provided an informative medium for addressing the religious issues raised by evolution and for showing that, in his opinion, Quakers should espouse the theory of evolution, provided they held firm to their religious principles.

Other writers soon followed Hodgkin's lead in the pages of the *Friends' Quarterly Examiner*. In 1871 the botanist Alfred Bennett launched a far more trenchant defence of science, which was applauded by the *Manchester Friend* but attacked by the *British Friend*.[38] His strategy was twofold: after separating science and theology, he then argued that this division benefited both parties. Although he noted that theologians were not yet prepared to admit a limitation to the scope of the Bible, Bennett advocated that 'the Bible was not intended to teach us scientific truths respecting the Origin of Life'. Scriptural passages, he insisted, should not be recruited in opposition to Darwin's theory, but 'the doctrine of Evolution must rest on the same grounds as any other scientific theory, and be judged [solely] by the light of experience and knowledge'. Yet, he noted, the origin of life stood outside scientific analysis. However, if certain scriptural passages appeared to be contradicted by science,

[37] Hodgkin, 'Concerning Grove's inaugural address'.

[38] See *MF*, 1 (1871), 14; *BF*, 29 (1871), 281–3, and 30 (1872), 1–2. For Bennett's reply see *BF*, 30 (1872), 46–7.

then those passages must 'be understood in a metaphorical or oriental, rather than in a literal or occidental, sense'.

Bennett advocated the above strategy because it avoided the pitfalls that would result if the Bible were evoked either to support or to undermine any scientific theory. Such an inappropriate deployment could only detract from the precious spiritual message of the Scriptures and lead religion into disrepute. Moreover, the study of the natural world opened 'one of the richest sources of communion with God'. He had no doubt that students of science would recognize those biblical passages in which nature is evoked and would readily accept that God governs nature through laws. But Bennett was also clearly disturbed by those Quakers who argued that religious faith required the suppression of the human intellect. Instead, he insisted, the mind is 'the crown and glory of man himself', and as a divinely ordained gift, it must be employed to study the natural world. Like other Quaker writers, he believed that there could be no conflict between science and religion provided theology does not trespass beyond its proper sphere and scientific theories are adequately tested by the scientific method.[39]

A powerful new voice first joined the fray in 1875. Educated at Bootham (where he currently taught) and possessing BA and BSc degrees from London University, Silvanus Phillips Thompson adopted a much more sophisticated approach when he argued in the *Friends' Quarterly Examiner* that science was not a closed system of knowledge; instead (as noted in section 6.2), with each new discovery the scientist is confronted by a further set of questions. Science was therefore, to use Karl Popper's phrase, an 'unended quest'. To illustrate his argument, Thompson cited Darwin's theory, which, despite being hotly contested, had led scientists into new fields of enquiry, such as mimicry, the geographical distribution of plants and animals, and the history of human societies. In reviewing the history of science, Thompson conceived a close and symbiotic relationship between knowledge and mystery; with every gain in our knowledge of the natural world, new mysteries confront the researcher; in turn, by engaging the mysteries of nature, scientists are spurred on to increasing knowledge through further research. In this he was opposing the overly rationalistic account of science defended by the Manchester radicals. While not offering any simplistic bromide for divine design, Thompson saw in our ability to wonder 'a quality of mind bestowed upon man wisely and well'. It was this ability to transcend our knowledge and to marvel at the structure of the world that distinguishes man from beast and which 'seems inseparable from the phenomena of consciousness, and shares both their emotional and

[39] A. W. Bennett, 'Religion and science'. See also *Friend*, 14 (1874), 284–5, 313, for Bennett's comments on Tyndall's Belfast Address.

their intellectual aspect'. Here, then, we see Thompson portraying science not as a finished product, but as an ongoing, progressive process in which the creative mind plays a major role. He did not pause to ask whether Tyndall's views about matter, or Darwin's theory—or any other—was or was not compatible with religion. Instead, what concerned him was the way in which individuals expanded their consciousness through the pursuit of science. Science, thus viewed, manifested the Inner Light at work.[40]

Thompson's biographers recalled that he 'gradually began to feel—and his opinions were shared by others—that the Society of Friends during the seventies and eighties was drifting more and more into Methodism . . . while forgetting its ancient call to a mystical and inner religion'.[41] Thompson kept faith with Quakerism, deriving strength from traditions that were largely ignored by most of his contemporaries. Likewise, the young Lawrence Richardson (1869–1953) felt the deadening hand of religious conformity while growing up in Newcastle. He later recounted that while there was considerable discussion of the place of the Bible in Quakerism, 'the more vocal portion (but certainly not all) were laying great stress on the need for *belief* in Bible and creed; and for evident conversion—"you *must* be born again"'. Finding this creed untenable, Richardson revolted in his late teens and came close to resigning his membership.[42]

Yet the winds of change were beginning to blow, albeit rather gently. By the mid-1880s, a liberal form of Quakerism was in the ascendant, which during the next few years was to exert a profound influence on British Friends. The anonymous *A Reasonable Faith* (1884) and Edward Worsdell's *Gospel of Divine Help* (1886) were 'major catalyst[s] in the transformation of British Friends'.[43] The authors of the former work sought a 'reasonable and scriptural' response not only to the rising tide of atheism, but also to the over-dogmatic and credal understanding of Quakerism propounded by their evangelical contemporaries. Emphasizing the importance of holiness and the sources of 'light', they criticized those Quakers who viewed the Bible literally and dogmatically. By contrast, they interpreted the Bible historically and as a progressive revelation. While the spiritual truths of the Bible should be savoured, 'neither its science nor its history, nor even its language—should be regarded as specifically inspired'.[44] In adopting this position, these authors were responding to the

[40] S. P. Thompson, 'Mystery of nature'. Thompson also published a paper entitled 'Religion and science' in a non-Quaker periodical.

[41] Thompson and Thompson, *Silvanus Phillips Thompson*, 320.

[42] L. Richardson, 'Newcastle-upon-Tyne Friends'.

[43] Kennedy, *British Quakerism*, 102–18; Isichei, *Victorian Quakers*, 32–43.

[44] [Frith, Pollard, and Turner], *Reasonable Faith*, 98.

higher forms of biblical criticism and to developments in science, especially Darwinism. In the second edition of his book, Worsdell advocated 'that an evolutionary interpretation of outward nature may be true, and that in the records contained in the Old Testament there may be an admixture of the legendary, and the survivals from a previous heathendom'.[45] These reformers sought to diminish the role of the Bible and to re-emphasize the notion of the Inner Light, that had been such an essential aspect of the earlier quietist tradition. Their works formed the basis of the liberalizing movement that was soon to sweep through the Society of Friends and break the hold of evangelicalism. In charting these changes, historians have tended to undervalue the importance of science, and particularly the theory of evolution.

From 1886 onwards, articles began to appear in the *Friends' Quarterly Examiner* that accepted evolutionary theory as an unproblematic truth. George Stewardson Brady, who eighteen years earlier had chastised his fellow Quakers for ignoring recent scientific developments, contributed a paper on 'The modern spirit in the study of nature', in which he surveyed the immense changes that Darwin's book had initiated. With great clarity he presented to his fellow Quakers the ways in which botany, zoology, psychology, and anthropology had been revolutionized and enriched by insights gleaned from evolutionary theory. Each organism was no longer to be understood as a static structure designed by God, but now possessed a history: 'whatever may be the final object of the Creator, He works always according to law, and that whatever is beautiful has been made so, not capriciously, but by a process of development'. Science had provided a new understanding of the world, and one that 'may be regarded as God's special revelation to this age of the world'.[46] Reneging on the theory or questioning whether it was true were no longer viable moves; Quakers must firmly grasp the theory of evolution.

Brady found immediate support from John E. Littleboy, a corn merchant, who reviewed Henry Seebohm's *History of British Birds*. Compared with Brady's uncompromising espousal of Darwinism, Littleboy found Seebohm reticent, and criticized him for not enthusiastically accepting the theory of evolution.[47] Four years later, Henry Marriage Wallis reviewed Alfred Russel Wallace's *Darwinism* in highly complimentary terms.[48] Likewise, the young Leonard Doncaster, later to pursue a successful scientific career, contributed a dauntingly precocious essay in 1894 on Darwinism to the Essay Society of Leighton Park School.[49] The timing is significant, because the writings of

[45] Worsdell, *Gospel of Divine Help*, 8.
[46] Brady, 'Modern spirit'.
[47] Littleboy, 'History of birds'. See also *FQE*, 20 (1886), 417–18, and *idem*, 'Birds of our district', 30.
[48] Wallis, 'Darwinism'.
[49] S. W. Brown, *Leighton Park*, 70–1.

Brady, Littleboy, Wallis, and Doncaster formed part of a liberalizing wave that was sweeping through Quakerism in the closing years of the century. A far greater sense of toleration and intellectual freedom prevailed. Moreover, the moderates (later to be called 'liberals') viewed themselves as closer to the Dissenting spirit of the early Quakers, whereas the evangelicals aligned themselves with fellow evangelicals in the Established Church and among such denominations as Methodists.

Not only was evolution valued by some Quakers as a scientific theory, but a number of Friends also espoused evolution as a progressive social and historical force. Probably the most zealous example of this new synthesis between evolution and Quakerism was formulated by the surgeon Jonathan Hutchinson (1828–1913), for whom evolution, progress, and Christianity merged into a single optimistic *Weltanschauung*. Hutchinson, who first read the *Origin* soon after it was published, fully accepted the proposition that humans have evolved from lower animals over an extended period. Moreover, he claimed to have immediately recognized that its implications extended well beyond biology: he 'realized the tremendous liberation of mind that evolution effected—liberation for the service of mankind—and he openly taught it with all its implications; only trying to base the convictions of his hearers on a broad foundation of scientific fact; yet by no means overemphasizing the facts at the expense of their lesson'.[50] The 'lesson' he derived from evolution was that an intimate connection existed between biological and spiritual progress. The physical and spiritual aspects of humankind had evolved together.

For Hutchinson, evolution was neither atheistical nor pessimistic. Instead, he believed that it offered a new theistic key to the universe, and particularly to the place of humankind in it. In particular, he associated evolution with 'Heredity'—the process of historical accumulation within the human species through which it progresses and achieves immortality. The individual will die, but each life contributes to the immortality of our species. As he wrote to his wife in 1881:

> My mind is so imbued with it [the idea of permanence], that, when I am free from headache, I have scarcely the perception of such a thing as death, in any gloomy sense. The things that have been are the things that will be, there is no loss, but a steady gradual gain, a permanence of life, though not of individuals. The world gets itself new clothes, the same spirit but a new covering for it. Darwinism comes in, with its happy proof of gain, and demonstration of the laws under which progress and better adaptation to our world are matters of necessity: so I am thankful for my life, and thankful on the part of those who will follow me.[51]

[50] H. Hutchinson, *Jonathan Hutchinson*, 175.
[51] Jonathan Hutchinson to J. P. Hutchinson, 1881, ibid. 151.

This optimistic creed posited an evolutionary process by which friendship, love, and affection would conquer all negative feelings. Hutchinson raised the notion of moral improvement—so important to Quakers—into a long-term historical force affecting the development of *Homo sapiens*. As his son noted, this view of evolution 'enhanced [for Hutchinson] the Christian conception of the Divine fatherhood; it sanctified all human relationships; it gave new dignity to human life; it conquered death; [and] it scattered superstition to the wind'.[52]

Perhaps rather surprisingly, late nineteenth-century Quakers very rarely contemplated the social implications of the theory of evolution. As pointed out earlier, an evolutionary perspective was used by Thomas Hodgkin (I), who deployed an evolutionary perspective in 1844 when discussing the development of human societies.[53] Likewise, the writings of the anthropologist Edward Burnet Tylor (1832–1917), who resigned from the Friends in 1864, are strongly marked by his commitment to evolution. As he wrote in 1865, 'the wide differences in the civilization and mental state of the various races of mankind' are due 'rather [to] differences of development than of origin, rather [to] degree than to kind'.[54] In adopting this view, both Hodgkin and Tylor maintained a monogenist account of race that cohered with Quaker values. While monogenism seemed to support and be supported by an evolutionary perspective on humankind, other aspects of social Darwinism were generally overlooked.[55] Probably the most prominent exception was John William Graham (1852–1932), whom we have already encountered as one of the first Quakers to study mathematics at Cambridge. During his studies he underwent a severe crisis of faith, which was initiated in part by the failure of Quakers to address the problems generated by modern science, especially evolution. On several subsequent occasions, beginning with a paper he presented to the First Universal Peace Congress (1890), he addressed the thorny question of whether the theory of evolution legitimated warfare. As a pacifist, he felt obliged to respond to the oft-repeated argument that warfare aids the process of natural selection, since wars were often assumed to improve the human race by occasioning the survival of the fittest individuals and nations, while precipitating the death of the weaker. Although clearly prepared to accept Darwin's theory when applied to 'the conflict between

[52] Jonathan Hutchinson to J. P. Hutchinson, 1881, in *Jonathan Hutchinson*, 219. See also Jonathan Hutchinson, *Wisdom and Knowledge*.

[53] Hodgkin, 'On the progress of ethnology', 119, 126–8.

[54] E. B. Tylor, *Researches*, 372–6; Burrow, *Evolution and Society*, 240–59.

[55] On the diverse positions taken on the social implications of Darwin's theory, see Paul, 'Darwinism'.

individuals of the same race', he questioned its applicability to such large and complex social structures as nations. In a civilized nation the 'blind law of selection' is overridden by co-operation between its members, whose survival is enhanced by working together for the common good. Indeed, all social institutions, such as schools and hospitals, function in order to enhance the survival of individuals by ameliorating the natural struggle for existence. Thus in modern society Darwinian competition does not control the interpersonal interactions between individuals.

Graham likewise refused to align the conflict between nations with Darwin's theory. Taking a broad view of the survival of the fittest, he pointed out that belligerency is not synonymous with fitness. For example, both Armenians and Jews possessed impressive records of survival, but were not war-like peoples. To the contrary, he forcefully argued that 'militarism does not tend to survival'; rather, 'military states cultivate within themselves the germs of decay, and are certain to be left behind, off the main track of progress'. Thus, far from war aiding survival and the progress of human societies, it is actually regressive and anti-evolutionary. Instead, he considered that human survival and progress depended on co-operation; thereby the individual relegates his selfish instincts so as to increase the welfare of the whole community. However, the principal human instincts, Graham argued, were not hatred and conflict, but 'sympathy, a fellow-feeling with others, leading to public spirit, self-sacrifice, co-operation, and all that is mightiest in civilized life'. Thus, while he acknowledged that humans are impelled by competition, the evolution of civilization results in this drive becoming dwarfed by the opposing force of co-operation. Warfare may have been appropriate in an earlier phase of history, and may even have served an evolutionary function, but it was now inappropriate and represented an anachronistic survival from the past. With the further evolution of humankind, he looked forward to a continued decrease in warfare.[56]

Graham was one of the contributors to the 1895 Manchester Conference, which is generally taken as a milestone in the liberalization of the Quaker movement. One session was devoted specifically to 'The attitude of the Society of Friends towards modern thought', which provided a forum for engaging various contemporary themes in philosophy, politics, and science that Quakers had addressed insufficiently. The session was chaired by Thomas Hodgkin (II, the historian), who criticized those theologians who either tried to impede any scientific research that challenged their understanding of the

[56] Graham, *Evolution and Empire*, 1–21. For his earlier engagements with this topic, see *Friend*, 30 (1894), 216–22; *idem*, 'Lecture on evolution and war'; *idem*, 'War and the survival of the fittest'.

Bible or distorted their biblical interpretations in seeking accord with modern science. Such moves, he considered, were of no service to religion, and inevitably resulted in its disrepute. The problem arose because such diehards imposed an inappropriate notion of truth on the Bible. By contrast, Quaker tradition sanctioned a very different approach, and one that was both intellectually honest and preserved the integrity of Christianity. Hodgkin reminded his audience that, while revering its teachings, George Fox did not conceive of the Bible as the infallible word of God that had to be accepted as literally true. Christ's vital message to humankind did not depend on those passages that were 'spoken unscientifically in the childhood of the world by the unscientific Hebrew sage'. Instead, when the Bible was properly understood, it was perfectly compatible with the pursuit of science.[57]

The other main speaker at that session was Silvanus Phillips Thompson, then Principal of Finsbury Technical College, who entitled his talk 'Can a scientific man be a sincere Friend?' In this highly optimistic lecture he argued that modern science has generated new and important insights, like the theory of evolution, that contemporary Quakers must fully engage. Moreover, the critical method of science had proved very effective for discriminating between truth and falsity. Not swayed by doctrines and opinions that cannot be subjected to scientific test, the scientist, as portrayed by Thompson, was an ethically superior being who used his intellect to gain knowledge of real and lasting value. Doubtless responding to those Quakers, principally evangelicals, who sought to downplay the intellect, he stressed the need to use the power of reason fully and effectively. Since God had endowed humans with this faculty, it was sacrilegious to ignore it. Yet, like religion, science has its limits: 'Each process has its own sphere, each discovers its own kind of truth.' Although admitting a number of points of contact, he argued that problems arise when one 'process' invades the proper domain of the other.

Discussing the limitations of religion, Thompson criticized as scientifically untenable such widely received dogmas as those underlying the Eucharist and Baptism. He therefore welcomed those recent scientific developments that had helped to sift the spiritual pearls from the dross. 'But that which is divine truth', he added, 'modern thought will leave wholly untouched, or will touch only to confirm.' In contrast to other branches of Christianity, Quakerism was not weighed down with indefensible beliefs. Instead, with its emphasis on the Inner Light, it found its natural ally in science. Both could progress and flourish together; indeed, 'all that is true, all that is real, all that is vital, will

[57] Hodgkin, 'Relation of Quakerism to modern thought', 207–9. See also Creighton, *Life and Letters of Thomas Hodgkin*, 149–50, 325, 337, 341, 361.

remain, will prosper, will grow; and our growth in the truth will be all the more sure, because modern thought shall have cleared away so much that choked and hindered the clear in-shining of the Divine light of Christ in the soul'. Thus, in answer to the question he posed at the outset, he asserted that a scientist can indeed be a sincere Friend.[58]

In contrast to the years immediately following the publication of the *Origin*, when most Quakers expressed no interest in evolution and the few who did viewed it with suspicion, by the closing years of the nineteenth century many leading Friends deemed science, especially evolution, to be a natural ally of Quakerism. This alliance was mutual, for not only did such Quakers accept evolution as a legitimate scientific theory that was commensurate with their religious beliefs, but evolution (portrayed primarily as a progressive force) justified the newly emerging liberal sensibility, with its dual emphasis on progressive revelation and progress in its many forms—including the progress of the individual, of the Quaker movement, of society, of technology, and of scientific knowledge. As Kennedy has emphasized, at the centre of this 'Quaker Renaissance' was a firm reaffirmation of the Inner Light as the touchstone of Quakerism. The notion of the Inner Light—the 'continuous and abiding . . . indwelling of Jesus Christ in the soul', to quote Joseph Edmondson—not only provided the link to the seventeenth-century wellsprings of Quakerism but also offered a forward-looking perspective. In contrast to the view of most mid-century evangelicals that the Bible represented a rigid statement of creed that demanded unwavering adherence, a far more questioning and interactive attitude was required, which included subjecting the Bible to critical study. William Charles Braithwaite, for example, noted that 'once Christians [had] grasped that the Bible was an "expression of the divine with the help of the human . . ." the right understanding of progressive revelation would lead to a "moral perspective" rather than [to] an infallible creed'.[59] The renewed emphasis on progressive revelation appeared to many Quakers to be a necessary correlate of organic evolution. They viewed progressive, evolutionary development as applicable not only to species, but also to the individual, the Society of Friends, and to society at large. Indeed, progress, optimism, and evolution were intimately connected in the Quaker mind, and provided a common vocabulary linking science and religion. However, it is important to notice that none of these commentators fully accepted the distinctively Darwinian mechanism for evolution—natural selection.

58 S. P. Thompson, 'Can a scientific man be a sincere Friend?'

59 Kennedy, *British Quakerism*, 164–6, from which the passages from Edmondson and Braithwaite are also quoted.

7.2 Responses to evolution by Quaker scientists

The evidence deployed above has been drawn principally from discussions of Darwinism in the Quaker press. By concentrating on such publications, we limit our perspective to reflections that occurred within the context of the British Quaker community. However, Quaker scientists not only addressed other Friends but also participated in the wider scientific community. They pursued their researches in such areas as botany and entomology; they corresponded with other scientists; they participated in scientific societies, and they contributed to scientific journals and wrote textbooks. In this section we focus on these activities, drawing attention to three generations of naturalists.

First we examine those older naturalists who formed a circle round Edward Newman. Born at around the turn of the century, these evangelicals collected natural specimens and catalogued God's creation. But they kept Darwin's theory at arm's length.

By contrast, the naturalists to be discussed in the following subsection were born in the late 1820s or early 1830s and constitute a second, transitional generation. Some of these Quakers adopted a neutral attitude to Darwin's theory, but others supported Darwin's theory in their scientific writings, yet questioned whether natural selection was the only mechanism at work. These scientists were children at the time of the Beacon controversy and adolescents in the period of strong evangelicalism. Many of them were educated at Quaker schools, especially Bootham and Ackworth, where they gained a firm grounding in natural history. At the time Darwin's book was published in 1859, they were young botanists, already making their way in the scientific world. Many proceeded to teaching positions in the newly established colleges and universities. Several of these Quaker scientists enjoyed friendly working relationships with Darwin.

Finally, we encounter a third generation, born after the mid-century and educated at Quaker schools. Although some members of this cohort paid little attention to evolution, those who did generally adopted a pragmatic attitude, accepting evolution as the best scientific theory available to the practising naturalist. This attitude was particularly apparent in the *Natural History Journal* (founded in 1877).

7.2.1 *The Newman circle*

By the time the *Origin* was published in November 1859, Edward Newman (1801–76) and his close Quaker associates—including the tea merchant William Bennett (who bred ostriches), the banker Thomas Corbyn Janson, Henry

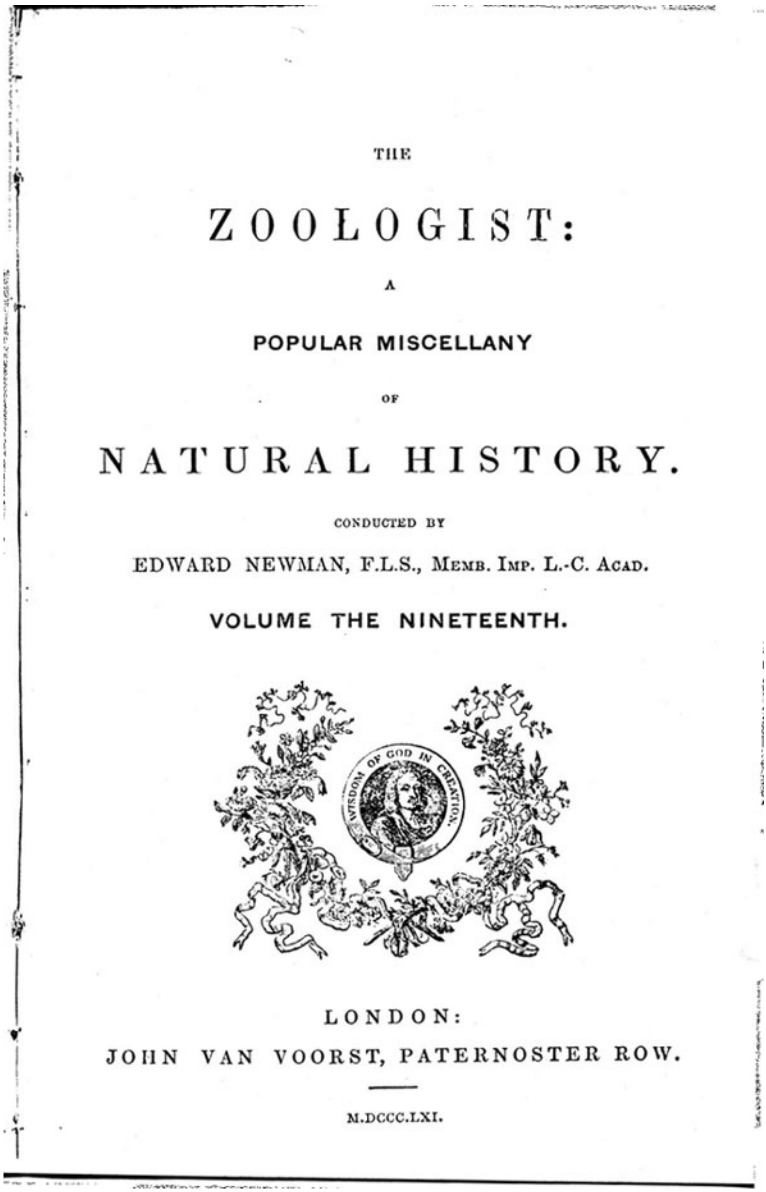
Doubleday, and the draper William Doubleday King—had been researching and publishing for three or four decades.[60] Although Newman earned his living primarily from writing on natural history, none of the surviving Newman circle held a teaching position. The group's scientific activities can be gleaned from the pages of Newman's *Zoologist*, which was devoted principally to observations and exact descriptions of specimens, with comparatively little attention to theory. As the testimonial presented to Newman in 1861 asserted, 'The "Zoologist" has become *a repertory of facts*, on one department of Natural History, at once valuable as voluminous.'[61] Likewise, in his preface to the first (1844) volume of the *Phytologist*, Newman asserted that the 'Phytologist owes its existence to the desire of preserving FACTS, OBSERVATIONS and OPINIONS relating...especially to British Botany'. He conceived this new venture as appealing to field botanists, but considered that it would be thought of as 'too trifling' by 'those of high scientific pretensions'. At least 10 per cent, and probably closer to 15 per cent, of the contributors to this first volume were fellow Quakers. 'My motto', he wrote in a later volume, 'has ever been "the smallest contribution thankfully received", and on this principle have I uniformly acted, accepting with eagerness the humblest addition to the stores of science. I firmly believe that this is the true principle of progress.'[62] The title-pages of both periodicals also indicate a motif to which the Newman circle readily subscribed; a portrait of the seventeenth-century naturalist John Ray appears inside a floral design surrounded by the text 'WISDOM OF GOD IN CREATION' (Fig. 7.1). Like Ray, Newman conceived of the organic world as God's creation, constituting a natural order that manifested God's providence.

The clientele for Newman's *Zoologist* and *Phytologist* consisted principally of amateur collectors, who prided themselves on knowing and naming the animals, and often plants, in their neighbourhood. A few had travelled further afield. They sought possession of specimens of each variety. Their cabinets overflowed with specimens, each variety and species unambiguously labelled with its proper Latin name, date, and place found. Their knowledge of local habitats was awesome. The joy of natural history was to appreciate the diversity of nature; the teeming varieties of birds, butterflies, or insects that God had created. Collection was an end in itself, and few who possessed this mentality could simultaneously theorize deeply about the nature of species.

[60] A number of Quakers contributed to the *Phytologist* and the *Zoologist*, including Edward Doubleday (1810–49), who served from 1841 to 1849 as assistant in the Zoological Department of the British Museum. Also, several Quakers subscribed to Newman's testimonial: *Zoologist*, 19 (1861), 7458–9.

[61] *Zoologist*, 19 (1861), 7457–60; emphasis added.

[62] *Phytologist*, 1 (1844), p. v; 3 (1848), p. viii.



THE

ZOOLOGIST:

A

POPULAR MISCELLANY

OF

NATURAL HISTORY.

CONDUCTED BY

EDWARD NEWMAN, F.L.S., MEMB. IMP. L.-C. ACAD.

VOLUME THE NINETEENTH.

WISDOM OF GOD IN CREATION.

LONDON:

JOHN VAN VOORST, PATERNOSTER ROW.

M.DCCC.LXI.

Fig. 7.1. Title-page from Newman's *Zoologist*, 19 (1861), which includes a portrait of the eminent naturalist John Ray and the phrase 'Wisdom of God in Creation'. Ray's *The Wisdom of God Manifested in the Works of the Creation* was first published in 1691, and passed through many editions. Reproduced with the kind permission of Leeds University Library.

As the biographer of Henry Doubleday remarked, he was ‘a penetrating observer [but] had no great scientific endowment’—meaning that his ability to theorize was limited.[63] Although many contemporary and subsequent naturalists adopted this perspective, it no longer reflected the cutting edge of science by the 1860s. Yet, its practitioners rightly insisted that they were making serious contributions to science by gathering specimens, describing them carefully, and setting them within a static taxonomic scheme, usually Linnaeus's, although Newman was also attracted to the classification scheme of the naturalist William Swainson. Moreover, through their labours they were adding further substance to the argument that the natural world was providentially designed.

In 1861 the *Zoologist* carried Newman's extensive review of the third edition of the *Origin*. Recognizing the intellectual sweep of the *Origin* and the judicious way in which Darwin confronted any problem that his theory encountered, Newman generously praised Darwin's competence and reputation as a naturalist. He was also quick to dismiss an unsatisfactory work by one of Darwin's opponents who had sought to undermine the *Origin* by arguments that were manifestly inadequate. Yet, while granting that Darwin's position needed to be taken seriously, Newman devoted much of this review to criticizing evolution. His main criticisms were based on the conviction that the Creator had employed architectonic principles to mould all organic beings according to a consistent providential plan. Resemblances were therefore to be found throughout nature. To stray from this perfect design by artificial selection would introduce variations that could not withstand the struggle for existence. Indeed, as breeders had shown, although deviations from naturally occurring species could be introduced, they were usually weak and were lost within a few generations. Likewise, in the wild, variations that strayed from natural forms could not survive. Hence, although Darwin's theory was plausible, it ‘is not compatible with our notions of [a special] creation as delivered from the hands of the Creator’.

In the concluding pages of the review, Newman directed a further and damning criticism against the theory of evolution. Although Darwin had carefully avoided committing himself on the crucially important issue of creation, Newman read his theory as inevitably implying a ‘clash with Revelation’. The citation of passages in which Darwin had portrayed the development of species naturalistically, as opposed to the result of special creation, only confirmed Newman's reading. ‘We must confess’, he wrote, ‘these passages pain us.’ Nor could he gain any solace from Asa Gray's attempt to show that natural selection was commensurate with natural theology. While the

[63] Mays, *Henry Doubleday*, 64.

American botanist had avoided any consideration of revealed religion, the evangelical Newman clearly perceived that evolution was opposed to the biblical narrative.[64]

One of the few clues to the attitude of the lepidopterist Henry Doubleday (1808–75) to the theory of evolution is provided by a letter written in 1871. Here he recited a litany of complaints against Otto Staudinger's recently published catalogue of lepidoptera, including his regret that Staudinger had 'adopted Mr. Darwin's notions about species'. The problem for taxonomists was that an evolutionary perspective undermined the notion of essentially distinct biological species. Instead, from an evolutionary standpoint, the definition of species became partly a matter of convention; moreover, evolutionary theory encouraged taxonomists to view certain examples that had previously been thought of as distinct species as merely different varieties of the same species. Staudinger acknowledged the force of Darwin's argument, and was prepared to recognize varieties in certain cases where Doubleday saw distinct species. Thus Doubleday rejected an important practical implication of Darwin's theory. Whether he likewise rejected other aspects of evolution is not known. However, like other members of the Newman circle, Doubleday was clearly anxious to maintain the traditional Linnaean-based system of classification which Darwin's theory had rendered increasingly problematic.[65]

Doubleday had corresponded amicably with Darwin before the publication of the *Origin*. Thus, in 1857, while writing his chapter on 'Variation under nature', Darwin obtained from Doubleday a number of butterflies and also much information. Later, they corresponded on primroses, oxlips, and cowslips. In a letter of 3 May 1860, Doubleday indicated that he had been reading 'with real pleasure your very interesting work', and expressed his intention of sending Darwin some comments.[66] However, he does not appear to have communicated his views to Darwin. Indeed, the absence of subsequent correspondence suggests a divergence of views.

Given the extensiveness of Darwin's correspondence, it is surprising that, despite his detailed knowledge of the animal kingdom, Newman was not among Darwin's regular correspondents. Moreover, Darwin did not send a presentation copy of the *Origin* to Newman or a review copy to the *Zoologist*.[67] Darwin was likewise less than enthusiastic when invited in 1861 by Newman's friends to contribute to his testimonial fund. While admitting

[64] E. Newman, review of *Origin of Species*.

[65] Mays, *Henry Doubleday*, 79; Staudinger and Wocke, *Catalog der Lepidopteren*, pp. xxii–xxiii. See also McOuat, 'Species, rules and meaning'.

[66] Henry Doubleday to Darwin, 3 May 1860, in *Correspondence*, viii. 184–5.

[67] *Correspondence*, vii. 533–6, ix. 420–5. Darwin did send a copy of Asa Gray's review of the *Origin* to the *Zoologist*; see *Correspondence*, ix. 395.

that 'naturalists are under a great debt of gratitude to him for organizing the collection of a vast amount of information & valuable facts connected with Natural-History', Darwin refused to contribute, on the grounds that other naturalists had equal claims to such an honour.[68] However, it is clear that neither Darwin nor his adjutants, such as Thomas Henry Huxley and Joseph Dalton Hooker, rated Newman's scientific attainments highly. Newman and the other Quaker naturalists of his generation were not part of the new group of élite naturalists that were steering natural history into exciting but dangerous territory.

7.2.2 *Silent systematists*

Although many contemporaries acknowledged that Darwin's theory was a profound contribution not only to science, but to thought in general, it would be wrong to assume that all scientists were impelled either to support it or reject it. Among those who continued their practical researches largely untouched by the intellectual ferment surrounding Darwin were a number of systematic botanists, including two key figures from the second generation of Quaker naturalists—John Gilbert Baker (1834–1920) and Daniel Oliver (1830–1916), who both worked at Kew Gardens.[69]

Baker grew up in Yorkshire, and attended Ackworth and Bootham, where he curated the herbarium of the Natural History Society. His first scientific papers were produced in his late teens, and at the age of 20 he published *A Supplement to Baines's Flora of Yorkshire* (1854). Five years later he became the organizing genius behind the Botanical Exchange Club, which served the needs of a large circle of amateurs, but ceased operating after fire swept through its premises in 1864. Although he was appointed first assistant keeper at the Kew herbarium (1866–90; later keeper) and lectured for many years at both the London Hospital and Kew Gardens, he displayed little intellectual sympathy with Darwin. His researches were not significantly changed by the appearance of Darwin's book. Many of his publications, such as his 'Revision of the nomenclature and arrangement of the Cape species of Anthericum' (1872), were concerned with systematics, and were directed to arranging and describing plants. But he did not employ Darwinian terminology and kept the theory of evolution at arm's length.[70]

68 George Maw to Darwin, 15 Mar. 1861, in *Correspondence*, ix. 55–6; Darwin to Maw, 17 Mar. 1861, in *Correspondence*, ix. 56–7.

69 Baker explained the purpose of Kew to fellow Quakers in a paper delivered at the Westminster Meeting House on 26th day, 1st mo., 1886, and subsequently published: 'On Kew Gardens'.

70 Baker, 'Revision of the nomenclature'.

One of Baker's research interests was the global distribution of species. Thus, in an address to the 1855 meeting of the BAAS, he considered the distribution of British plants in relation to geology, especially the permeability of rocks. Each species, he admitted, possesses a specific range of adaptability, while many species 'can adapt themselves, more or less decidedly', to different lithological regions. Twenty years later, in his *Elementary Lessons in Botanical Geography*, he sought to document the ways in which heat, moisture, and human intervention had been responsible for the geographical distribution of different species of plant. Although the topic was potentially amenable to a Darwinian explanation, he was unwilling to appeal to natural selection. Thus, when discussing representative types, he asserted that 'most botanists' would now assume that they had a common ancestor but 'diverged gradually through living under different climatic conditions'. Tantalizingly, he concluded his discussion of representation by claiming that it 'furnish[es] another strong argument in favour of the theory of evolution'; however, his explanation owed more to Lamarck than to Darwin. Adaptability of species to specific locales continued to be his main theme, and thus he ignored notions like competition and natural selection.[71] Other indicators of Baker's distance from Darwinism were the lack of correspondence with Darwin and also the absence of the names of leading Darwinians from his Royal Society certificate when he was elected in 1878.

Among Quaker botanists, none was closer to Darwin than Baker's neighbour and colleague Daniel Oliver. Born at Newcastle in 1830, he attended the Quaker school at Wigton, but refused to enter business, which was 'utterly distasteful to him'. Instead, he was determined to pursue his enthusiasm for botany. It is said that he 'became somewhat of a strict Friend [during his early manhood], but he [subsequently] entirely threw over such rigidity, though to the spirit of truth and freedom he remained firm', indicating that he moved from an evangelical to a more moderate position. His early botanical publications were rewarded by membership of both the Edinburgh Botanical Society and the Linnaean Society. Beginning in 1851, he lectured in botany at Durham Medical School, but his career took a dramatic turn in 1858 when, after writing to Sir William Hooker about the possibility of joining a surveying expedition, he was invited to join the staff of the herbarium at Kew. At the invitation of Joseph Dalton Hooker, the Assistant Director at Kew, he performed cross-breeding experiments on Darwin's behalf, and they were soon engrossed in a lengthy correspondence. Both naturalists carried out experiments on the mechanism of drosera, and exchanged notes and specimens. Darwin was clearly impressed by Oliver's abilities as an experimenter, and

[71] Baker, *Flowering Plants*; *idem*, *Elementary Lessons*, 94–6.

considered him very well-informed on botanical subjects: 'What a wealth of knowledge you have!', wrote Darwin.[72] When the chair of Botany became available at University College London, Darwin recommended Oliver:

> I have been quite impressed at the range of his knowledge on facts buried in all sorts of foreign publications. I have been even more impressed at the philosophical caution he has shown in sifting the evidence on certain points laid before him, & in suggesting new experiments.[73]

In 1860 he was appointed to the professorship, which he held for the next twenty-eight years.

As with Baker, much of Oliver's scientific output was devoted to describing and classifying specimens. From 1861 he became the botanical editor for the *Natural History Review*, and contributed papers, reviews, and bibliographical essays. As he wrote to a friend, the bibliographical section has 'occupied me so. We propose to give the titles & brief discussions of all worth-while papers published in our respective departments. . . . This part of the new work ought to be useful to working Naturalists.'[74] The newly constituted editorial board, which also included Huxley and John Lubbock, endeavoured to breathe life into the *Review*. In 1864 Oliver was appointed Keeper of the Kew Herbarium and Library, a position he held until his retirement in 1890. During a period of over thirty years he worked tirelessly in tending, studying, and classifying the botanical collections sent from all parts of the world. As one contemporary noted, 'Probably no one man ever knew so much as he of those aberrant types which puzzle the most experienced botanists.'[75] He published some fifty papers in scientific journals, mostly descriptions of new and interesting species that he curated at Kew. His main publications, which included the first three volumes of the *Flora of Tropical Africa* (1868–77) and the *First Book of Indian Botany* (1869), likewise contained an abundance of detailed botanical information. Elected to the Royal Society in 1863, he received the Society's Royal Medal in 1884 for 'his Investigations in the Classification of Plants, and for the great services which he has rendered to Taxonomic Botany'.[76]

It is surprising that none of Oliver's books and articles that I have examined contains any discussion of the theory of evolution. It is not mentioned in his syllabus of lectures at University College, nor in the course for women he delivered at the South Kensington Museum in 1870. Nor does he appear to

[72] Darwin to Daniel Oliver, 21 Sept. 1860, in *Correspondence*, viii. 375–6; Darwin to Oliver, 23 Oct. 1860, in *Correspondence*, viii. 442.

[73] Darwin to William Sharpey, 28 Oct. 1860, in *Correspondence*, viii. 448.

[74] D. Oliver to Henry [Brady?], 17 Nov. 1860, MS Portfolio 27/36, LSF.

[75] W. B. Hemsley, cited in *Journal of Botany*, 55 (1917), 91.

[76] CM, 6 Nov. 1884.

have considered evolution relevant to his taxonomic researches. Thus he acknowledged that in writing his *Flora of Tropical Africa* he had followed the schemes of William Hooker, Alphonse de Candolle, and George Bentham.[77] Another point of contact with Darwin was Oliver's 1862 paper criticizing Oswald Heer's 'Atlantis hypothesis', according to which Europe and America were joined during the Miocene period. As Oliver pointed out, the distribution of many botanical species militated against this thesis. He not only cited the *Origin*, but received encouragement from Darwin: 'I am glad to hear from Hooker that you are going to consider O. Heer: his Atlantis-map seems very wild.—The view, which I give in [the] Origin of migration by north during old warmer period seems to me much simpler & agrees better with geological facts.'[78] However, their consensus on this issue appears not to have extended to the theory of evolution, on which Oliver remained silent.

These two leading Quaker botanists were apparently unwilling to deploy in their botanical researches the theory of evolution by natural selection.[79] They were primarily observers and classifiers of specimens; indeed, they were among the most skilled and knowledgeable systematic botanists of their generation. Yet they paid little attention to high-level theory of evolution by natural selection.

7.2.3 *Judicious supporters of evolution*

As noted above, those Quakers who supported evolution tended to be moderates who perceived the need for the Quaker movement to engage significant developments in contemporary thought. However, while championing organic evolution in Quaker periodicals, some of these writers adopted a significantly different stance when writing in the scientific press for a non-Quaker audience. Although they acknowledged that natural selection was an important factor in shaping species, they repeatedly argued that it was not the only mechanism, and that some other factor (or factors) was also causally relevant. Several of their criticisms appeared in the journal *Nature* (founded in 1869), that most innovative venture in Victorian science publishing. This cheap, quarto-sized, secular weekly offered its readers accessible accounts of contemporary news and developments in science. In his exposition of its early history, A. J. Meadows attributes the success of *Nature* to the combination of Norman Lockyer's firm and visionary editorial control and the backing and

[77] Oliver, *Notes on Ten Lectures*; *idem*, *Flora of Tropical Africa*, i. p. vi.

[78] Darwin to Oliver, 5 Oct. 1860, in *Correspondence*, viii. 411–12; Darwin to Oliver, 30 Nov. 1861, in *Correspondence*, ix. 355–6. See Oliver, 'Atlantis hypothesis'.

[79] It may also be significant that, unlike the Quaker naturalists to be discussed in the next section, neither Baker nor Oliver published on the relationship between science and religion.

expertise of Macmillan, the publisher. While there is no doubt that Lockyer was the main mover, he was assisted by several other scientists, including Alfred Bennett, who served from 1869 to early 1873.[80] Having previously worked as a publisher, edited the *Friend*, and gained a science degree from London University, Bennett was well suited to this position.

Several of the articles on evolution that appeared in the first five volumes of *Nature* were written by three Quakers—Bennett, George Stewardson Brady (1832–1921), and Edward Fry (1827–1918). Although I have not located any evidence to show that these Quakers orchestrated their contributions, Bennett's role as co-editor and the similarities between their arguments raise the possibility that some collaboration existed. The first in this sequence was a short contribution to the 8 September 1870 issue written by Brady, who directed the attention of readers to the phenomenon of mimicry. Mimicry indicated that a species could adapt itself to its environment in order to gain protection against predators. The example of stick insects was well documented, but Brady identified two further examples of camouflage by marine creatures. One was a small starfish from the Firth of Clyde that appeared almost indistinguishable from the seaweed in which it lived; the other was the protection offered to the fragile shellfish *Lima Hians* by its well-camouflaged nest.[81]

Although this contribution to *Nature* indicates Brady's support for Alfred Russel Wallace's discussion of mimicry, and thus for some interpretation of the theory of evolution, a rather more nuanced position emerges from the Presidential Address he delivered before the Tyneside Naturalists' Field Club a few months later. Here Brady explicitly upheld Darwin's theory as a crucial scientific innovation. However, he added that 'almost all naturalists' concur that natural selection,

> though it may or may not have been the most powerful factor in the production of new species, must at least have exerted an influence by no means insignificant. And, in justice to Darwin and Wallace, it must be remembered that neither of them claimed for the principle the sole agency in the process: both have indeed distinctly recognized that the probable existence of other, at present unrecognized, but doubtless highly important directing and controlling influences.

Brady was particularly sympathetic to Wallace's argument that natural selection by itself was not adequate to account for human evolution, because the

[80] Meadows, *Science and Controversy*; MacLeod, 'Genesis of *Nature*'; *idem*, 'Social framework of *Nature*'. See also John Dalton Hooker to Darwin, 28 Nov. 1872, in *Calendar*, 8561; Alfred W. Bennett to Darwin, 16 Mar. 1873, in *Calendar*, 8811. Bennett was sometimes described as the co-editor of *Nature*.

[81] Brady, 'Note on some instances of protective adaptation'.

human brain is highly developed. Thus, while an enthusiastic supporter of evolution, Brady added the significant caveat that some other causal mechanism operated in tandem with natural selection.[82]

At the BAAS meeting held in Liverpool in late September 1870, Bennett presented a paper, subsequently published in *Nature*, in which he readily accepted the general theory of descent, but likewise criticized the mechanism of natural selection as inadequate for explaining all instances of organic change. He highlighted Wallace's example of a particular species of *Leptalis* that is almost indistinguishable from a completely separate species of butterfly. Although this example of mimicry had been offered as an exemplary case of natural selection, Bennett argued that a major problem arose in postulating a slow transition from the normal species to this uncommon form of *Leptalis*. The difficulty lay in accounting for the first few generations, since changes in the direction of the uncommon species would be so small, and of no advantage to the species, that they would themselves be eliminated by the process of natural selection. (This objection was raised by Newman in his 1861 review of the *Origin* in the *Zoologist* (see above).) Hence, argued Bennett, natural selection had to be supplemented by some other principle; in particular, he conceived that variation was not random but possessed preferential directions for development.

Bennett's final argument may reflect his religious commitments. Drawing again on an argument articulated by Wallace, he noted that instinct appeared to play a significant role in the development of mimicry. Indeed, 'the power of mimicry' seemed to be paralleled by the degree of development of the nervous system. This line of argument led Bennett to consider the role of 'an unconscious Organizing Intelligence' which, by being impressed on organic variability, supplemented and empowered natural selection. Thus he envisaged that 'the instinct of animals should . . . assist them to modify their bodies, by slow and gradual degrees, so as to adapt them to the circumstances with which they are surrounded'. This reintegration of instinct into organic development enabled him to save some notion of intelligent design in the physical world, although he was highly critical of those earlier writers who used the notion of design to displace all attempts to discover the laws of organic development.[83] This intervention did not, however, impress Darwin, who complained to Wallace that he could not understand why Bennett had evoked the action of mind in explaining the modifications in plant structure.[84]

82 Brady, 'Address'.

83 A. W. Bennett, 'Theory of natural selection'. See also Hooker's reply in *Nature*, 3 (1870–1), 49–50, and Bennett's rejoinder, ibid. 171.

84 Darwin to Alfred Russel Wallace, 22 Nov. 1870, in Marchant, *Alfred Russel Wallace*, i. 253–4.

Early in 1871 the Catholic comparative anatomist St George Jackson Mivart published his *Genesis of Species*, which challenged the central role attributed by Darwin to natural selection. This was the most sustained attack by a contemporary scientist that Darwin's theory had faced, and one that wounded Darwin deeply. In reviewing Mivart's book in *Nature* a few weeks later, Bennett upheld some of Mivart's specific objections to the efficacy of natural selection. He claimed that Darwin and Wallace had proposed a mechanism which, they contended, accounted for the evolution of all animal and vegetable forms 'from one or a few primordial germs'. However strong the evidence in favour of natural selection, Bennett asserted that this was an injudicious claim, and one that Mivart had forcefully challenged. In insisting that this issue was still unresolved, Bennett placed the ball firmly in the Darwinian camp, and called for the development of alternative theories—especially concerning the role of intelligence—that would better explain specific phenomena than did natural selection.[85]

The third member of the trio, Edward Fry, later related that in 1861, when he first read the *Origin*, he was filled 'with critical apprehension no less than eager delight'.[86] A decade passed before he made public his 'apprehensions' in a letter published in *Nature* a few weeks after Bennett's review of Mivart. Fry argued that on simple mathematical considerations, natural selection, by itself, was not adequate to produce significant changes in species. While accepting that natural selection operated in nature, Fry insisted that other factors must also be operative. In particular, he argued that variability must be taken into account, provided that specific modes of variability were endowed with greater force. This seemed to be confirmed by the existence of parallel classes and subgroups in both placental and marsupial quadrupeds. Likewise, argued Fry, the three main groups of *Quadrumana* displayed similar parallelisms, thus suggesting that similar forces were operating in the variability found in each group.[87]

A year later Bennett reviewed for *Nature* the sixth edition of the *Origin*, in which Darwin responded to his critics, particularly Mivart. While he recognized Darwin's success in resolving some of these problems, Bennett still adhered to the objection he had raised at the 1870 BAAS meeting: that in explaining mimicry, natural selection by itself appeared incompetent in accounting for the initial stages. He fully recognized the monumental contribution that Darwin's book had made to modern thought, and regretted that its sales were far lower than many popular works that added not a jot to

[85] A. W. Bennett, 'Genesis of species'.
[86] A. Fry, *Memoir*, 63. See also E. Fry, 'Darwinism and theology'.
[87] E. Fry, 'Variability and natural selection'.

human knowledge. Thus, while not underestimating the importance of Darwin's theory, he noted that 'each succeeding edition of the "Origin of Species" lessens the distance between Mr. Darwin and those [like himself] who believe that the influence of natural selection, though a *vera causa*, had been overrated as an element in the evolution of species'. Along with natural selection, some other force, relating to 'spontaneous variability', was increasingly being acknowledged.[88]

Following the publication of this review in *Nature*, Darwin wrote to Bennett: 'I thank you sincerely for your generous review of the last. Edit. of the Origin, more especially as we differ so greatly & I quite agree with you that the only way to arrive at the truth is to discuss & freely express all differences of opinion.' Although Darwin here emphasized their disagreements, Bennett should be seen not as a dogmatic opponent of evolution, but rather as a critical supporter. A similar letter followed Bennett's 1875 'magnificent Review in Nature' of Darwin's book on *Insectivorous Plants*.[89] Over the next few years they exchanged several friendly letters.

We thus encounter three Quaker naturalists who, while voicing no objection to the transformation of species or to the mechanism of natural selection, nevertheless repeatedly stressed that other factors must also be responsible for shaping species. Although they were not alone in adopting this view, it appears that these Quakers found this position congenial for several reasons. It avoided the extreme positions adopted both by dogmatic evolutionists and by their equally determined detractors. Instead, they articulated a thoughtful middle position that preserved their individual integrity and enabled Brady, Bennett, and Fry to remain respected members of the scientific community. Thus, when Brady was elected to the Royal Society, Darwin was one of his signatories, while Huxley supported Fry's candidature.[90] Second, Bennett, Brady, and Fry readily accepted that species were not fixed, but that evolution had occurred. This view was widely shared by many moderate Quakers of their generation, and, as noted above, it cohered with the emerging opposition to the dominant evangelicalism within the Quaker movement, being instead commensurate with the notions of progress and progressive revelation. Third, in insisting that natural selection was insufficient, these Quakers considered that some non-material agency—perhaps mind or will—was also

[88] A. W. Bennett, 'Darwin's "Origin of Species"'.

[89] Darwin to Alfred W. Bennett, 29 Feb. 1872, in *Calendar*, 8227. See also Bennett's review of Darwin's book on insectivorous plants in *Nature*, 12 (1875), 206–9, 228–31, and Darwin to Bennett, 12 July 1875, in *Calendar*, 10074.

[90] Certificates EC/1883/17 and EC/1882/06, RSL. Brady was elected 8 June 1882 and Fry on 13 Dec. 1883. Bennett was not considered for a Fellowship.

at work in the physical universe. Thus, by adopting a more Lamarckian account of evolution, they expressed their opposition to the increasingly prevalent philosophy of materialism. Fourth, although they did not criticize natural selection in public for its potential to legitimate conflict among humans, they may have found the concept incompatible with Quaker pacifism.

Finally, it should be remembered that, as noted earlier, Newman considered that 'our notions of [a special] creation as delivered from the hands of the Creator' implied that organisms were constructed on certain architectonic principles that enabled them to survive. A similar point was made by Fry, whose initial scientific explorations had been in zoology. Thus he came under the influence of Georges Cuvier, Lorenz Oken, and Richard Owen, and attended the zoology lectures of William B. Carpenter at the Bristol Institution. From his mentors he learned that 'each given specific form is the resultant of two forces—the archetypal idea and the final cause or the adaptation to the environment'. While the latter could readily be assimilated to evolution, the former could not, since it required that a unity of form exists throughout all creation. Moreover, while not denying that many natural phenomena could be understood in material terms, Fry was highly critical of any reductionist philosophy of materialism, and insisted that 'in nature there speaks to me a spiritual being'. His own researches into mosses and, later, mycetozoa confirmed this conviction. It is not known whether Bennett and Brady would have agreed with him, but Fry viewed Darwinian natural selection as incomplete, because it omitted the spiritual and the archetypal which he, as a Quaker, accepted as a crucial aspect of God's creation. Even in his final contribution to the subject, dating from 1902–3, he sided with Lord Kelvin and other physicists who argued against those geologists and biologists who stipulated an exceedingly old earth (which would allow very slow geological and biological changes to occur). Against Darwin, Fry mustered a number of botanical arguments in favour of rapid changes in species, citing Mivart and Bennett's 1870 *Nature* article.[91]

Bennett, Brady, and Fry were clearly uncomfortable with the robust version of evolution by natural selection that was supported by a number of contemporaries, including such agnostics as Huxley and John Tyndall, who espoused evolution as a scientific creed. Instead, they adopted a less dogmatic and more open approach, thus exemplifying the Quaker attitude to scientific theories discussed in the previous chapter.

[91] A. Fry, *Memoir*, 32, 159. See also E. Fry's later writings, especially 'On the utility to flowers of their beauty'; 'Theology and materialism'; 'Age of the inhabited world'.

7.2.4 *Later Victorian Darwinians and the* Natural History Journal

At a meeting held at Bootham in 1882, attended by such scientific luminaries as John G. Baker, Silvanus P. Thompson, and Alfred Bennett, Robert Miller Christy pointed out that Darwin's works were not in the school library. William Newbould, a botanist and Anglican cleric who was present, came to the rescue, and offered the library a copy of the *Origin*.[92] Two years later, a meeting of the Old Scholars' Association considered how to mark the fiftieth anniversary of the Natural History Society. James E. Clark, who taught at the school, suggested that a copy of a recent etching of Charles Darwin would be a suitable gift. 'After a lively discussion of the work and character of Charles Darwin by H[enry] M[arriage] Wallis who had seconded the resolution, and E[dward] Grubb, MA, the proposition was carried unanimously.' At the subsequent presentation ceremony, Joseph Rowntree dilated on the importance of Darwin in subjecting natural history to the reign of law.[93]

These two vignettes reflect the uncertainty of some late Victorian Quakers about how to react to Darwin's theory. Yet, by the early 1880s, there was little opposition by Quakers to the theory of evolution, and the earlier calls for natural selection to be supplemented by some other mechanism had almost died away. Although many late Victorian Quaker naturalists continued the taxonomic tradition, but did not directly engage evolution,[94] these vignettes also show the emergence by the mid-1880s of a group of Quaker naturalists who supported evolution. These Quakers—mostly amateur naturalists—were keen to deploy evolutionary ideas in their research and teaching. However, they were not dogmatic followers of Darwin, but generally adopted a pragmatic attitude towards his theory. They tended to be younger than the naturalists discussed in the previous subsection, most having been born after mid-century, and had attended one of the Quaker schools, most often Bootham.

Probably the most enthusiastic Quaker supporter of Darwin was Henry Marriage Wallis (1854–1941), a corn and seed merchant in Reading. In 1881 he had written to Darwin with an observation about the growth of hair on the ears of his young son, an observation that related to Darwin's evolutionary scheme in his *Descent of Man*. In this communication Wallis added: 'I must take this opportunity of acknowledging the debt I, in common with the rest of thinking people, owe to you Sir for having opened my eyes & given me a key plan to the jungle of phenomena around us.'[95] Wallis subsequently became

[92] *NHJ*, 6 (1882), 136. [93] *NHJ*, 7 (1883), 87, and 8 (1884), 3.

[94] E.g. Arthur Lister (1830–1908) published his extensive catalogue of mycetozoa in the Herbarium of the British Museum: A. Lister, *Monograph of the Mycetozoa*.

[95] H. M. Wallis to Darwin, 14 Mar. 1881, Darwin Papers, MS 210.9: 15, Cambridge University Library.

President of the Reading Literary and Scientific Society and Honorary Curator of Zoology at Reading Museum, and he was a frequent lecturer on natural history and antiquarian topics. For example, in the early 1890s he lectured on the evolution of birds. While accepting that considerable gaps existed in the fossil record, he showed how known fossil remains enabled the likely evolutionary path—beginning with the amphibians—to be traced. One of his lectures began with the comment that he would be treating his subject as an evolutionist,

> not that Darwin had proved his thesis—the great theory was a theory still—but since the accumulated observations of the thirty odd years which has elapsed since the 'Origin' was published has immensely strengthened its positions, we might perhaps accept evolution as a working hypothesis, as a master-key which undoubtedly unlocked scientific difficulties, otherwise insoluble.[96]

Wallis's message was both an enthusiastic endorsement of evolution as a scientific explanation of recondite natural phenomena, but also pragmatic: evolution was 'a working hypothesis'. In 1897 he returned to the development of the human ear with a paper in which he compared humans with other anthropoids. The published version included the text of two letters he had received from Darwin sixteen years earlier.[97]

A second example is provided by Robert Miller Christy (1861–1928), who was likewise educated at Bootham, and became a banker, printer, and amateur naturalist. Although his writings on the flora and fauna of Essex were mostly descriptive, he drew on occasion on Darwin's work. In particular, in a paper 'On the species of the genus Primula in Essex' that he presented to the Essex Field Club in 1882, he firmly engaged Darwin's botanical writings, especially his *Different Forms of Flowers on Plants of the Same Species* (1877). Here Darwin had published his experimental researches on the *Primula.* These researches had begun in 1861, when Darwin returned to the problem of how to understand sterility among hybrids, which he had flagged in the *Origin of Species.* There he argued that the accepted view of hybrid sterility—that it was a means of keeping species distinct—was untenable, and that an evolutionary account would provide a very different explanation of the phenomenon. Huxley had subsequently challenged Darwin, by asserting that the theory of natural selection would remain unproven until sterile varieties of a species could be produced by artificial selection. Spurred on by Huxley, and recognizing the great importance of sterile hybridity to justifying the theory of natural selection, Darwin therefore began researching the *Primula.* His 1877 book contained his mature view that the different forms of *Primula* are able to

96 Wallis, 'Evolution of the bird'; *idem*, 'Descent of the bird'.
97 Wallis, 'On the growth of hair'.

be fertilized by pollen from another form, and that when artificially fertilized by its own pollen, produced less vigorous offspring, bearing some resemblance to hybrids. Such a view cohered with his theory of evolution.[98]

Christy's 1882 paper included a few specific disagreements with Darwin's empirical conclusions; for example, whereas Darwin claimed that the short-styled version of the cowslip produced more seeds than the long-styled version, Christy found that the long-style version was the more prolific. Despite such disagreements on specifics, this paper was a serious engagement with Darwin's 1877 book, and Christy pursued further a number of topics that Darwin had discussed. As *The Different Forms of Flowers* was a major publication in Darwin's long-term evolutionist project, Christy's paper on the *Primula* was likewise a contribution to the evolutionary research programme.[99]

The pragmatic interest in Darwinian evolution found in the papers of Wallis and Christy is also reflected in the pages of the *Natural History Journal*, which was administered by a cluster of Quaker schools. Amidst the plethora of botanical descriptions, issues of theory occasionally intruded, and there were a number of references to Darwin's work scattered through the early volumes. For example, Benjamin Le Tall, who was one of the editors and a teacher at Bootham, listed several introductory books that he considered appropriate for the aspiring botanist, adding: 'After these simpler treatises, let Darwin's books be read.'[100] Likewise, in 1883 Edward Worsdell (subsequently author of the *Gospel of Divine Help*) published an extensive list of suggested readings that included Darwin's *Origin* and several works by Huxley.[101] Furthermore, in 1882 the *Journal* published a summary of Darwin's recently published book on vegetable mould and the action of worms. Since Darwin had died recently, the editors (James E. Clark and John William Graham) added a short appreciation of this 'Prince of Naturalists'. Darwin was praised as the 'intellectual genius' who had discovered the simple laws underlying diverse natural phenomena.[102]

The earliest explicit discussion of Darwin's theory appeared in the third volume under the heading 'Protective colouring'. The author, 'J. N.', concluded his discussion by enquiring how colour adaptations had been produced. One explanation was that, as part of God's plan, 'the beneficent Creator' had coloured animals in order to protect them from predators.

[98] Darwin, *Different Forms of Flowers*; Editorial preface and appendix 6 to *Correspondence*, x. pp. xv–xvii, 700–11.
[99] Christy, 'On the species of the genus Primula in Essex'.
[100] *NHJ*, 1 (1877), 48.
[101] *NHJ*, 7 (1883), 143–6.
[102] *NHJ*, 6 (1882), 67.

J. N. agreed, but added that Darwin had suggested the '*secondary causes* of such beautiful adaptations'. While treating evolution as a conjecture, and one that was not free of problems, the author offered an outline of the theory and how it operated. He also mentioned that Darwin had employed the mechanism of sexual selection, concluding his discussion thus:

> Natural and Sexual selection may well have a share in determining the colours and other properties of plants and animals; but the existence of secondary causes does not eliminate a First cause; nor do we behold less evidence of purpose in the order of the world when we are in some measure given a glimpse into one of the methods by which the Creator works his sovereign will.

Here, then, was a neat, irenic solution that combined divinely ordained design with the operation of physical causes. Perhaps because this was the first occasion on which natural selection was discussed in the *Journal*, the editors added a short note in which they indicated that J. N.'s paper opened up a new and challenging topic. However, the editors added the rider which we have already encountered: natural selection might not be sufficient to explain all relevant phenomena, and therefore some other causal factor may also have to be acknowledged.[103]

In the following year Henry Wallis contributed a paper in which he argued that Darwin's theory was confirmed by the striped zebra-like markings on horses imported from Poland and on mules from America.[104] In another early article entitled 'A faded rose', Edmund Catchpool sought to answer the question why roses are predominantly red. He appealed to evolutionary theory because, as he claimed, it is 'the only reason that can be understood for anything about plants and animals'. But, he added, it 'does not follow that it [evolutionary theory] is the true reason'. He then called on his young readers to seek out the true reason, which, he admitted, may be beyond our ken. Even though he left the issue of truth unresolved, Catchpool appears to have been willing to utilize Darwin's theory, because he recognized its ability to explain a specific and challenging phenomenon in the natural world.[105]

From these references to Darwin's theory in the *Natural History Journal* it would appear that by the late 1870s many young Quakers, even schoolchildren, were being introduced to Darwin's theory. Moreover, it is clear that J. N., Wallis, Catchpool, and other Quakers were prepared to deploy the theory in their scientific writings. In contrast to the contributions to the *Friends' Quarterly Examiner*, which focused on questions of science and religion, the emphasis in the *Journal* was on scientific practice. As the editors asserted in

103 J. N., 'Protective colouring', *NHJ*, 3 (1879), 81–5.
104 *NHJ*, 4 (1880), 114.
105 Catchpool, 'Faded rose', 59.

their declaration of intent, one of the *Journal's* main aims was to assist 'the earnest and rational pursuit of Natural History'. Moreover, the title-page cited a passage from Carlyle extolling the reader to engage in practical activities: '*Let every man* find *his work and* do *it*'.[106] (See Fig. 3.4.) The tone was secular, and there were few references to either design arguments or to Quaker beliefs and practices. Questions of the truth of the theory and of its bearing on religion were far subsidiary to the need to train competent naturalists at a time when the relevant sciences were seen to be progressing rapidly. Whatever their personal reservations, aspiring Quaker naturalists were clearly prepared to use Darwin's theory to further their participation in major and exciting areas of scientific research.

[106] J. E. Clark and B. B. LeTall, *NHJ*, 1 (1877), 1. Cf. Eccles. 9: 10: 'Whatever thy hand findeth to do, do it with thy might.'

8
Jewish Attitudes and Practices

In his introduction to the first number of the *Jewish World* (founded in 1873), the editor contrasted the responses of two sections of the Jewish community to events in the wider Victorian society. He noted that members of well-established and assimilated Jewish families paid little attention to traditional Jewish practices, but were often swayed by 'the teachings of modern science . . . [which] estrange [them] from the paths of the faith in which [they have] been nurtured'. By contrast, although the more recent immigrants from Germany and Poland rejected the old-fashioned superstitions still maintained by the ghetto-dwellers of Eastern Europe, they did not 'blindfoldly accept the teachings of Darwinism, Voyseyism, or any other philosophic "ism" founded on crude and speculative data . . . They are a model of the modern professing Jew.' Although the editor did not portray these more recent immigrants as especially antipathetic to science, he claimed that their clearer sense of Jewish identity encouraged an aloofness from fashionable scientific notions.[1] This portrayal of Anglo-Jewry as subject to the often opposing forces of tradition and modernism coheres with much recent historical analysis, and provides the ground for the ensuing discussion.

In locating Anglo-Jewish attitudes to science between the poles of tradition and modernity, we lose the possibility of delineating a specifically 'Jewish way', in contrast to the reasonably well-defined 'Quaker way' of pursuing science, as argued in Chapter 6. Moreover, Jewish tradition does not encompass an immutable set of beliefs and practices, but partially reflects historical modifications to Jewish thought in its recurrent encounter with non-Jewish cultures. For example, the cosmological writings of Maimonides, which were cited by a number of Anglo-Jewish writers on science, reflected his attempt to synthesize certain aspects of Aristotelianism with the Torah account of creation. In the present narrative, Anglo-Jewish writers will likewise be portrayed as selectively deploying resources from the Jewish tradition in their engagement with science. However, to understand such engagements, we must pay close attention to the context, in particular Anglo-Jewry's ambivalent position in British—principally Christian—society. Faced with the ever-present

[1] *JW*, 14 Feb. 1873, 4. Charles Voysey resigned his position as an Anglican cleric in order to preach a theistic vision of religion.

problem of assimilation into British society, Jewish writers on science had to position themselves carefully with respect to both tradition and modernity.[2]

In the first section we examine three examples of how science was deployed in the service of Jewish observance. Subsequently we trace the decline around the mid-nineteenth century of 'Mosaic science', which appealed to some Jewish writers as a way of asserting Jewish tradition while minimally engaging with modernity. By contrast, in the third section we will examine how Anglo-Jewish writers discussed the primarily Christian topic of design in the natural world. Finally, we turn to a set of methodological and epistemological issues, in order to show how Jewish writers on science drew selectively on both traditional and modern perspectives.

8.1 Science and ritual

In contrast to Quakerism, which downplays the role of ritual,[3] Judaism accords it a central role: devout Jews must perform prescribed deeds (*mitzvot*), such as keeping the Sabbath holy and eating kosher food. As the following examples show, science has sometimes been relevant to such religious practices.

8.1.1 *The Hebrew calendar*

The historian John Heilbron has argued that we should not base our understanding of Catholic attitudes to science solely on the rhetorically charged Galileo affair. Instead, he shows that the Catholic Church readily encompassed science, particularly astronomy, in addressing a problem of great religious importance. In determining the date of Easter, Catholic astronomers of the seventeenth and eighteenth centuries utilized magnificent cathedrals as their observatories, and developed a range of mathematical techniques. Why did the dating of Easter deserve this attention? The deceptively simple answer is that it falls on the first full moon after the vernal equinox. However, Church authorities could not wait for the vernal equinox and the first full moon thereafter, because, in the highly bureaucratized Church, the date had to be promulgated long in advance, and the faithful all over the world had to celebrate Easter on the same day, despite local variations in the observation of both the equinox and the full moon. In this instance, as in many others,

[2] This theme has been articulated by Todd Endelman and David Ruderman, from, respectively, social and intellectualist perspectives. See esp. Endelman, *Radical Assimilation.*

[3] See, however, P. Collins, 'Quaker plaining'.

a high level of astronomical knowledge was essential for framing the religious calendar, and both astronomy and astronomers have played an important role in the conduct of religion. Thus, contrary to the widely received view that the Church was resolutely opposed to scientific innovation, especially in the area of astronomy, Heilbron argues that it was the major proponent and patron of astronomical research.[4]

Jewish communities likewise require an accurate calendar (*luach*), since many Jewish observances are specified by the calendar, which is compiled by astronomical measurements of time. The Hebrew calendar contains information not only about Hebrew dates, which do not correlate straightforwardly with either the Julian or the Gregorian calendar, but also about the times for the commencement and end of the Sabbath and festivals. Indeed, the timings of services and the recital of prayers are specified by the movements of the sun and moon. As these timings depend on the time of sunset, which in turn varies with geographical location, the commencement of the Sabbath will vary between Amsterdam and London, and between London and Manchester. Calendars are therefore place-specific (or have to offer alternative times for several different locations). Although calendar making has a long history within Judaism, discussion will be limited to the attempts by nineteenth-century Anglo-Jewish mathematicians to construct and improve the Hebrew calendar for local use.

The Hebrew calendar is based on a very different set of principles from either the Julian or the Gregorian calendar, since it combines both lunar and solar parameters. Months are lunar, being either of twenty-nine or thirty days' duration. The year consists of either twelve or thirteen months, with the embolismic year (possessing the extra month) occurring seven times in each cycle of nineteen years. Moreover, two of the named months are of variable length, being of either twenty-nine or thirty days' duration; thus the length of the Hebrew year can be 353, 354, 355, 383, 384, or 385 days. This considerable variation in the length of the year implies a complex relationship between the Hebrew and Gregorian calendars; in consecutive years a particular Hebrew festival, such as *Rosh Hashana* (the New Year), will fall on significantly different Gregorian dates. (A similar variation occurs in the dating of Easter, since it likewise depends on the lunar cycle.)

In England, the first annually produced Jewish calendars were published by Isaac Abendana at Oxford in the 1690s. Given the difficulty and expense of producing a calendar each year, in 1717 David Nieto issued a calendar specific to London that contained relevant information for each year for almost the

4 Heilbron, *Sun in the Church.* On the support of science by Jesuits, see Harris, 'Transposing the Merton thesis', and *idem*, 'Confession-building'.

ensuing century. Another long-duration calendar was Elias H. Lindo's *Jewish Calendar for Sixty-Four Years* (1838), which, although ending with the year 5662 (1901–2), included tables showing how to extend calculations to the year 6000 (2239–40). Lindo's calendar, which received the imprimatur of both the Chief Rabbi, Solomon Hirschell, and the *haham* of the Sephardi synagogue, David Meldola, listed the Hebrew alongside the 'English' dates and noted festivals, new moons, time of commencement of the Sabbath, and the cycle of Torah portions to be read at each weekly Sabbath service.[5] (See Fig. 8.1.)

In his preface Lindo (1824–83), a businessman with strong scholarly and communal interests, emphasized the importance to the community of accurate calendrical knowledge:

> [N]o science is more worthy of cultivation and encouragement, than that, which calculating time by the aid of Astronomy, adjusts the results of observations, thus obtained, to the ordinary use and instruction of man in the various relations of historical knowledge, commemorative guidance, or religious observance. . . . [A] correct Calendar is of imperative necessity to the descendants of that People, who are enjoined by Scripture authority to the performance of Rites and Ceremonies upon the periodical return of certain 'days, times, and seasons'.[6]

Fully aware of both biblical authority and rabbinical tradition, Lindo devoted an introductory essay to the history of the Jewish calendar. He also added a technical chapter, in which he introduced the reader to both the astronomical factors that affected the calendar and the various constraints specified in Torah. For example, he explained why the first day of Passover cannot occur on a Monday, Wednesday, or Friday. Moreover, he showed how to calculate the times of the new moon, since this astronomical event is deemed important and requires the recitation of certain prayers. In compiling his calendar, Lindo displayed a high degree of mathematical knowledge and the ability to perform long and often tedious computations.

Jewish calendars and almanacs also contained increasing amounts of communal information. Consider, for example, the *Hebrew and English Almanack* published by Isaac Vallentine for the years 5599 and 5600 (1838–40), which was a relatively slender pamphlet. A separate page was devoted to each Hebrew month, giving similar information to Lindo's. However, this improved calendar also contained lists of Jewish institutions, postal rates, the names of London bankers, mail coaches and steam ships, a brief chronological list, and the birth dates of members of the Royal Family. By contrast, the advertisement for an edition of Vallentine's *Almanack* published seven years later (5606–7 (1845–7)) included not only the usual calendrical information but also

[5] *JC*, 23 June 1865, 2; Lindo, *Jewish Calendar*.
[6] Lindo, *Jewish Calendar*, p. iii.

A critical dissertation on the exact commencement and conclusion of Sabbath, for the latitude of London, as calculated by Mr. H. Philoppowski. The phases of the Moon, the Eclipses, the Tekuphoth [Equinoxes], according to Mar Sh'muel, and Rabbi Ade, the Mahometan Almanack for both years, and the precise time of night on Fasts by the above; a Chronological Table from the Creation to the present day; the Jewish and Christian Holidays, for the ensuing ten years; a WEATHER TABLE COMPLETE, by the celebrated Dr. HERSCHEL; a list of the Metropolitan and Provincial congregations and Charitable Institutions, with their Offices; the exact Time and Station of all Steam Packets and Railways; new Post Office Regulations, rates of postage; Jewish Seminaries, Foreign Consuls in London; Bankers, etc., etc.[7]

This impressive volume, which sold for 6*d*., faced competition from the *Hebrew, English and Mahometan Almanac* produced by Herschell E. Filipowski (1816–72). Yet Filipowski appears also to have worked for Vallentine and soon to have developed his own *Almanac* into a more extensive publication entitled *Assiph, or Harvest: The Annual Hebrew Magazine . . . with an Hebrew and English Almanac*, which also sold for 6*d*. (1*s*. 6*d*. for a large edition). Incorporating a calendar (Fig. 8.2), the 5608 edition contained a dissertation on the calendar of the Karaites, a treatise that included the formulae for calculating the Hebrew calendar, as well as literary extracts, lists of communal organizations, and much else. As Filipowski was committed to the extension of Hebrew learning, the complete text was printed in both Hebrew and English.

Herschell Filipowski was a prolific writer, who edited two periodicals and published works ranging from books on Hebrew prophecy and studies of the festivals to actuarial tables and anti-logarithms. Accomplished in several languages, he even translated Shakespeare into Hebrew. At various times he appears to have been a printer, specializing in Hebrew type, a schoolmaster at the West Metropolitan Jewish School, and an occasional lecturer at Sussex Hall, where he clearly failed to inspire his audience. Unlike Lindo, whose wealth enabled him to indulge in calendar making, Filipowski depended on his several literary and scientific ventures for his income.

Welcoming the publication of Vallentine's *Almanack* for 5606 and 5607, the *Jewish Chronicle* pointed to the 'meagreness' of previous almanacs published in Britain, compared with their continental counterparts. The *Chronicle* particularly praised Filipowski's prefatory essay, in which the defects of Lindo's *Calendar* were identified, especially his erroneous method for calculating the termination of the Sabbath in London. Although the Sabbath should terminate when three stars are visible, this is not an appropriate procedure to follow, since the stars are often occluded by clouds. Therefore,

[7] *JC*, 12 Sept. 1845, 240.

1842					
Tisri	1 2	M T	New Year	5 6	Sept.
	3	W	Fast of Guedaliah	7	
	6	Sa	Vayalech	10	
	10	W	Kipur	14	
	12	F	Sabbath at 5½	16	
	13	Sa	Aazinu	17	
	15 16	M T	Tabernacle	19 20	
	21	S	Hosana Raba	25	
	22 23	M T	Feast of the 8th day	26 27	
	26	F	Sabbath at 5	30	
	27	Sa	Beresheet	1	Oct.
Hes.	30 1	T W	New Moon	4 5	
	4	Sa	Noah	8	
	10	F	Sabbath at 4½	14	
	11	Sa	Lech Lecha	15	
	18	Sa	Vayera	22	
	24	F	Sabbath at 4	28	
	25	Sa	Haye Sarah	29	
	28	T	. . . .	1	Nov.
Kis.	30 1	Th F	New Moon	3 4	
	2	Sa	Toledot	5	
	9	Sa	Vayetsé	12	
	15	F	Sabbath at 3½	18	
	16	Sa	Vaishlach	19	
	23	Sa	Vayesheb	26	
	25	M	Hanuca	28	
	28	Th	. . . .	1	Dec.
Tebet	30 1	Sa S	Mikets New Moon	3 4	
	7	Sa	Vaigash	10	
	10	T	Fast of Tebet	13	
	14	Sa	Vaihi	17	
	21	Sa	Shemot	24	
	28	Sa	Vaera	31	
	29	S	 1843	1	Jan.
Sebat	1	M	New Moon	2	
	6	Sa	Bo	7	
	12	F	Sabbath at 4	13	
	13	Sa	Beshalach	14	
	15	M	Laylanot	16	
	20	Sa	Itro	21	
	27	Sa	Mishpatim	28	
Adar	30 1	T W	New Moon	31 1	Feb.
	3	F	Sabbath at 4½	3	
	4	Sa	Teruma	4	
	11	Sa	Tetsavé	11	
	14	T	Little Purim	14	
	17	F	Sabbath at 5	17	
	18	Sa	Ki Tisa	18	
	25	Sa	Vayakel Shekalim	25	
	29	W	. . . .	1	Mar.
Vead	30 1	Th F	New Moon Sabbath at 5½	2 3	

1843					
Vead	2	Sa	Pekudé	4	
	9	Sa	Vaikra Zachor	11	
	13	W	Fast of Esther	15	
	14 15	Th F	Purim	16 17	
	16	Sa	Tsav	18	Mar.
	22	F	Sabbath at 6	24	
	23	Sa	Shemini Para	25	
Nis.	1	Sa	New Moon Tatzriang Ahodes	1	April
	7	F	Sabbath at 6½	7	
	8	Sa	Metsorang Agadol	8	
	15 16	Sa S	Passover	15 16	
	28	F	Sabbath at 7	28	
	29	Sa	Aharemot	29	
Yiar.	30 1	S M	New Moon	30 1	May
	6	Sa	Kedosim	6	
	13	Sa	Emor	13	
	14	S	Second Passover	14	
	18	Th	33 of the Homer	18	
	20	Sa	Behar	20	
	27	Sa	Behukotai	27	
Sivan	1	T	New Moon	30	
	3	Th	. . . .	1	June
	5	Sa	Bamidbar	3	
	6 7	S M	Sebuot	4 5	
	12	Sa	Naso	10	
	19	Sa	Beangalotecha	17	
	26	Sa	Shelach Lecha	24	
Tam.	30 1	W Th	New Moon	28 29	
	3	Sa	Korah	1	July
	10	Sa	Hukat	8	
	17	Sa	Balak	15	
	18	S	Fast of Tamuz	16	
	24	Sa	Pinehas Dibré	22	
Ab	1	F	New Moon	28	
	2	Sa	Matot Mazgé Shimgu	29	
	5	T	. . . .	1	Aug.
	9	Sa	Debarim Echa	5	
	10	S	Fast of Ab	6	
	15	F	Tubeab	11	
	16	Sa	Vaethanan Nahamu	12	
	22	F	Sabbath at 6½	18	
	23	Sa	Hekeb	19 27	
Elul	30 1	Sa S	Rehé New Moon	26	
	6	F	Sabbath at 6	1	Sept.
	7	Sa	Shophetim	2	
	14	Sa	Ki Tetsé	9	
	20	F	Sabbath at 5½	15	
	21	Sa	Ki Tabo	16	
	28	Sa	Netsabim	23	

NOTES.

Sept. 5, M. New Moon, M. 11*h.* 48*m.* 36⅔*s.*
Dec. 4, Verse to be changed, Tebet 1.
17th year of 295 Cycle.
Year consists of 385 days.

1 Golden Number.
29 Epact.
* A Dominical Letter.
April 16, EasterSunday.

* The Dominical or Sunday Letter is one of the first seven letters of alphabet, used to indicate the date of the 1st Sunday in January, thus if the 1st January is Sunday A is the Dominical Letter; if on Saturday, Sunday would be the 2nd, consequently B would be the Dominical Letter, and so on.

TO FIND THE DOMINICAL LETTER.

To the given year add its fourth part, and 6 for the present century, (and 5 in the following) divide the total by 7, the remainder deducted from 7 will give the number of the letter, reckoning A to be 1, B 2, C 3, D 4, E 5, F 6, and G 7.

an accurate astronomical method was required. Although Lindo claimed that his figures had been calculated by George Biddell Airy, the Astronomer Royal, Filipowski identified a number of manifest errors in Lindo's table. One erroneous claim was that sunset (being the termination of the Sabbath) occurred at the same time over a seven-day period: for example, at 4.55 p.m. during the whole week of 9–15 January. Yet the actual time of sunset differed from one day to the next over that period. An even more striking error was that Lindo had miscalculated the times of twilight, probably using figures for a more southerly latitude, 'perhaps for some parts of Spain and Portugal'.

The overall errors were significant; for example, Lindo had calculated the termination of the Sabbath to be eighteen minutes too late for 1 January, but twenty-two minutes too early for 11 June! According to Filipowski, for almost a decade London Jews had been ending the Sabbath and festivals at the wrong time. Even more serious was the implication that, since the termination of the day affects the time at which the circumcision of a male child takes place, users of Lindo's *Calendar* might have performed that operation on the seventh or ninth day, instead of the eighth day as required by Jewish law. Clearly accurate calculations were required, 'founded in Astronomical and Rabbinical principles'. Purchasers of Vallentine's *Almanack* thus benefited from Filipowski's high level of mathematical and religious knowledge.[8]

The amount of information contained on each page—typically a page covered a single Hebrew month—varied considerably. Some calendars simply included the basic information required by the practising Jew, such as the Hebrew and English dates, the dates of the festivals, the Torah portions to be read each Sabbath, and the times of commencement and termination of the

Fig. 8.1. A page from E. H. Lindo's *A Jewish Calendar for Sixty-Four Years, Detailing the New Moons, Festivals, and Feasts, with the Sections of the Law as Read in the Synagogues every Sabbath during the Year; Also the Days on which the Hour for Commencing Sabbath is Altered, together with the Corresponding Christian Dates. To which are Added Tables for Continuing the Calendar to A.M. 6000–2240 C.Æ. and a Chronological Table, forming a Summary of Jewish History from the Flood to the Present Time. With other Useful Tables* (London: Thompson, 1838). This page shows the Hebrew year 6503 (1842–3). This was an embolismic year, consisting of 385 days. Although some detailed information is given at the bottom of the page, the table includes only the dates of the new moons and festivals, the portions of the Torah to be read each Sabbath (e.g. Vayalech on 6 Tishri = 10 September), and the time of the commencement of the Sabbath (but only to the half-hour when the time changed). Reproduced with the kind permission of Leeds Library and Information Services.

[8] Quoted in *JC*, 19 Sept. 1845, 247–8.

ברביעי בחדש אחד עשר השמש נכנס במזל דלי

☽ Jan. 13th 11^h 46^m A.M.	מולד	Thursday 6^h 16^m 5^c A.M.
○ „ 20 0 4 P.M.	תקופה	Jan. 6th 4 30 A.M.
☾ „ 28 11 58 A.M.	☾ Perigee	Jan. 13 2^h A.M.
● Feb. 5 1 42 A.M.	☾ Apogee	„ 27 8 A.M.

JANUARY. Epiphany	Th	6	א	ה	ר״ה תקופת מר שמואל
Shabbath com. at 3^h 30^m	F	7	ב	ו	התחלת שבת בשלישית ומחצה
Night at 5^h 3^m	𝔖	8	ג	ש	Ex. 6. 2. וארא
1st Sunday after Epiphany	S	9	ד	א	
	M	10	ה	ב	
Hilary term begins	T	11	ו	ג	
Cambridge term begins	W	12	ז	ד	
	Th	13	ח	ה	
Oxford term begins	F	14	ט	ו	התחלת שבת 4^h 0^m
Night at 5^h 10^m	𝔖	15	י	ש	Ex. 10. 1. בא
2nd Sunday aft. Epiphany	S	16	יא	א	
	M	17	יב	ב	
	T	18	יג	ג	
	W	19	יד	ד	השמש נכנס במזל גדי
	Th	20	טו	ה	חמשה עשר ר״ה לאילנות
Shabbath com. at 4^h 0^m	F	21	טז	ו	קדוש לבנה עד 12^h 38^m A.M.
Night at 5^h 22^m	𝔖	22	יז	ש	Ex. 13. 17. בשלח
3rd Sunday aft. Epiphany	S	23	יח	א	
	M	24	יט	ב	
	T	25	כ	ג	
	W	26	כא	ד	
	Th	27	כב	ה	
Shabbath com. at 4^h 30^m	F	28	כג	ו	התחלת שבת ברביעית ומחצה
Nt. 5. 33 [Whitehall 1649	𝔖	29	כד	ש	Ex. 18. 1. יתרו
Charles I. beheaded at	S	30	כה	א	
Hilary term ends	M	31	כו	ב	
FEBRUARY 29 days	T	1	כז	ג	
Purification, Candlemas	W	2	כח	ד	
	Th	3	כט	ה	ער״ה
Shabbath com. at 4^h 30^m	F	4	ל	ו	א׳ דר״ה, ה״ש ברביעית ומחצה

WARNING.

אומרים לצרעה לא מדובשך, ולא מעוקצך, (שמות רבה. ילקוט בלק תשמ״ה, תנחומא בלק רל״ז ע״א).

Say thus to the Bee; I desire neither thy Honey nor thy Sting.

בט״ו בחדש העשירי השמש נכנס במזל גדי

☽ Dec. 15th 3^h 26^m A.M.	מולד	Tuesday 5^h 32^m 4^c P.M.
○ „ 21st 10 8 P.M.		
☾ „ 29th 1 48 P.M.	☾ Perigee	Dec. 18th 1^h P.M.
● Jan. 6 0 7 P.M.	☾ Apogee	„ 30 10 A.M.

DECEMBER.	W	8	א	ד	ר״ה [תתקס״ה
Maimoindes d. 1205.	Th	9	ב	ה	יום מות הרמב״ם ד׳ אלפים
Shabbath com. at 3^h 30^m	F	10	ג	ו	התחלת שבת בשלישית ומחצה
Night at 4^h 46^m	𝔖	11	ד	ש	Gen. 41. 1. מקץ
	S	12	ה	א	
	M	13	ו	ב	
	T	14	ז	ג	
[ends	W	15	ח	ד	
Ezra died. Cambr. term	Th	16	ט	ה	עזרא הסופר נאסף אל עמיו
Shab. com. at 3^h 30^m Oxf.	F	17	י	ו	תענית עשרה בטבת
Night at 4^h 46^m [term ends	𝔖	18	יא	ש	Gen. 45. 18. ויגש
	S	19	יב	א	
	M	20	יג	ב	
St. Thomas	T	21	יד	ג	קדוש לבנה עד סוף ליל רביעי
⊙ enters ♑ at 10^h 5^m	W	22	טו	ד	יום הקצר, תקופת החורף
[A.M. the shortest day	Th	23	טז	ה	
Shabbath com. at 3^h 30^m	F	24	יז	ו	התחלת שבת בשלישית ומחצה
Night 4^h 49^m Christmas	𝔖	25	יח	ש	Gen. 4. 18. ויחי
St. Stephen's. [day.	S	26	יט	א	תקופת ר״א 8^h 47^m 20^c P M.
	M	27	כ	ב	בשנת ג׳ אלפים תשכ״ג התחילו
	T	28	כא	ג	הנוצרים למנות למשיחם לפי
	W	29	כב	ד	יסוד עולם מ״ד פי״ן כ״י.
	Th	30	כג	ה	
Silvester [Night at 4^h 56^m	F	31	כד	ו	התחלת שבת 3^h 30^m
JANUARY 1848. 31 days	𝔖	1	כה	ש	שמות Ex. 1. 1. מבה״ה
	S	2	כו	א	
	M	3	כז	ב	
	T	4	כח	ג	
	W	5	כט	ד	ער״ה

GOVERNMENT.

אוי לו לדור שאבד מנהיגו, אוי לה לספינה שאבדה קברניטה. (ב״ב צ״א. ילקוט היי שרה ק״י).

Woe unto the generation without a guide! Woe unto the Ship deprived of her Pilot.

Fig. 8.2. A double-page spread from the almanac attached to Herschell Filipowski's *Assiph, or Harvest: The Annual Hebrew Magazine . . . with an Hebrew and English Almanac* (London: Meldola, Cahn, 1847). This shows the thirty-day month Shevat 5608 (corresponding to 8 December 1847 to 5 January 1848), and the twenty-nine-day month of Tevet 5608 (6 January to 4 February 1848). The standard information of Jewish interest includes the Hebrew and English dates, the times of commencement and termination of the Sabbath (3.30 p.m. and 4.46 p.m. for the Sabbath of 10–11 December), and the Torah portion to be read on the Sabbath (Mketz: beginning Genesis 41: 1). Other notable dates in the Jewish calendar include the new moons and the Fast of Tevet (10 Tevet (17 December)). Also included are such dates in the Christian calendar as Christmas, Epiphany, St Thomas's Day (21 December), St Stephen's Day (26 December), St Sylvester's Day (31 December), Candlemas (2 February), Epiphany, and the three succeeding Sundays. Dates of secular significance include the Legal, Oxford, and Cambridge terms. (Jews, it should be remembered, were not admitted to Oxford or permitted to take degrees at Cambridge until several years after this calendar was compiled!) There's also a sprinkling of information relating to both Jewish and British history: for example, the death of Maimonides in 1205 (2 Tevet), and the beheading of Charles I in 1649 (30 January).

At the top of the page some data are given relating to the orbit and appearance of the moon, and the winter solstice is noted on 22 December. Also, in Hebrew are given the dates when the sun entered a new astrological house: Capricorn, the goat, on 15 Tevet; Aquarius, the water-bearer, on 14 Shevat. The aphorism at the bottom left is from *Midrash Tanchuma Balak* 6; that on the right from the *Commentary on Chayei Sarah*. By permission of the British Library.

Sabbath. At the head of each page of Filipowski's 5608 *Almanac* was printed the phases of the moon and the times of its apogee and perigee. But he also included a considerable amount of other information, both secular and religious, including (surprisingly) the start and end of the terms at Oxford and Cambridge, Jewish and Christian festivals, and historical dates ranging from the death of Maimonides to the marriage of Queen Victoria in 1840. Although Filipowski cited the time of the start of each Sabbath to the preceding half hour, he gave to the minute the time of its conclusion; thus, on Friday 21 January 1848 the Sabbath commenced at 4 o'clock, but terminated at 5.22 p.m. (see Fig. 8.2).

Around the mid-century several other calendars were produced, including an expensive *Illustrated Hebrew Calendar for 5606* (covering 1845–6) by the lithographer David de Lara. De Lara, who was supported by Moses Montefiore, employed the latest chromolithographic techniques. Proof copies of this 'Elegantly printed [volume] in Twelve Colours and Gold', sold for 5*s.* and 3*s.* 6*d.*, and Queen Victoria was among those who received a presentation copy.[9] Only towards the end of the century did a substantial annual publication partially displace the relatively slim *luach.* Drawing on earlier models, but especially the calendars published by Vallentine, the *Jewish Chronicle* published in 1896 the first annual edition of the *Jewish Year Book* under the editorship of Joseph Jacobs. While a calendar containing the requisite information about Sabbaths and festivals occupied twelve or thirteen pages, the *Jewish Year Book* soon became the repository of communal information, including biographies of eminent members of the Anglo-Jewish community and the office-holders of numerous synagogues and other organizations. By then, calendar making had become part of 'normal science', and was no longer the innovative, scientifically challenging enterprise that it had been for Lindo and Filipowski.

8.1.2 *The electric light*

Early in 1892 the *Jewish Chronicle* printed a short exchange that elucidates the interface between recent technological developments and traditional Jewish concerns. A member of the Anglo-Jewish community had asked William Crookes, 'the eminent Electrician' and President of the Institution of Electrical Engineers, whether switching on and off an electric lamp transgresses the Sabbath. Crookes, whose reply was published in the *Chronicle*, launched into his subject with gusto, in the belief that the question was a scientific one and therefore required a scientific answer. Presumably having been informed

[9] *JC*, 8 Aug. 1845, 220; *VoJ*, 10 Oct. 1845, 4.

that Jews 'shall kindle no fire throughout . . . [their] habitations upon the sabbath day' (Exodus 35: 3), he understood the question to be whether fire is produced in an electric light bulb. As he explained, the type of lamp currently used for domestic lighting contains an incandescent filament encased in an evacuated glass bulb. The first question could then be resolved into a second question: as fire and flame are produced by combustion, does combustion occur in the lamp's filament? Crookes's answer was unambiguous: no combustion occurs. Being made of carbon, the filament will not burn inside the evacuated bulb, and it is therefore very stable at high temperatures. Moreover, as all the air has been removed from the bulb, no gases can be ignited. As the mode of operation of the electric lamp differs so markedly from common fire, he argued that Jews could use such lamps without breaking the Sabbath.[10]

Crookes's easy solution did not satisfy several readers, who contributed letters over the next few weeks. As one noted, Crookes had 'short circuited' the question. Some of his critics also commented on the meaning of the Torah text in order to shift the problem from whether fire was kindled in the electric lamp to whether any process was forbidden that produced heat and light. It was pointed out that, contrary to the biblical injunction (Exodus 35: 2), work would be done when switching a light on or off. Others argued that Crookes's analysis was scientifically faulty, because glass bulbs contain only a partial vacuum, so that the residual air causes the surface of the illuminated filament to be slowly destroyed. Moreover, sparks will be produced at the generator: that would surely be breaking the Sabbath![11] Amid all the criticism of Crookes, 'The Asker of the Question' contributed a supportive letter in which he sought to disarm Crookes's critics. The Asker, who clearly held progressive religious views, sought to demonstrate that each objection led to an untenable conclusion. For example, if we take seriously the argument that we should not use electric light because the slow destruction of the filament is contrary to Jewish law, then we should refrain from walking on the Sabbath because our shoe leather will likewise be slowly eroded. Horrified by his opponents' arguments, the Asker urged his fellow Jews to use common sense to settle this matter, rather than appealing to arcane exegeses found in the Torah and Talmud.[12]

These exchanges concluded with an editorial which suggested that the issue should be resolved by a rabbi, not a scientist. 'Professor Crookes's communication', added the editor, 'is highly interesting, since it suggests the possibility of religious questions presenting themselves for decision from time to

[10] Crookes, 'Sabbath observance'.

[11] *JC*, 15 Jan. 1892, 8–9; 29 Jan. 1892, 7; 12 Feb. 1892, 10.

[12] *JC*, 5 Feb. 1892, 8.

time, as the result of scientific progress.' However, while science may raise religious questions, rabbinical opinion was not unanimous, for while Orthodox rabbis would certainly consider the switching on and off of electric lights on the Sabbath to be contrary to Jewish law, 'Liberal Rabbis' would submit to scientific opinion. Unlike their Orthodox brethren, these Liberal rabbis would follow the Asker's lead and seek the advice of non-Jewish scientists. Thus Crookes's intervention resulted in a dispute between Orthodox and progressive Jews, and displayed their contrasting attitudes to science and to scientific authority. This disagreement is an example of what Geoffrey Alderman has called the 'end of consensus' among Anglo-Jewry, which became increasingly apparent during the closing years of the nineteenth century.[13]

8.1.3 *Some problems of* kashrut

Early in 1844, a short but interesting exchange appeared in pages of the *Voice of Jacob* concerning a problem that has repeatedly confronted Jews who adhere to the dietary laws (*kashrut*). A correspondent, J. W. Levy of Bristol, wrote to complain about the adulteration of food, and especially about how shopkeepers often tampered with groceries by the addition of non-kosher ingredients. One example cited by Levy was butter, to which hog's lard was sometimes added, thereby rendering the butter unkosher (*traife*). 'Could you not call on some scientific persons amongst us (and I hope there are many), to make known the best means of detecting those spurious articles?', he pleaded.

The only published response appeared over the signature 'Van Helmont'. This correspondent was clearly well versed in chemistry and was probably an apothecary or an industrial chemist, since the detailed experimental procedures he suggested were extraordinarily precise. Indeed, the experimental test he offered for determining whether butter is adulterated was 'very delicate', and could only be performed by 'an *experienced* analytical chemist'. In this experiment the butter sample interacted with potassium hydroxide, and produced crystals of the resulting salt. A similar procedure had then to be followed using a sample of butter that was known to be pure. If the two sets of crystals looked identical, then the test sample was pure; however, if the crystals looked different, it was contaminated. Levy had also expressed concern over the purity of olive oil sold in shops. Van Helmont again answered in impressive detail, explaining that olive oil went rancid when it contained an excess of hydrogen. In order to sweeten the rancid olive oil, dishonest shopkeepers mixed it with either a lead preparation or some form of vegetable or animal oil—the latter being *traife*. To test for lead, van Helmont advised

[13] *JC*, 19 Feb. 1892, 6. Alderman, *Modern British Jewry*, 209–64.

that hydrogen sulphide should be passed through the olive oil; any lead would then appear as a precipitate. Likewise, he prescribed tests to detect both added vegetable and animal oil.

Despite the impressive experiments suggested by van Helmont, only a handful of British Jews would have possessed the skill, apparatus, and chemicals required to carry out these determinations. Yet the editor of the *Voice of Jacob* was so concerned about the adulteration of food—particularly given the low price of imported lard—that he expressed the hope that the *dayanim* (the judges who sat on the court that determined issues of *kashrut*) would pursue these matters further. There is, however, no evidence that the *dayanim* looked to the scientifically able members of the community for advice.[14] Nevertheless, this is an interesting example of the potential of science to address traditional problems arising from Jewish observance.

8.2 Mosaic science

Passages from the Old Testament, especially the opening verses of Genesis, have often been aligned with theories in geology, astronomy, and other sciences in order to show the convergence between science and Revelation. Even Emanuel Mendes da Costa, who did not evoke Revelation in his published works on fossils and shells, read a paper to the Royal Society in 1757 on fossilized plants, which concluded with a Mosaic coda. At this meeting he displayed several specimens of iron in which were embedded cones of vegetable origin. These, he considered, were 'buried in the Strata of the Earth, at the time of the universal deluge according to Moses'. Moreover, he indicated that two instances of scientific evidence confirmed that 'there really was such a Deluge'. First, the effects of the Flood could be seen in 'the heavings, displacements, & breaks of . . . metallic veins'. Second, the 'remains of plants and animals being found in places very remote from those where they are to be met with when living' also confirmed the force of the Flood.[15] With his *Natural History of Fossils* soon to be published, it may have been politically expedient for da Costa to show the assembled Fellows that he could integrate science and Revelation.

While some Christian writers used biblical quotations for rhetorical or illustrative purposes, others sought to base their science firmly on biblical foundations. For such writers this God-given text promulgated certain knowledge of God's creative acts, and therefore of the resulting structure of the

[14] *VoJ*, 2 Feb. 1844, 79; 22 Mar. 1844, 111.

[15] JB, xxxii. 544–5. Read at the Royal Society on 28 Apr. 1757.

universe. Since the appropriate verses of Genesis are brief and succinct, they require considerable elaboration and analysis in order to provide even a skeletal cosmogonical theory. Yet much ink was spent on this project during the seventeenth, eighteenth, and even nineteenth centuries.[16] While the King James translation was adequate for some writers, others sought the true and accurate account of creation in the original Hebrew text.

One instructive example is provided by John Hutchinson, an early eighteenth-century land steward, fossil collector, and theological writer, who claimed that the Torah contained the true structure of the world. First, however, the original version of the text had to be recovered. This was achieved by removing the erroneous vowels and Masoretic points that Hutchinson accused 'the rabbis' of introducing in order to mislead Christians. Fulminating against Newton and Newton's followers for rejecting Revelation, Hutchinson developed his own system in several works, including his aptly entitled *Moses's Principia* (1724 and 1727). In these writings he offered two parallel interpretations of the Torah; it contained not only a moral message, but also the true physical system of the world. In order to elucidate the latter, he subjected certain Hebrew words to a set of procedures (which were dismissed as arbitrary by David Levi writing later in the nineteenth century).[17] By employing various linguistic tricks and associations, Hutchinson was able to draw from the Hebrew text a mechanistic account of the universe involving a circulating fluid that could manifest the properties of fire, light, and air, thus preserving the Trinity in its physical manifestation. As Hutchinson's theories were allegedly based firmly on Revelation, they achieved considerable popularity, especially among Tory High Churchmen, who considered that Newton's natural philosophy encouraged both anti-Trinitarianism and atheism.[18] Moreover, a number of Christian writers sought to decode the geological truths hidden in the Bible by interrogating either the Hebrew text or its English translation.

The early decades of the nineteenth century witnessed the increasing self-consciousness and self-confidence of the emerging scientific community. With a few exceptions, the members of this community turned their backs on such writers as Granville Penn, George Fairholme, and Sharon Turner, who had advanced scriptural, or Mosaic, theories of the earth.[19] However, some writers continued to base science on Scripture, and they still commanded a sizeable readership principally among both evangelicals and High Anglicans.

[16] Collier, *Cosmogonies of our Fathers*.

[17] Ruderman, *Jewish Enlightenment*, 61–74.

[18] On Hutchinsonianism, see Wilde, 'Hutchinsonianism'; *idem*, 'Matter and spirit'.

[19] See G. Penn, *Comparative Estimate*; Fairholme, *General View of the Geology of Scripture*; S. Turner, *Sacred History of the World*.

Although some of these writers were satisfied with the King James translation of the Bible, others acknowledged the importance of the 'original Hebrew', since any translation via the Greek was liable to distortion. Although the better-educated Christian clergymen knew some Hebrew—and Hebrew–English dictionaries abounded—Jews and even converted Jews, such as the arch conversionist Joseph Frey, were prized for their linguistic abilities.[20] Some English Jews also utilized their expert knowledge of the Torah and Talmud in order to demonstrate the convergence of Judaism and science. Among these were Lazarus Cohen, whose *New System of Astronomy* was published in 1825, and Michael Hart Simonson, who wrote *Joshua and the Sun and Moon . . . Philosophically Explained* (1851), and contributed articles on science to the *Jewish Chronicle*. Although both authors lacked a scientific education and held theories that were out of kilter with contemporary scientific opinion, they sought to display their privileged knowledge of Hebrew and thus of the true system of the world. While Cohen wrote principally for a non-Jewish readership, Simonson addressed his fellow Jews.

Cohen, who kept a shoe and patten warehouse in Exeter, published in 1808 a political work, *Sacred Truths*, in which he objected to the Sanhedrin convened by Napoleon in Paris in 1806. Some years later, 'encouraged by a mathematician of acknowledged abilities', he issued a prospectus for a book that would analyse the earth's motion. However, after encountering a number of other publications on astronomy, he subsequently wrote his *New System of Astronomy*, in which he engaged not only the earth's motion but also explained other phenomena, including the tides, winds, and certain airborne 'malignant disorders'.[21]

Despite its title, Cohen's book does not offer a *new* astronomical system, since, although it contains some novelty, its author was poorly informed about recent scientific developments, and clearly lacked the mathematical skill necessary to solve the problems he encountered. Instead, he drew on a wide range of earlier authors, including Johannes Kepler, Isaac Newton, the eighteenth-century chemist Pierre-Joseph Macquer, William Jones of Nayland (a High Anglican cleric who advocated a version of Hutchinsonian natural philosophy), James Ferguson (a writer of popular scientific texts), and the *Encyclopaedia Londinensis* (1810). The details of Cohen's system need not detain us other than to note that he advocated a universal fluid whose flux, expansion, and contraction were responsible for the earth's motion and other

[20] Binfield, 'Jews in evangelical dissent'.

[21] Lazarus Cohen, *New System of Astronomy*; *idem*, *Sacred Truths*. The 'mathematician' was probably John Macdonald, FRS, a military engineer from Exeter. See also Susser, *Jews of South-West England*, 220–1.

physical phenomena. Cohen was indebted to Isaac Newton's notion of a very rare and highly elastic fluid filling all space, but he also drew selectively on fluid theories that were incompatible with Newton's, such as the mechanistic theories of Descartes and of Hutchinson, in which the movements of planets were explained by the flow of a fluid filling all of space. Although few early nineteenth-century scientists took such theories seriously, they generally formed part of a politically conservative, High Church reaction against the alleged atheism of modern science; a concern often linked to the French Revolution.[22]

Cohen's work can be examined from this political and religious perspective. His *Sacred Truths* clearly manifests his conservatism and horror at the political events that engulfed France during and after the Revolution. In accord with those Christian High Churchmen who zealously attempted to construct a version of science based on the Mosaic account, Cohen set out to demonstrate the 'remarkable coincidence of the movements of the heavenly bodies with the accounts we are to understand of them in Scripture'.[23] Like many earlier writers, both Christian and Jewish, he sought to extract maximum meaning from the opening verses of Genesis, especially verse 2 of chapter 1. Complaining that Christians usually misinterpreted this verse, he argued that 'the Spirit of God moved on the face of the waters' should be taken as referring to the mighty wind that played such a crucial role in his own mechanistic theory. This questionable argument was allegedly derived from his interpretation of the Hebrew text, and was supported by quotations from a diverse range of commentators.

Simonson, like Cohen, lived in a provincial Jewish community; after teaching in a Jewish school in Birmingham, he was appointed reader and *shochet* (ritual slaughterer) at the Halliwell Street congregation in Manchester. Well known as a controversialist, he had displayed an uncompromising defence of the rabbinic tradition in an earlier pamphlet, in which he supported the observance of the second day of festivals.[24] Soon after he published his *Joshua*, Simonson contributed to the *Jewish Chronicle* over twenty extracts from his own commentary ('Yalkut ben Shimoni'), 'a manuscript which treats upon Genesis philosophically'.[25] He began by complaining that those Christian authors who analysed the Bible in English translation 'could not explain the hidden meanings of the Hebrew words'. By contrast, the rabbis knew that 'every letter has its own signification and use'. Thus, only someone, like himself, who could read Hebrew and therefore had access to the Torah and

22 Wilde, 'Huchinsonianism'; *idem*, 'Matter and spirit'.
23 Lazarus Cohen, *New System of Astronomy*, 140.
24 Simonson, *Holy Convocations*; B. Williams, *Making of Manchester Jewry*, 200–1.
25 Simonson, *Joshua and the Sun*.

the Talmudic commentaries could comprehend God's plan as explicated in Genesis, where 'Moses tells us . . . *how* the solar system has been contrived, and who the Contriver is'. Rather disarmingly, Simonson informed his readers that 'the theory [he was proposing] is not mine; the scheme is Moses's; the interpretation thereof is only your humble servant's'.[26]

Like Cohen's book on astronomy, Simonson's text was a farrago of references to the Bible, to rabbinic commentators, and to modern scientific authors, including Charles Babbage and William Whewell. However, Simonson's primary argument was that key biblical terms required correct interpretation. Starting with the Hebrew word *mayim* ('waters'), which refers to any fluid, he stated that 'the Deity brought these two sorts of atoms [oxygen and hydrogen] together, mixed them, as it were, and therefrom the expanse or atmospheres were formed'.[27] A similar arbitrariness is apparent in Simonson's explanation of Joshua's evocation, 'Sun, stand thou still upon Gibeon', in his 1851 book, which received two reviews in the *Jewish Chronicle*. The first—a brief anonymous notice presumably by the editor—praised Simonson for having 'rescue[d] that portion of the sacred Scriptures from the odium cast upon it by unbelievers, and from the cavilling of would-be philosophers'.[28] However, Hertz ben Pinchas subsequently subjected *Joshua* to a gentle but searching analysis, showing that in order to 'make the original [text] square with his favourite hypothesis, the Rev. M. H. Simonson has had recourse to much scheming and ingenuity'. In particular, Hertz demonstrated that the author had not only taken liberties with his translations, but his interpretations raised as many problems as they solved.[29]

Simonson was not alone among contemporaries in seeking physical truths in the Torah text. Early volumes of the *Jewish Chronicle* carried a number of other articles discussing the exegetical problems raised by the opening verses of Genesis, problems that would also have been familiar to Christian theologians. For example, the meaning of the word *yom* ('day') in the context of the creation was unclear: did it refer to a day of twenty-four hours or to a period of indefinite duration?[30] Again, there was disagreement over whether darkness (referred to in Genesis 1: 2 and 1: 18) was the mere absence of light, or whether it was itself a substance. In answering this question, one correspondent appealed not only to biblical exegesis but also to Newton's optical writings.[31] However, the most sustained attempt to align Genesis and science

[26] *JC*, 5 Sept. 1851, 383.
[27] *JC*, 5 Dec. 1851, 70.
[28] *JC*, 2 May 1851, 238.
[29] *JC*, 25 June 1852, 302–3; 2 July 1852, 310–11; 9 July 1852, 314–15.
[30] *JC*, 12 Apr. 1861, 6, esp. the editor's comments.
[31] *JC*, 16 Mar. 1860, 7; 13 Apr. 1860, 6; 4 May 1860, 5.

comprised a series of articles under the heading 'Creation' that commenced in September 1860. During the course of ten months and thirty-nine parts, the anonymous author surveyed this vast topic, beginning with the opening verses of Genesis and moving on to the planetary system and to the nature and development of biological organisms. Close analysis of the Hebrew text was again combined with speculative ideas drawn from a limited range of scientific sources. Like many earlier biblical commentators, this author exploited Genesis to justify a ubiquitous ethereal fluid, the vibrations of which were responsible for a wide range of physical phenomena. Although the writer made occasional appeals to concepts drawn from contemporary science, such as the wave theory of light and the sun's energy, his knowledge of science was limited.[32]

It is surprising that this extensive series of articles went almost unchallenged, possibly indicating the low level of scientific attainment within Anglo-Jewry. The only published criticism, which was written by a Christian, prompted the editor, Abraham Benisch, to defend his columnist on the grounds that he was attempting to harmonize religion and science. Perhaps failing to realize that the specific theories advocated were untenable, Benisch stated his belief that through constant re-evaluation, the true aspects of both science and religion would emerge, so that Revelation and science would be reconciled. Another regular columnist adopted a similar tack by insisting that cooperation between science and religion was essential; he therefore chastised those who rejected any science that appeared to clash with Revelation. Moreover, since the Bible required considerable interpretive skills this writer argued that theologians must be prepared to revise their interpretations in the light of scientific developments, warning that to adopt an excessively rigid interpretation of Torah posed a threat to religion itself.[33]

After the early 1860s, the number of attempts to align Genesis and science in the Jewish press declined significantly. However, occasional articles continued to appear that celebrated the confluence between the Torah or Talmud and modern science. For example, in a lecture delivered at Jews' College in 1869, Hermann Adler—the Chief Rabbi's son—sought to demonstrate that a number of scientific discoveries had been prefigured in the Talmud. To Rabbi Joshua (first century CE) was attributed the discovery of Halley's comet—a claim that precipitated a critical letter from a reader.[34] A further example is the report published in the *Jewish World* in 1875 of a lecture delivered in

[32] The first in this series appeared on 7 Sept. 1860, and the last on 28 June 1861.

[33] *JC*, 5 Oct. 1860, 4; 12 Oct. 1860, 2; 2 Nov. 1860, 6; 9 Nov. 1860, 2; 19 Apr. 1861, 6.

[34] H. Adler, 'Wisdom and wit of the Talmud'. A comet is mentioned in B. *Ber.* 58a. See also *JC*, 31 Dec. 1869, 3–4; 7 Jan. 1870, 3; 15 Dec. 1871, 8–9.

New York on 'Creation's science and the science of creation' by a rabbi who sought to harmonize Genesis with geology. Not only did he find the biblical narrative confirmed by science; he also proclaimed that the astronomical and geological knowledge contained in the Torah pre-dated by many centuries the discoveries made by scientists.[35]

Such examples indicate that, since the Torah and the rabbis were so far advanced in comparison with secular learning, Jews should take intellectual pride in their tradition. As the Torah was given specifically to the Jewish people, Jews possessed a unique relation to that font of unerring knowledge. Moreover, through their knowledge of Hebrew, the original language, they were uniquely able to read God's uncorrupted word—'the original Word revealed by the Sacred Lips to the chosen people'[36]—and were not dependent on dodgy translations. From this strong position Jews could proclaim their superiority to those Christian commentators who, being ignorant of Hebrew, were dependent on inadequate translations that failed to convey the Torah's manifest truth. Thus, it was argued, only Jews were able to appreciate the true convergence between science and Revelation; an argument that should be seen as raising the intellectual status of Jews, who had so often been charged with intellectual inferiority.

Yet this belief in the *prisca sapientia* exerted little influence over the many acculturated British Jews, and it was attacked by Morris Joseph (1848–1930), a rabbi who bridged Orthodox and Reform traditions, in a sermon delivered in Oxford in 1886. Reflecting on the recent controversy between Huxley and William Ewart Gladstone in the periodical press, Joseph attacked Gladstone for reading the Bible as a scientific account of creation. He criticized this strategy because the Torah was liable to misinterpretation if it was forced to cohere with such modern theories as evolution and the nebular hypothesis. Moreover, as the views about the structure of the universe contained in the Bible were framed for an earlier civilization, they were likely to be refuted by the progress of scientific knowledge. Joseph was also concerned that the Bible would be brought into disrepute if it were seen to cohere too closely with any specific scientific theory, which might subsequently be shown to be false. Most importantly, the Bible should be savoured for its timeless moral and religious meanings, which should be firmly differentiated from any quasi-scientific claims that it contained. Thus the opening verses of Genesis should be interpreted as evidence that the world was created by divine fiat and not as a simple assertion that it was made in just 'six days'. Joseph separated science and Revelation, criticizing those apologists, both Jewish and Christian, who

[35] *JW*, 24 Apr. 1874, 2.
[36] 'Science and speculation', *JC*, 28 Aug. 1874, 348–9.

simplistically celebrated the confirmation of biblical statements by modern science. The Bible had to be valued for its own merits.[37]

8.3 Physico-theology

In his analysis of the history of design arguments John Hedley Brooke has emphasized the many functions that they have performed in Christian contexts, ranging from the refutation of atheism to the inculcation of piety.[38] He also highlighted the universality of such arguments, which were directed to 'reasonable' people from across the Christian spectrum: thus, High Churchmen and Low Churchmen, Protestants and Catholics, Anglicans and Dissenters, could all consent to the proposition that the perfection that can be seen in, say, the design of a flower, indicates that it was created by an intelligent designer. Brooke's argument might lead us to expect that Anglo-Jewish writers would have made extensive use of design arguments. The writings of Todd Endelman and David Ruderman might lead us to the same conclusion. According to Endelman, Anglo-Jewry sought to acculturate to the norms of English society—including, presumably, the prevalent deployment of design. Again, in his analysis of the writings of David Nieto, the *haham* of the Sephardi community during the early eighteenth century, Ruderman writes that Nieto absorbed 'the dominant theological positions of his Christian contemporaries and . . . reformulate[d] them as Jewish theology' when addressing his Bevis Marks congregation consisting of 'assimilated, secularized, highly ambitious but politically and culturally insecure Jewish merchants'.[39]

However, contrary to these expectations, surprisingly few Anglo-Jewish writers deployed design arguments, in comparison with their very frequent occurrence in the writings of Christians, Quakers included. Before examining some of the few examples of their use in Jewish texts, it is appropriate to determine why design arguments were not more widely used. Their lack of prominence cannot be explained by any incompatibility with Jewish philosophy. Indeed, the opening verse of Psalm 19—'The heavens declare the glory of God and the firmament showeth his handiwork'—was frequently cited, and provided a valuable resource, for both Jews and Christians, demonstrating that the universe was divinely designed. In similar vein, Judah Halevi (early twelfth century) exclaimed: 'For in the smallest worm there are revealed the wonders of His wisdom in a manner unfathomable to our mind.'[40] Yet the

[37] M. Joseph, 'Theology and science'.
[38] Brooke, 'Natural theology of the geologists'.
[39] Endelman, *Jews of Georgian England*; Ruderman, *Jewish Thought*, 317.
[40] Ruderman, *Jewish Thought*, 33.

centrality of Torah to Judaism also provides some leverage to the above question. While design arguments were particularly important to Christians who emphasized rationality over Revelation, British Jews were closer to those High Church and evangelical Christians who, while not denying divine design, saw natural theology as subsidiary to Revelation. Another reason for the relative absence of such ideas in the writings of Jews is that, in contrast to Christianity, there is little emphasis on religious belief; instead, Judaism generally stresses the importance of *mitzvot*—the performance of duties. Design arguments also have little bearing on the fundamental covenantal relationship between the Jewish people and God. There is no question in Jewish theology but that the physical world was created by God; yet there is also no requirement to demonstrate his power, wisdom, and goodness. Thus, within Judaism there are no strong reasons to use providentialist arguments in trying to convince a Jew of the existence and attributes of God. Moreover, since very few members of Anglo-Jewry engaged in nature study, most being urban dwellers, little attention was paid to the kinds of empirical observations on which design arguments were based, such as the structure of flowers or the annual agricultural cycle. As we shall see, in those instances in which Anglo-Jews deployed design arguments, the context usually indicates an external stimulus. For example, in appealing to divine design, Nieto formulated a response to his congregants who, in his view, were excessively attracted by deism and dismissive of science.[41] It should also be noted that while the two books analogy—that the 'book of nature' is to be read in a similar way to the Bible—was extensively deployed by Christian theologians, it was not used in rabbinic commentaries.[42]

Despite their general absence, it is worth considering the few significant uses of design arguments by British Jews. Like Nieto, Emanuel Mendes da Costa, who belonged to his congregation,[43] borrowed from contemporary providentialist discourse, which he encountered in such books as John Ray's *The Wisdom of God Manifested in the Works of the Creation* (1691), which opened with a discussion of Psalm 104, verse 24: '*How manifold are thy Works, O Lord! In Wisdom hast thou made them all.*' The paradigm parson-naturalist, Ray surveyed numerous aspects of the physical world, including the planets, the oceans, fossils, birds, meteors, the heart, ears, teeth, and bladder. Every facet of nature appeared so well designed and suited to its purpose that it exhibited God's providence. On almost every page of his book Ray drew the

[41] Ibid. 310–31; Petuchowski, *Theology of Haham David Nieto.*

[42] See Harrison, *Bible, Protestantism, and the Rise of Natural Science*, for the history of the two books metaphor.

[43] Da Costa was 11 years old when Nieto died.

triumphant conclusion that all creation manifested God's 'Wisdom and Goodness'.

Following this contemporary convention, da Costa included theological reflections in the prefaces to his three main publications. For example, in his *Elements of Conchology* (1776) he claimed that the study of beautiful shells will 'insensibly... lead the amazed admirer into the contemplation of the glory of the Divinity'. Likewise, in the dedication to his more weighty and expensive *British Conchology* (1778), he portrayed his patron, Sir Ashton Lever, as a 'truly religious' naturalist who contemplated 'the numberless, stupendous, and incomprehensible Works of the Awful and Eternal DIVINITY'.[44] Natural theological tropes also appeared frequently in his correspondence. For example, writing to the Cornish clergyman, William Borlase, he stated that the study of natural history 'leads us to the Causes of our Creation, viz. to adore the great Eternal Being, & to provide Ourselves with the worldly necessities we want'.[45] His use of providentialist language appears to have been shaped by his search for patrons, and he therefore deployed conventional physico-theological terminology that would have been acceptable to his readers, both Christian and Jewish. Interestingly, da Costa displayed some traditionally Jewish conventions: for example, he avoided using the name of God, preferring instead 'the Almighty', 'the Divinity', or 'the Great Creator'. However, he was committed to a form of providentialism that was principally Christian, rather than specifically Jewish.

A later Jewish writer who deployed design arguments in writing for his patrons was Alexander Alexander (1804–87), an optician from Exeter. In his *Treatise on the Nature of Vision* (1833) he engaged a topic of practical importance, and a traditional subject for physico-theological reflection. In concluding the introduction to this work, he articulated the pantheistic and potentially dangerous claim that the faculty of sight 'has ever been considered one of the greatest gifts [that] nature has bestowed on mankind', but quickly added that through the powerful agency of sight, 'we become acquainted with the works of the Creator, [and] we are enabled to trace His wisdom, His power, and His goodness, in every object that surrounds us'. He then turned to the significance of the eye itself:

> an organ not less to be admired for its mechanical properties, than its wonderful structure. Its appearance, and the numerous contrivances... by which all its motions are performed, excite unutterable astonishment, and clearly point it out as one of the most inimitable works of Divine Wisdom.[46]

[44] Da Costa, *Natural History of Fossils*, p. vi; *idem*, *Elements of Conchology*, 1; *idem*, *Historia Naturalis Testaceorum Britanniae*, i. pp. iii–viii.

[45] Da Costa to William Borlase, 16 June 1748, EMdC, ii. 11.

[46] A. Alexander, *Treatise on the Nature of Vision*, p. xi.

We should look to Alexander's social context to ascertain his reason for deploying these appeals to divine design. The work was dedicated to the king, William IV, 'by special permission'. Alexander was also 'optician in ordinary to their Royal Highnesses the Duchess of Kent, and the Princess Royal [subsequently Queen Victoria]'. The list of subscribers included the Duke of Bedford, many local aristocrats, and a host of eminent medical men. However competent an optician, Alexander was nevertheless their social inferior, and was highly dependent on their patronage. In this context, conventional appeals to divine design were not only appropriate, but particularly fitting for an author who was not of the Christian faith.

The most enthusiastic deployment of design arguments by an Anglo-Jewish writer appeared in J. L. Levison's *Mental Culture; or a Means of Developing the Human Faculties* (1833). Here, Levison (1800–74) argued that phrenology was the great motor of human progress and improvement. During the previous decade, phrenology had taken root in Britain, but despite its widespread popularity, it remained a highly contentious subject. Clergymen in particular attacked phrenology as both materialistic and atheistic, since it explained the operations of the mind by a physical entity, the brain, composed of a number of distinct organs, each of which was responsible for a specific mental faculty. Thus, for example, the size of the organ of 'philoprogenitiveness' determined whether a person possesses the potential to love children, while the organ of 'memory' determined the ability to memorize. By contrast, theology conspired with much contemporary philosophy in upholding a dualism between mind and matter, and portrayed the mind as immaterial. Since phrenology reduced mental operations to the matter comprising the brain, it was branded as atheistic. However, some phrenologists, like Levison and later George Combe, sought to refute this charge, and to demonstrate that phrenology led not to atheism, but instead raised our appreciation of God through the signs of design to be found in the structure of the mind/brain. The 'great truth' proclaimed in Levison's book was that 'the mental laws form no exception to those unerring arrangements which the Almighty Mind hath imprinted on all the other numerous objects of this well-harmonized creation!'

The fact that the mind had been designed by 'that Fountain of all goodness, power, and wisdom, the eternal and immutable Great Cause of all things' engendered a number of implications. Most importantly, Levison argued that knowledge of the laws governing the human mind would enable those familiar with phrenology to live good, pious lives, since they would be adhering to nature and would not be struggling pointlessly against the immutable structure of the world. (Levison thus appears to have granted the individual a degree of free will, which he did not attempt to reconcile with his otherwise deterministic account of mind.) He also used the following physico-theological argument to assert the truth of phrenology. This science, he claimed, 'is too perfect to be speculative, and too illustrative of the mental operations, to be mere invention of a human being: like all the works of God, it bears indelible evidence of comprehensive design, and constant harmony'.[47] Although he mounted a spirited defence of phrenology, Levison is unlikely to have impressed Christian readers. When George Combe, the leading phrenologist in Britain, published a similar defence in 1847, it was met by a barrage of opposition from those who considered that he had merely confirmed their view that phrenology is atheistical.[48] While Levison contributed to the controversy over phrenology, his theological arguments were in no sense Jewish. Indeed, his book could have been written by any deist. Yet it is interesting precisely because a Jew employed the armoury of the deist in writing for a general audience.

The above examples suggest that writers like da Costa, Alexander, and Levison deployed design arguments principally with an eye to their predominantly non-Jewish readership. Rarely did design arguments occur in the Jewish periodical press, compared with their common appearance in the Quaker press or in most of the other Christian periodicals.[49] One of the very few exceptions was an article 'On the history of nature as conducive to religion', published in an early issue of the *Jewish Chronicle*. Its anonymous author insisted that nature study was important for the promotion of religion, since God's providential plan could be perceived in the structure of the physical world. Thus, 'in the education of our children', parents should 'make the study of nature, and through it of nature's God, a primary feature'.[50] A much later example occurred in an 1873 lecture on geology delivered to Jewish working men by David Lionel Salomons, in which he deployed Paley's famous watchmaker analogy.[51]

The contexts of these last two examples should be noted; the former was an argument directed to children (via their parents), and the latter a lecture to working men. Context is also crucially important in the following examples. *Sabbath Evenings at Home; or, Familiar Conversations on the Jewish Religion, its Spirit and Observances* (1856), was written by Miriam Mendes Belisario and revised by David de Sola, the cantor at the Bevis Marks Synagogue. Adopting

[47] J. L. Levison, *Mental Culture*, 102, 113.

[48] Combe, *On the Relation between Religion and Science*. See Gibbon, *Life of George Combe*, ii. 227–37.

[49] Information from Jonathan Topham, who has studied several Christian, mainly evangelical, periodicals.

[50] 'On the history of nature as conducive to religion', *JC*, 10 Dec. 1841, 22–3.

[51] *JW*, 11 Dec. 1873, 3.

the dialogue form that was endemic in both scientific and Christian educational works, Belisario sought to comprehend all aspects of the Jewish religion in twenty-four conversations between two children—Ruth and Jacob—and their aunt. 'Natural religion' was the subject of the second conversation, which commenced with the aunt explaining the meaning of the term to Ruth, who was clearly much more intelligent than her brother. The night sky, Ruth's garden, and a country holiday provided evidence of God's relation to the physical world: 'we cannot take a walk in our garden . . . without at every step meeting some memorial of God's power and goodness'. When Ruth watered her plants, thus enabling them to grow, her aunt asserted: 'we recognise the All-directing hand of the Almighty. *Nothing* is too insignificant for His fostering care, for *all* is alike the work of His creation.' Except for the occasional turn of phrase, these passages would not have looked out of place in a book directed to Christian children.[52]

'Natural religion' also occupied the first sixty pages of a primer by Nathan Solomon Joseph entitled *Religion Natural and Revealed: A Series of Progressive Lessons for Jewish Youth* (1879). Educated at University College London, Joseph was a member of Simeon Singer's congregation, and shared his fairly progressive approach to religion. As he lamented in his preface, the 'rationalistic tendencies of modern thought have administered a rude shock to all religions'. Yet his response was to write a book that avoided dogmatism but instead appealed to the reasoning powers of its young readers. While the bulk of the work was directed to Torah and its implications for how we live, the section on natural religion contained a number of arguments based on observations of the physical world. Indeed, the book opened with a number of design arguments. Stones, plants, and birds could not be self-existent, but require a maker. Drawing the analogy with a steam-engine, Joseph proceeded to argue that the human body must likewise have been designed. Having established the existence of God to his satisfaction, Joseph appealed to the natural world in order to determine his attributes.[53]

A third example is Ellis Davidson, whom we encountered in section 5.8, whose lectures and books were directed to working men and to children. He frequently used design arguments. Even his *Bible Reader* (1877) contained extensive appeals to nature in order to delineate divine design and to support a providentialist theology. For example, having described God as 'the Maker of heaven and earth, and all that is in them', he stated that God 'watches over

[52] Belisario, *Sabbath Evenings at Home*, 15–26, 186–7.

[53] N. S. Joseph, *Religion Natural and Revealed*, pp. v–ix, 1–60. However, in an appendix (pp. 257–9) to be used by teachers, he admitted that the argument from design had been 'weakened, if not wholly invalidated' by the theory of evolution.

us throughout our whole lives'.[54] Like the two previous works, Davidson's many theological reflections could have been written by a non-Jew for a non-Jewish juvenile readership.

Thus, on the rare occasions when Jewish authors appealed to design arguments, they were usually addressing either a broad, largely Christian audience or children. The juvenile texts by Belisario, Joseph, and Davidson did not present design arguments in isolation, but also discussed Torah and Jewish observances. Thus the approach to God via nature was presented as a supplementary approach to religion, and a further bulwark against the temptations of irreligion. Moreover, Jewish children could join their Christian neighbours in pursuing this universal and non-denominational facet of religion.

8.4 Scientific method

Discussions of scientific method tend to focus on attitudes to empiricism, on the one hand, and on the role of theories, hypotheses, and speculations, on the other. For some scientists and philosophers, these have represented rival paths to understanding the physical world, while for others, facts and theories bear a close reciprocal interrelation. As noted in Chapter 6, Quakers of the eighteenth and nineteenth centuries tended to be empiricists, who stressed the importance of personal witness. While they were often prepared to employ scientific theories, they remained sceptical about any such system of thought, and were open to alternative explanations. In this section the views of Anglo-Jewish writers on these issues will be examined. However, in contrast to the fairly limited range of positions adopted by Quakers, no uniform viewpoint emerges.

If there has been a Jewish attitude to empiricism, it can best be characterized as rather unenthusiastic, but not anti-empiricist. In the Torah and rabbinic sources the senses are deemed necessary and important. For example, in referring to those who lived in biblical times, Deuteronomy 11: 7–8 emphasizes the significance and validity of sensory evidence, since with their own eyes these people, having 'seen all the great acts of the Lord which he did', will thereby be persuaded to keep all the commandments. Their acceptance of God's commandments depended not on an act of faith but on perceiving the visible evidence of God's actions. However, later generations, who do not possess direct experiential evidence of God's 'great acts', have to depend on testimony. Empirically based knowledge is therefore transmitted through testimony, both textual and oral. Thus, in contrast to religious traditions

[54] Davidson, *Bible Reader*, 21.

that express scepticism about the use of the senses, Judaism at least possesses an empiricist core. Although such a stance evokes similarity with science, it should not be overemphasized, the significant point being the somewhat limited claim that empirical evidence is recognized as important in the Torah.[55]

A few examples can be given of (principally eighteenth-century) Anglo-Jewish writers who asserted that knowledge of nature must be based on observation and experiment. In adopting this position, they were inevitably influenced by the strong contemporary empiricist tradition exemplified by the writings of Bacon and Locke, and often attributed also to Newton. Emanuel da Costa, for example, opened his *Natural History of Fossils* by stating that he would describe specimens 'according to the appearances which they exhibit to the senses'. Mordechai Gumpel Schabner Levison likewise stressed the authority of experiment in his 1776 dissertation on the nature and function of the blood. Yet, he contrasted the philosophically inclined physiologist, who is 'deservedly crowned with honor and reputation, for his observations that tend to discover the knowledge of diseases and their cure', with the careless empiric who submits animals to considerable pain by a 'multiplicity of experiments'.[56] For Levison, then, empirical evidence was crucial for advancing scientific knowledge, but experiment is not an end in itself; instead, it must be judiciously planned and performed in order to advance science by useful discoveries. In adopting their empiricist positions, da Costa and Levison were probably far more indebted to British empiricism than to Jewish sources.

While accepting the need for empirical evidence, most Jewish commentators have been willing—even avid—to frame higher-level generalizations. As Hyam Maccoby has remarked, the aim of Talmudic discourse is 'to systematize the laws found in the Torah, so as to make them flexible enough to be applied to new situations'.[57] While this emphasis on new situations again stresses the need to engage experience, the way of resolving such situations is to work from known cases by analogy or through framing general principles. The Jewish legal system is therefore founded both on case law, such as events that were recounted in the Torah, and on the need to evolve general principles that enable a rabbi to determine principles that help to resolve individual cases.

[55] Maccoby, *Philosophy of the Talmud*.

[56] Da Costa, *Natural History of Fossils*, pp. v–vi; G. Levison, *Essay on the Blood*, pp. xvi, xviii. David Ruderman (*Jewish Thought*, 353–7) argues that in a later work written in Hebrew Levison's enthusiasm for empiricism undermined traditional Jewish commitments.

[57] Maccoby, *Philosophy of the Talmud*, 162.

However, scientific theorizing involves far more than a willingness to engage generalizations and abstractions; in particular, scientists must develop and assess models of the physical universe. No clear consensus existed among medieval Jewish thinkers, who adopted a range of views about the physical theories of the Greeks. Thus, while some writers kept Greek philosophy and science at arm's length, others confronted it directly. Gersonides (fourteenth century) was perhaps the most enthusiastic about accepting Aristotle's astronomical theories, while Maimonides sought to retain those parts that were commensurate with a Jewish perspective, jettisoning in particular Aristotle's claim that the universe has existed for all time as an idea incompatible with Genesis. The early fifteenth-century Spanish philosopher Hasdai Crescas likewise reflected critically on Aristotle's science, accepting that the world is eternal but, as Norman Solomon has noted, also arguing (*contra* Aristotle) that the same laws applied in both the celestial and the terrestrial domains.[58] A number of early modern Jewish scholars, such as Moses Isserles, the Maharal, and David Gans, paid increasing attention to secular scientific theories, but also often sought to distinguish clearly between scientific theories of the natural world and the more metaphysical issues pertinent to religion. Thus science could be pursued independently of religion. David Ruderman sees this separation as particularly important in creating an early modern Jewish approach to science and scientific theorizing, allowing for a pursuit of science unhindered by religious scruples and a willingness to frame theories that offered good explanations of the empirically derived evidence.[59]

From this perspective da Costa's caution to his readers 'not to indulge in hypotheses and systems' seems overly defensive, and may again indicate his eagerness to adopt contemporary English norms.[60] Far more consistent with the above approach would be Jacob de Castro Sarmento's 1737 analysis of the tides using Newton's theory of gravitational attraction, Henry de Worms's 1862 study of the earth's motions (which drew on a wide range of scientific theories), and Raphael Meldola's enthusiasm for Darwin's theory of evolution.[61] Moreover, the appeal to more abstract and generalizing modes of

[58] Solomon, 'Natural Science'.

[59] Ruderman, *Jewish Thought*, 54–91.

[60] The quixotic Da Costa was strongly opposed to the intellectual systems adopted by his contemporaries, particularly if they contradicted his own. See Da Costa, *Natural History of Fossils*, pp. v–vi; *idem*, *Elements of Conchology*, pp. iv–v; da Costa to Edward Wright, 5 Apr. and 17 July 1759, EMdC, xi. 271–2, 282–4; Poultney to da Costa, 28 Oct. 1778, EMdC, viii. 90–1. See also da Costa to John Anderson, 10 Feb. 1776, EMdC, i. 29; da Costa to Poultney, 25 Apr. 1776 and 3 Oct. 1778, EMdC, viii. 57–8, 84–5. J. E. Smith (*Correspondence of Linnæus*, ii. 495) suggests that Da Costa's hostility to Linnaeus resulted from his failure to be elected to the Royal Swedish Academy.

[61] Sarmento's work is discussed in sect. 5.4, Worms's in 3.3.2, and Meldola's in 9.4.

thought is exemplified by those mid nineteenth-century Anglo-Jewish mathematicians who either focused on pure mathematics or applied mathematical techniques to practical problems. For example, in drawing up actuarial tables, Benjamin Gompertz utilized the methods of calculus. While he made use of empirical evidence, the thrust of Gompertz's research was to frame a general theory of life expectancy. Indeed, he is best known for his 'law of mortality', which postulates that mortality follows a geometrical progression. With the exception of da Costa's rather conventional rejection of hypotheses, these examples suggest a robust attitude towards scientific theorizing, which contrasts with the suspicion of reason and theory among evangelical Quakers. Most importantly, in contrast with the Quaker emphasis on the individual's experiential judgement of evidence, Jews seem more willing to deploy abstract ideas, such as scientific theories, in applying intellectual rigour to the secular problems of science.

One specific epistemological issue deserves close attention. In his insightful analysis of Talmudic attitudes to knowledge, Menachem Fisch has characterized two opposing approaches. Some of the rabbis who contributed to the Talmud emphasized the maintenance of tradition, thus minimizing change and asserting their role as conservative interpreters of *halachah* (the Law). By contrast, other rabbis advocated a far more critical and open-ended approach to decision making that allowed traditional views to be challenged. For example, Rabbi Elazar ben Azaria (first century CE), who became the leading rabbi at Jabne, adopted the procedure of decision by majority vote, thereby enabling tradition and authority to be challenged if the arguments for change were sufficiently strong. Thus rational argument could triumph over dogma and tradition. Moreover, any decision could be overthrown if the counter-evidence subsequently obtained were compelling.

Of the examples offered by Fisch, the dispute between Rabbis Elazar and Eliezer ben Hyrcanus (over whether a particular variety of earthenware oven was to be deemed kosher), is particularly fascinating. Eliezer appeared to be losing the argument and with bad grace. He therefore sought support from a higher authority: 'He said to them [the assembled rabbis]: If the *halachah* agrees with me, let this carob tree prove it. Whereupon the carob tree was torn a hundred cubits out of its place.' His opponents remained unimpressed. After several other attempts to sway them by further miracles, Eliezer ben Hyrcanus appealed to the ultimate authority: '[He cried] "If the *halachah* agrees with me, let them prove it from the heaven!" [whereupon] a heavenly voice issued forth and declared: "What have you against R. Eliezer, for the *halachah* agrees with him everywhere!"' This divine intervention did not settle the dispute, however, since Rabbi Elazar's supporters chastised God for interfering, reminding him that such matters of contention have to be decided by humans. Thus appeal to authority, even the highest authority, was not an appropriate method for resolving problems. Instead, it is incumbent on humankind to find the best available solution, but to recognize that any solution is provisional, and may in time be replaced by a better one.[62]

Similar epistemological attitudes are to be found in eighteenth- and nineteenth-century Anglo-Jewish publications, including Levison's *Essay on the Blood* (1776). The context for these reflections was a dispute between Levison's mentor, John Hunter, and another physician, James Hendy, who had challenged Hunter's contention that the blood is alive.[63] In responding to this attack on his teacher's physiological theories, Levison focused on Hunter's critical empiricism, claiming that 'you [Hunter] would not hesitate to reject' scientific theories 'the moment their fallaciousness be proved' by counter-evidence. Elaborating on this theme in his preface, Levison pointed out that speculative knowledge was necessarily open to possible refutation, and he expressed the hope that his views would

> not be treated with the severity of criticism, but with the generosity of candour, even should some of them be found fallacious; for many true discoveries have been investigated by the means of some new, even false opinions started; and many precious and noble edifices have been raised upon the ruins of others; if that should be my case; if this essay should excite men to real knowledge [by testing] . . . my conjectures; I shall . . . think my labour well paid, and amply rewarded.[64]

While such anti-dogmatism had been emphasized during his education at Hunter's medical school, Levison may have found it all the more appealing because, having previously studied under an eminent German Talmudist, this approach to scientific theorizing cohered with the anti-authoritarianism within the Jewish intellectual tradition.

A second example of an open-ended attitude towards scientific knowledge appears in Herschell Filipowski's *Sefer Assiph*, which included the first number of his *Annual Hebrew Magazine* (5608 (1847–8)). Expressing his intention to publish several signed essays in the next number, he stated that every 'man of science will acknowledge that "*truth is the result of discussion*", and that [in the search for truth] delight is [to be] found in removing a doubt if it be within his power'.[65] Filipowski appreciated that the development of scientific knowledge depended on its progressive refinement in open debate, and not on dogmatic assertion. As an able Talmudic scholar, he, like Levison, may

[62] Fisch, *Rational Rabbis*; Maccoby, *Philosophy of the Talmud*, 159–72, 191–201.
[63] Hendy, *Essay on Glandular Secretion*.
[64] G. Levison, *Essay on the Blood*, pp. iv–xviii.
[65] Filipowski, *Assiph*, n.p.

have recognized that this prescription for science paralleled the anti-authoritarian strand within Judaism.

Finally, an informed exposition of Jewish epistemology was published in the *Jewish Chronicle* in 1876. The writer championed the extension of scientific education in schools, a move which he considered should be particularly welcomed by the Jewish community, because Judaism, unlike Christianity, was commensurate with the scientific approach to knowledge. He also claimed that the Jewish understanding of miracles was not opposed to science, since miracles were not the arbitrary whims of the deity but were enacted by God only in order to impress us with a moral point. To illustrate his argument, the author used the example given above of the dispute between Rabbis Elazar and Eliezer ben Hyrcanus, which placed decisions firmly in human hands. At the same time, added our author, the rabbinical tradition considered that nature is law-like; however, the historical events related in the Torah had often been embellished and poeticized. Therefore such problems as the age of the earth and the motions of the heavenly bodies must be addressed by science, and should not be seen as part of religion. From this standpoint science was deemed independent of religion.

For this author, authority was the crucial issue. While Christianity had repeatedly asserted its authority over men's minds—thereby coming into conflict with science—Judaism had not: 'Never sat the rabbis in judgement on these scientific questions and gave their verdict *ex cathedrâ* on them.' Instead, Judaism had encouraged freedom of thought, and the Talmud demonstrated that diverse but perfectly acceptable divergences of opinion could be adopted on almost every subject. Citing the example of kabbalah as an extreme mutation of Jewish tradition, the author noted that it was never outlawed by the rabbis. Rather than imposing its authority over scientific issues, Judaism had tolerated 'the broadest differences of opinion in all philosophical and scientific matters'. In its intellectual openness and critical awareness, the Jewish tradition had an ally in science.[66]

Although the author of this 1876 article was perhaps too fervent in his insistence that Judaism had always supported science, he nevertheless recognized that Jewish tradition allowed a high degree of autonomy in the study of the physical universe. Rather than appealing to the authority of either Torah or rabbinic tradition, he considered that Jews should use reason in order to theorize about the structure of the natural world. Such theories were to be encouraged. One implication of this view was that we are fallible, and that the best scientific knowledge will arise only through dialogue.

[66] 'Advancement of science', *JC*, 14 Apr. 1876, 25–6. A present-day example would be Gould, *Rock of Ages*.

While it is tempting to argue that this writer expressed a specifically Jewish approach to science, the evidence presented in the preceding sections is not overwhelming. Although a number of Anglo-Jewish writers of the eighteenth and nineteenth centuries adopted views that were commensurable with the traditional viewpoint he articulated, others, such as da Costa, maintained opposing positions that owed more to contemporary scientific practices, and were thus responsive to the social pressures on Jews in Britain.

9
Jewish Responses to Evolution

While an extensive literature exists on Christian responses to the challenges posed by science, especially evolution, Jewish responses have attracted little attention. As we shall see, Anglo-Jewish writers not only mediated between their religious tradition and recent developments in science, they also framed their views in response to the contemporary place of Jews in a dominantly Christian country. To what extent, then, did Anglo-Jewish writers endorse the views of the radical scientific naturalists? Or did they share the views of the many Christians who considered science as materialist and atheistical?

9.1 Positioning Anglo-Jewry with respect to mid-Victorian science

As pointed out in section 8.2, the Jewish periodical press rarely carried articles on Mosaic science after the early 1860s. Instead, Anglo-Jewry became increasingly aware of recent developments in contemporary science. Thus the anonymous author of an 1863 article on 'The wonders of nature' cited the contemporary Arctic explorations of Elisha Kane, and then portrayed nature as magnificent, noble, and mysterious. For this writer, nature was continually in flux and evolving into higher forms. Although not manifestly influenced by Darwin's book, this article captured the contemporary ethos of progress and evolution.[1] Another example of the increasing visibility of science was the *Jewish Chronicle*'s recognition in 1865 that scientific research had challenged the biblical narrative—'a remarkable sign of the times'. Clearly perturbed by this challenge, it published the text of the 'Scientists' declaration', which had been signed by 700 'scientists', who sought to reaffirm the harmony between science and religion that had recently been disturbed by materialistic and evolutionary ideas.[2]

Yet, the overwhelming consensus, as reflected in the mid-Victorian Jewish press, was that Judaism and science were not merely compatible, but that Jews and Judaism positively encouraged the scientific enterprise. Thus in 1853 the

[1] *JC*, 10 Apr. 1863, 5.

[2] *JC*, 14 July 1865, 7; Brock and MacLeod, 'Scientists' declaration'. Despite the large number of signatories, few scientists of note signed the declaration.

Hebrew Observer carried a short article on *Haham* Raphael Meldola (1754–1828), who, it was stated, included among his Christian friends the eminent astronomer Sir William Herschel. Nor was Meldola 'a stranger to the cultivation of science, which, as an enlightened man, he pursued with considerable success'.[3] The community could therefore take pride in this respected Sephardi rabbi who was also 'an enlightened man' and a cultivator of science. Although Anglo-Jewry included few such leaders, it wanted to portray itself, both to its own members and to the Christian majority, as engaging the modern world, and therefore as participating in the nation's intellectual progress. This response should be understood in the context of both the Anglo-Jewish community and also the community's relationship to the wider, Christian society, in which science was increasingly seen as aligned with atheism. In particular, science was deployed within Anglo-Jewry to answer the recurrent gibes of the anti-Semite and the conversionist who claimed that Jews were intellectually inferior to Christians. By responding positively to science, Anglo-Jewry sought to negate these criticisms and to dispel the widely perceived cultural deficit.

One of the staunchest advocates of the peaceful and necessary coexistence of science with Judaism was Abraham Benisch (1811–78), who edited both the *Hebrew Observer* (1853–4) and the *Jewish Chronicle* (1855–69, 1875–8). Thus, in discussing the curriculum to be adopted by the proposed Jews' College and School in 1853, Benisch urged the inclusion of both mathematics and natural philosophy, on the grounds that while science required the steadying hand of Scripture, '[t]rue religion can but find a complement in the spreading of [natural] knowledge'. Taking his cue from a recent lecture by the Chief Rabbi, Benisch appealed to imagery derived from the Song of Solomon: he likened science and Revelation to ' "two roes that are twins"; they supply, support, and complete each other'.[4] Likewise, a report of the 1868 Norwich meeting of the BAAS provoked an editorial in the *Jewish Chronicle* proclaiming that these annual meetings were particularly relevant to Jews because Judaism encourages scientific progress: 'Not only has it [Judaism] nothing to fear from the advancement of learning, but the furtherance of such advancement is in full accordance with the spirit of the faith, and with the duties of a believer.'[5] Even Tyndall's Belfast Address, which was widely interpreted as advocating a materialist, anti-religious, and evolutionary philosophy, was interpreted by two rabbis—A. L. Green and Hermann Adler (the Chief Rabbi's son)—as

[3] *HO*, 15 Apr. 1853, 115.
[4] *HO*, 16 June 1853, 188. Cf. S. of S. 4: 5.
[5] 'The British Association at Norwich', *JC*, 4 Sept. 1868, 4.

confirming the view that proper advances in scientific knowledge must necessarily cohere with Torah.[6]

However, during the 1860s and particularly the 1870s, the Jewish press published a number of articles that not only argued the compatibility between Judaism and science, but also sought to demonstrate that Judaism could engage science far better than Christianity. For example, one of the regular columnists reflected on the turmoil within Christianity caused by Tyndall's 1874 Belfast Address. 'There is hardly a Christian doctrine', asserted the writer, 'which does not directly or indirectly place itself in opposition to some established principle, departure from which would involve a logical contradiction or a physical impossibility.' He particularly cited the doctrine of salvation according to which a person will be saved if he or she adopts Christianity; by contrast, those who have not heard of Christianity or who deny it will be assigned to perdition. Such a doctrine was clearly incompatible with a rational scientific mentality. Unlike Christianity, Judaism required no such bizarre beliefs. Thus, there 'is only one theology in existence which is not antagonistic to science—this is Jewish theology'.[7]

The contrast between Christianity and Judaism was also emphasized by the *Jewish Chronicle* in its response to the evidence presented by the BAAS in 1876 to a Royal Commission charged with investigating science teaching. The writer (possibly Benisch) posed the question whether the introduction of science into the classroom would have any impact on the religious outlook of children. In answering this question, he reflected the uneasy state of Jewish–Christian relations. The impact on Christianity, he argued, would be profound, since Christianity is a dogmatic religion, and young minds trained in science will therefore rebel against the authority of an intransigent and unyielding creed. By contrast, Judaism made no such demands, but allowed liberty of opinion and advocated toleration 'of the broadest differences of opinion in all philosophical and scientific matters'.

The conclusion consequently at which we arrive is that while the dominant religion will have to undergo great modifications and will sustain great shocks by the general diffusion of science education, Judaism will only be the more firmly established and will find no insuperable difficulty in harmonising the results of Science with the religion given on Sinai.[8]

6 *JC*, 28 Aug. 1874, 352; 4 Sept. 1874, 368; C, 'Tyndall', *JC*, 11 Dec. 1874, 589. The pseudonymous author—'C', possibly a non-Jew—could find no evidence in the Belfast Address that Tyndall was an atheist; rather, he had kept within the legitimate domain of natural science. At worst, Tyndall could be accused of having stoked controversy by a careless choice of words. In 1881 one correspondent even referred to Tyndall's 'celebrated address . . . at Belfast': *JC*, 2 Sept. 1881, 3–4. See Lightman, 'Scientists as materialists'.

7 'Science and theology', *JC*, 24 Sept. 1875, 412.

8 'Advancement of science', *JC*, 14 Apr. 1876, 25–6.

Thus, in the writer's opinion, the extension of scientific education could only be beneficial to Anglo-Jewry, and therefore should be warmly welcomed.

One of the most prominent discussions of science and religion appeared in a pair of leader articles in 1864, in which Benisch responded to a widely reported lecture delivered by the Bishop of London, Archibald Campbell Tait. Under the title *Harmony of Revelation and the Sciences*, Tait had taken issue with those Christians, especially evangelicals, who in turning to the Bible had denied that reason should play any role in religion, and also those, following Hume, who argued that in contrast to science, which is beholden to reason, religion rests solely on faith. Clearly troubled by these arguments and the difficulties they raised for Christians with respect to both science and their own understanding of Christianity, Tait insisted on placing reason at the forefront of religion, and refused to accept any doctrine, however revealed, if contradicted by reason. Without reason, he warned, religion is liable to slide into superstition. Benisch was greatly heartened by this lecture, and recognized

> Dr. Tait as one of ourselves, since the position taken by him is precisely that held by the most orthodox and most eminent Rabbis. These have long ago declared that knowledge must precede faith, and that no statement, whatever the amount and weight of external evidence brought forward in its behalf, can have proceeded from God, if it is in direct contradiction to reason.

This position, he claimed, was further justified by the Pentateuch and the Prophets; for example, King David asked for 'wisdom and knowledge' rather than faith (2 Chr. 2: 10–12).

While Tait had sought to align reason, religion, and science, Benisch derived a very different moral from the Bishop's lecture. Since this eminent churchman had adopted a Jewish perspective on the role of reason, Benisch predicted that Christian–Jewish relations should improve dramatically. While each group would maintain its own religion, Christians would cease trying to convert Jews, instead accepting them as equals, both intellectually and morally. The highly contemptible doctrine of salvation would be abandoned in favour of more reasonable principles which could be accepted by both Jews and Christians.[9] Benisch's response is interesting because, although he possessed little knowledge of recent developments in science, he turned the Bishop's lecture into a pointed attack on evangelical Christians, and identified an intellectual position that was acceptable to Jews and more rational Christians.

[9] *JC*, 18 Nov. 1864, 4–5, and 2 Dec. 1864, 4–5. Tait, *Harmony of Revelation and the Sciences.*

The Chief Rabbi, Nathan Marcus Adler (1803–90), adopted a similar tack in an 1872 Sabbath sermon. Taking 'Science and religion' as his theme, Adler, who had studied at the universities of Göttingen, Erlangen, Würzburg, and Heidelberg, expressed a wide range of opinions about modern science, which reflected the concerns of Anglo-Jewry. Although he warned that if practised in an overly scientistic manner, science could pose a threat to Judaism, he was generally supportive of science. The sermon opened with a reference to the contemporary 'warfare or contest between Science and Religion', which he considered to be a long-running dispute but one that had recently become more intense, with the majority of Christians united in their hostility to reason, and thus to science. By contrast, there had been little or no conflict between science and Judaism. Since 'faith and reason go hand in hand', 'our holy faith has nothing to fear' from science. He thereby demonstrated the superiority of Judaism over Christianity in engaging science, and therefore modernity.[10]

A far more aggressive tone was adopted by Myer Davis, the editor of the *Jewish World* (which, selling at 1*d*., sought to undercut the *Jewish Chronicle* by appealing to a broader audience), in an editorial on Tyndall's Belfast Address. He suggested that in light of the prevailing conflict between Christianity and science, the Christian press should 'be filled with . . . reports that Christianity is losing its hold upon its professors, and that it is no more than it was of yore'. Faced by 'the steady advances of Materialism and Free Thought on the one hand, and by Ritualism on the other', Christianity was under attack, and Christians were therefore no longer in a position to cast aspersions on Jews. Erring on the side of caution, Davis advised his readers not to enter the fray between science and Christianity, but to stand above the mêlée. Yet, faced with widespread anti-Jewish and conversionist propaganda, Davis was clearly hoping that the tormentors of the Jewish community would be humiliated by losing their battle with Tyndall, Huxley, and the other scientific naturalists. Judaism, so often vilified by Christians, would emerge the more resilient religion.[11]

In these and in many other articles Judaism was portrayed as the torch-bearer of reason, set against the hordes of superstitious Christians. This perception was on occasions justified by the strong intellectual tradition within Judaism, exemplified both by Talmudic discussion and by the contributions of Jews to such areas as medicine and mathematics, especially during the golden age of Spain. Thus, a reviewer in the *Jewish Chronicle* noted that while science had blossomed under Judaism and Islam in medieval Spain,

[10] N. M. Adler, 'Science and religion', *JC*, 21 June 1872, 167.
[11] *JW*, 30 Oct. 1874, 4–5.

Christianity had not only suppressed that vital flowering, but had repeatedly sought to curb the growth of science. History therefore showed that Judaism had supported science, while Christianity had opposed it.[12]

The historical example of Maimonides was also cited frequently as showing how any apparent contradiction between science—in this case, Aristotelian science—and Judaism could be resolved rationally. For a committed Jew, Aristotle's assumption that the world was eternal had to be rejected in favour of a God-created one; however, Maimonides accepted many other aspects of Aristotelian physics. In his synthesis, reason did not have to bend before faith.[13] For mid-Victorian commentators like Benisch and Adler, this historical perspective indicated that Judaism could weather the current storm, because it had repeatedly succeeded in accommodating scientific innovation. Moreover, as pointed out earlier, these Jewish writers portrayed Jewish tradition as encouraging intellectual enquiry without hindrance by the religious authorities.[14] Thus, unlike Christianity, Judaism had allowed diverse viewpoints to flourish. In the light of this intellectual and anti-authoritarian stance within Jewish tradition, science posed no threat, and could only strengthen Judaism.

The arguments discussed above indicate that writers in the Jewish press adopted a somewhat detached and superior position in observing the turmoil that engulfed Christianity when it was confronted by the atheistical trends of modern science, especially Darwinism and its associated philosophy of materialism. Indeed, these writers portrayed Christianity as vulnerable to attack on those very issues that, in their opinion, divided Christianity from Judaism. While Christianity was embroiled in public conflict with science, Jews could now show that their tradition was not inferior, since it did not pit religion against science, and reason against Revelation. Unlike Christianity, it was the natural friend of science, and not its adversary. This viewpoint manifested the new confidence of Anglo-Jewry in the post-emancipation period, and offered a timely refutation of the stereotypical portrayal of Jews as intellectually inferior and of Judaism as an outmoded religion. Thus, the predominant Anglo-Jewish response to the challenging developments in Victorian science was not to confront them directly, but to deploy them in the ongoing, long-running, and painful controversy with those anti-Jewish elements within Christianity.

[12] Review of John William Draper, *History of the Conflict between Religion and Science*, in *JC*, 23 Apr. 1875, 57. See also 'Advancement of science', *JC*, 14 Apr. 1876, 25–6; 'Evolution', *JC*, 9 Sept. 1881, 4–5.

[13] Maimonides, *Guide of the Perplexed*; Rudavsky, *Time Matters*.

[14] *JC*, 14 Apr. 1876, 26.

9.2 Jewish assessments of evolution

Ralph Colp jun., Edward Dodson, and David Kohn have drawn attention to a fascinating Victorian Jewish response to the theory of evolution. In 1876 Naphtali Levy, from Radom in Russian-occupied Poland, wrote to Darwin enclosing a small Hebrew book he had written demonstrating the confluence between Jewish thought—especially his interpretation of Genesis 2: 7—and Darwin's theory of evolution. Immured in the controversy raging over the religious implications of evolution, Darwin was delighted and surprised to receive this ringing endorsement of his theory from a learned Jew and a complete stranger. Levy's enthusiasm for Darwin—'may he live long!'—contrasts with the fear and suspicion with which many contemporary Christians greeted Darwin's theory.[15] However, Levy's enthusiastic outburst was hardly typical, as Marc Swetlitz has shown in his studies of American Jewish reactions to Darwin in the period 1860–90. He argued that responses were very mixed, ranging from ringing support to outright rejection of the theory. Although American Reform Jews were generally more sympathetic to evolution than were traditionalists, Swetlitz found no strong correlation between religious affiliation and attitudes towards Darwin's theory. Instead, he accounted for a range of different responses to Darwin in terms of their authors' concerns about the future of the Jewish community in America, a subject of considerable apprehension to both Reform rabbis and traditionalists.[16] Was the Anglo-Jewish response similar to that of their American contemporaries? Or was it enthusiastic, like Levy's?

The *Jewish Chronicle* did not review the *Origin* or any of the other religiously controversial scientific works that appeared during the years following the book's first publication in 1859. However, as noted above, during the 1860s and 1870s the Jewish press contained a number of articles that welcomed science as perfectly compatible with Judaism. Although the theory of evolution was not often mentioned explicitly in those articles, it was implicitly included as posing no problem to Jews.

This comfortable assurance was rudely shattered in 1869 when the *Jewish Chronicle* published a letter from Alfred Gutteres Henriques, a barrister, respected communal leader, and member of the Reform synagogue. In this letter Henriques argued forcefully the radical thesis that Judaism is thoroughly incompatible with the 'Law of Evolution'. For example, he claimed that, in contrast to evolution, which posits continual change and mutability,

[15] Colp and Kohn, '"A real curiosity"'; Dodson, '*Toldot Adam*'. It is unclear whether Levy was an accredited rabbi.

[16] Swetlitz, 'Responses of American Reform rabbis; *idem*, 'American Jewish responses'.

'Jewish teaching insists on the very opposite mode of thought. Judaism is based on immutability.' He also argued that traditional forms of Judaism were outmoded in several other respects. Scientific rationalism denied the legitimacy of a hereditary priesthood, repudiated the biblical requirement of public sacrifices, and opposed the traditional legal and economic systems sanctioned by Jewish tradition. Indeed, although the central dogma of God's unity still remained intact, modern science undermined so many facets of traditional Judaism that Henriques doubted whether it could ever be revivified as a religion after Darwin's onslaught.[17] Not surprisingly, he was described by Israel Finestein as the 'most vocal . . . advocate' of progressive Judaism in Britain during the mid-Victorian period.[18]

The editor of the *Jewish Chronicle*, Michael Henry, was clearly so distressed by this forthright letter that he took the unusual step of prefacing it with remarks intended to refute Henriques's arguments. Contrary to Henriques's alignment of science with truth, Henry presented science as 'feeble', since its theories were not immutable; history showed that a theory accepted at one time will be rejected at a later date, and replaced by another. In contrast to the vicissitudes of science, proclaimed Henry, 'Judaism is eternal': it has 'withstood the scientific enquiries of centuries', and would not succumb to any present-day opponent. He then asserted, perhaps inconsistently, that 'every advance made by science demonstrates the truth and vitality of Mosaic Revelation'. Science and Judaism were, he believed, fully convergent. Not convinced that his editorial remarks had undermined Henriques's arguments sufficiently, Henry published a full-page article in the following week's issue, in which he repeated his criticisms at considerably greater length. With increasing fervour he questioned the claims of science, and reasserted the superiority of Moses' Law over the law of evolution.[19] These remarkable editorial interventions indicate that Henriques posed a significant threat to the community and to Jewish tradition. He had rejected the much-vaunted harmony between science and Judaism that the community had sought to foster and deploy in constructing its opposition to both anti-Semitism and the conversionists. Most importantly, he had challenged the liberal ideal that a Jew could be an English gentleman immersed in secular learning. The implication of Henriques's argument was that Jews had to choose between an outmoded religion, based on tradition, and the modern world (which included the theory of evolution). No compromise was possible. Henry has therefore to refute Henriques's intervention firmly.

17 *JC*, 20 Aug. 1869, 8.

18 Finestein, *Anglo-Jewry in Changing Times*, 99.

19 'The scripture and science', *JC*, 27 Aug. 1869, 5. A far more moderate critique of Henriques appeared on p. 3 in a letter by 'RYALL'.

The views of Michael Henry, who edited the *Jewish Chronicle* during the crucial years 1869 to 1875, deserve further discussion, since, unlike most British Jews, he was reasonably well informed about recent developments in science. Highly respected as a Jewish scholar,[20] he had worked as a patent agent, joined the Society of Arts, assisted the editor of the *Mechanics' Magazine*, contributed to the *Mining Journal*, and edited the *Inventors' Almanack*. He was also elected to the Institution of Civil Engineers, and showed considerable interest in the BAAS, whose annual meetings he attended on several occasions. His professional activities brought him into regular contact with inventors and engineers, and he would also have encountered scientists and been familiar with current scientific news, including reactions to Darwin's theory. During his period as editor, the *Jewish Chronicle* reviewed an increasing number of secular and scientific books, and he was clearly more concerned than was his predecessor, Benisch, to bring science to the notice of the Jewish community.

Unlike Henriques, Henry fervently believed that science was fully compatible with Judaism. However, he increasingly recognized that scientific naturalists such as Huxley and Tyndall posed a threat not only to Christianity but also to Judaism. In order to understand his response to evolution, we need to appreciate his views about the difference between science and technology. He considered that technology, in contrast to the speculative nature of scientific theories, was firmly based, and its results justified by practice—a view doubtless based on his experience as a patent agent and as an editor of technical periodicals. While he supported the introduction of technical subjects into Jews' College School, he remained highly sceptical about the theories used by scientists, and wrote critical articles on Darwinism (1871) and also on the BAAS presidential addresses delivered by William B. Carpenter (1872) and John Tyndall (1874).

In the opening paragraph of his 1871 editorial on 'Darwinism', Henry claimed that Darwin's theory should neither be rejected as 'wicked and silly' nor be advocated uncritically. Moreover, while it 'is opposed to the Biblical account of the creation, . . . it is by no means subversive of the doctrine of the existence of a Creator; nor does it necessitate the supposition that that CREATOR is one whit less powerful than the most pious of us would declare'. Yet as the editorial progressed, Henry became ever more critical of the theory, which, he claimed, had not been proved and was incapable of proof. Indeed, it was easily refuted by many arguments. For example, he cited the case of the gorilla—allegedly our closest neighbour biologically—which is significantly different from ourselves in terms of brain size and the functions performed by

[20] [Henry], *Late Michael Henry*.

certain internal organs.[21] Nor could he find any evidence that humans were now more intelligent than they had been in biblical times—a prediction, he believed, of the theory of evolution. These counter-arguments also indicated the unsettled nature of scientific theories. The favourite theory of today would inevitably be rejected at a later date. Henry concluded this editorial by contrasting the futility of scientific theorizing with 'the beautiful accuracy of the Biblical account of the creation as proved [*sic*] by modern scientific research'. Thus, despite his initial assertions, Darwin's theory was dismissed as trivial when compared with the robust Genesis narrative.[22]

In several other editorials, Henry repeated his argument that scientific theories, like evolution, were not true and solid, but were liable to be rejected and replaced. But the issue that increasingly concerned him was the authority that scientists were claiming for themselves and for their views. For example, in 1874 he chastised Tyndall for propagating his self-image as 'the priest of a new religion', the religion of science. Indeed, Henry was clearly concerned that Tyndall's recent BAAS presidential address in Belfast provided an unwelcome platform from which scientists would try to exercise authority. Since science only provides capricious, partial, and uncertain knowledge, he claimed that Tyndall had misled the public by portraying scientific theories as immutable truths whose meaning extended far beyond the facts themselves. In articulating this false view of science, Tyndall had set knowledge, 'which should ever be the handmaid of Faith', not only above religion, but also in conflict with it. Henry was shocked by Tyndall's chutzpah, reiterating his belief that when science was properly understood, it could not conflict with Revelation. Indeed, science should 'testify to the Greatness of the Creator palpable in the marvels of His workmanship'.[23]

The implications of evolution and the activities of Darwin's anti-religious followers informed Henry's reflections on the presidential address two years earlier by the Unitarian physiologist William B. Carpenter. Having devoted a full page of the previous week's issue to reporting Carpenter's address, Henry praised the President for criticizing those arrogant scientists, most notably the arch evolutionist Huxley, who overstated the certainty of science and cast doubt on religion. He was particularly vexed by the 'bigotry of science [which] is the most fanatic and impassable of all modern bigotries. "*There can be no doubt*" is the fixed formula with which the last new scientific theory is propounded.' Such an attitude was not only philosophically deplorable, but exerted a deleterious influence on the 'incredulous, self-sufficient, academic

[21] In making these claims, Henry may have been drawing on arguments developed by the anti-Darwinian Richard Owen.

[22] 'Darwinism', *JC*, 15 Dec. 1871, 8–9.

[23] 'Science and speculation', *JC*, 28 Aug. 1874, 348.

youth of the Victorian age . . . which relegates the Bible with a complacency half patronizing, half scornful, to the category of obsolete literary antiques, and elevates the text book of the last fashionable professor to the dignity of the Bible'.[24] Henry was clearly concerned that young Jews were being deterred from religion by the antics of these high-profile evolutionists, who were atheists or agnostics. He had no objection to science, even the theory of evolution, as long as it was maintained in its proper place: 'Knowledge . . . should ever be the handmaid of Faith.'[25]

Although, as noted above, the Chief Rabbi's 1872 lecture on 'Science and religion' contained a generally enthusiastic assessment of modern science, he concluded with two caveats that Henry would have endorsed. The first was to urge his auditors not to allow science to gain an undeserved prominence: in expressing the correct relationship, he drew an analogy between the 'Torah [which] is like the sun, the greater luminary, and science [which is] like the moon, the lesser luminary'. Second, reminiscent of some of the Quakers discussed above, he warned his listeners not to be diverted by speculative science, but to continue performing scrupulously all their religious duties, such as following the dietary laws and observing the sanctity of the Sabbath. Provided these injunctions were heeded, Adler warmly encouraged the community to embrace modern science.[26]

While Henry and Adler were supportive of science, but recognized the need to maintain it in its rightful place, Nathan Solomon Joseph published an enthusiastic assessment of both science and evolution in his 1879 textbook *Religion Natural and Revealed*. Joseph's aim was to provide pupils with a rational, modernist introduction to Judaism, and in an appendix he portrayed evolution as 'a highly probable theory' that had been accepted by most scientists. Yet his main concern was to address the frequently articulated objection that the theory was incompatible with notions of divine design. In response, he argued that if evolution had been responsible for producing such a coherent universe as we perceive, then the case for the divine Creator would be strengthened, not weakened. Like some pro-evolutionary Christians, Carpenter included, Joseph considered that God would have acted more intelligently by deploying natural selection as the grand designing principle than by fashioning each species separately.[27]

[24] A contributor to the *Jewish World* in 1875, possibly Henry, likewise claimed that educated people tended to adopt the theory of evolution, and were therefore experiencing increasing difficulty in reconciling 'conventional Jewish ideas': *JW*, 4 June 1875, 5, and 11 June 1875, 5.

[25] 'Annual meeting of the British Association: The president's address', *JC*, 16 Aug. 1872, 279–80; 'Religion and science', *JC*, 23 Aug. 1872, 290–1; 'Science and speculation', *JC*, 28 Aug. 1874, 348–9.

[26] 'Science and religion', *JC*, 21 June 1872, 167.

[27] N. S. Joseph, *Religion Natural and Revealed*, 257–9.

Darwin was warmly welcomed not only by progressive thinkers like Henriques and Joseph, but also by writers who found in Darwin's theory timely support for traditional Judaism. For example, in 1875 the author of the 'Judaica' column in the *Jewish Chronicle* identified a passage in the Talmud that substantially agreed with Darwin, although it employed specific examples rather than a general theory. This writer directed attention to the Talmudic thesis that God changes the world every seven years, by transforming one animal type into another; for example, 'the kunkumah (supposed to designate some species of serpent) [is changed] into a stork, [and] the louse becomes a scorpion'. Moreover, in another Talmudic passage humankind was portrayed as originally hermaphroditic, but subsequently 'divided into two beings of different sexes'. According to this columnist, 'a somewhat similar hypothesis was brought forward by Darwin in his "Origin of Species"'.[28] Although the arguments of these two examples are weak, they are interesting, because the authors avoided the widely touted view that science and religion were in conflict, and instead identified passages from Jewish tradition that cohered with Darwin's theory.

The 'Judaica' column of the *Jewish Chronicle* carried a further entry relating to Darwinism, but copied from a rather surprising source. The quoted passage was written by Richard Congreve, a rationalist and elder in the Church of Humanity. (This 'church' followed the positivist teachings of Auguste Comte, whose deistic views were anathema to committed Christians.[29]) Congreve speculated that if we accept the evolutionary scenario in which all creatures, ourselves included, have evolved by natural selection, then, 'far from losing sight of God[,] we should be guided along the actual path through which his creative energy accomplished its perfect work, and hear the song of the morning stars when the foundations of the earth were fastened and the cornerstone thereof laid, and all the sons of God shouted for joy'. The inclusion of this passage suggests that the editor (now Benisch again) or an assistant was prepared to entertain a poetic account of creation in which God deployed continuous evolution.[30]

During the 1880s and 1890s, assessments of evolution carried in the Jewish press were generally even more favourable than those published in the 1860s and 1870s. For example, the *Jewish Chronicle* printed a report of the presidential address by John Lubbock at the 1881 BAAS meeting, in which he stated that, in contrast to the widespread controversy within Christianity, Judaism had not conflicted with the theory of evolution; instead, the theory had been

[28] *JW*, 23 Apr. 1875, 2; *JC*, 1 Oct. 1875, 435.
[29] T. R. Wright, *Religion of Humanity*.
[30] *JC*, 22 Oct. 1875, 482.

'anticipated by the Talmud and Midrash'! Readers of the *Chronicle* would have been delighted to hear this highly respected naturalist and banker confirming the view that Jewish tradition had discovered a great truth about the natural world many centuries before the scientists. Moreover, claimed Lubbock, in employing an evolutionary understanding of creation, we do not dispense with a Creator; instead, the theory 'only increases a thousand fold our reverence for a Being who could endow an amorphous cell of protoplasm with such infinite potentialities. . . . The doctrine of Evolution only makes the chain of Nature appear to us so much more complete, and the harmony of her laws so much more sublime'.[31] Likewise, in 1883 the *Jewish Chronicle* reported a recent lecture by Huxley. By contrast with Michael Henry's earlier criticism of the theory of evolution as inadequately grounded, and his complaint that scientists like Huxley were arrogant, the *Chronicle* now sided with Huxley against those who considered that evolution undermined the notion of divine design. Huxley is reported as noting that both the theory of evolution and special creation could explain adaptation: 'The only difference is that in the latter case the Creative Power is conceived of as doing its Will at once, in the former it is thought of as doing it slowly throughout long periods of Time.' Thus, while not challenging the account of creation given in the Torah, which was so important to Jews, this writer offered support for Darwin's theory.[32]

One of the most theologically sophisticated late Victorian Jewish responses to evolution is to be found in *The Jewish Religion* (1891) by Michael Friedländer (1833–1910), the long-serving principal of Jews' College, which trained many generations of students for the rabbinate. Starting with the indubitable proposition that God created the world *ex nihilo*, he argued that the act of creation cannot be comprehended by our limited intellects, and we should therefore 'follow the guidance of the Divine Word'. However, although he appeared initially to be dismissive of science, when discussing the theory of evolution, he insisted that we 'have great confidence in our reasoning power, and in the results of science based on reason, but', he added quickly, 'we have still greater confidence in the truthfulness of Divine teaching'. Friedländer's revealing equivocation indicates the recurrent problem facing Anglo-Jewish writers who insisted on engaging modernity while remaining true to tradition.

Friedländer then proceeded to articulate several familiar points of opposition between evolution and the biblical account of creation; for example, while the Bible attributes the creation of plant and animal species to God's specific acts, evolution portrays creation as a gradual process. Which of these

[31] 'Evolution', *JC*, 9 Sept. 1881, 4–5.
[32] 'Huxley on evolution', *JC*, 22 June 1883, 3.

incompatible accounts should be accepted? Like other contemporary Jews, Friedländer appealed to history for the answer. Confronted on many previous occasions with the claims of secular philosophies, Jews had neither adopted them uncritically nor rejected them outright in favour of biblical truth. Instead, they had reconciled science with religion. Thus Maimonides had bridged Aristotelianism and Torah, and Moses Mendelssohn had amalgamated Jewish and Enlightenment philosophies. Likewise, argued Friedländer, the theory of evolution would in time be squared with a plausible interpretation of Genesis. Yet he also introduced an irenic argument that further reduced the potentiality for conflict between science and Genesis. While admitting that evolution could have produced the currently known species, he pointed out that God might have created the original species by some other means that is beyond our comprehension.[33] This is an interesting strategy, because it allowed both for divinely created species and for the operation of evolution in the post-creation period. Hence the truth of Genesis was preserved without denying the validity of the theory of evolution. Like most Jewish Victorians, Friedländer tried to bridge reason and religion, Darwin and Torah.

One of the few late Victorian Jews who reflected on the social implications of evolution was the Chief Rabbi's son, Hermann Adler, who had been educated at University College London and the universities of Prague and Leipzig, and was acting as 'Delegate Chief Rabbi' at the time he delivered his 1882 sermon on the nature of progress. While readily accepting that impressive progress had occurred in many spheres, he drew several contrasts between science and religion. In particular, he criticized the theory of evolution for its moral bankruptcy, since it legitimated competition, violence, and cruelty. As the fittest will survive, 'the strong and gifted' will 'inherit the earth', but 'the weak and simple must be blotted out'. However, his argument was not directed against the theory of evolution, which he seems to have accepted unquestioningly. Instead, he insisted that religion must act as a moral counterbalance to the deleterious effects resulting from evolution.[34]

A minor controversy flared up in the *Jewish Chronicle* for 1891, which illuminates growing tensions within Anglo-Jewry. In an editorial column, Asher Myers warmly praised a widely discussed recent article by the Duke of Argyll, who was not only a supporter of several Jewish causes but also a prominent anti-evolutionist.[35] Argyll was applauded for offering 'scientific proof as to the possible truth of the Biblical narrative of the Deluge' and for

[33] Friedländer, *Jewish Religion*, 30–9, 174–83.
[34] H. Adler, 'Divine Revelation'.
[35] Argyll, 'Huxley on the warpath'.

condemning 'Professor Huxley's derisory denial of it [which] is shown to be of no scientific value whatever. Ridicule is easy enough, but it is no argument.' The *Chronicle*'s support for Argyll brought a sharp response from Alfred Henriques, who contrasted the learned Huxley, whose 'splendid reputation' stands 'second to none in this country', with Argyll's 'feeble attempts' to support Scripture. 'I thought', added Henriques, that 'the Noachian Deluge had been disestablished long since through the labours of our geologists and others.' He then repeated some of the arguments that Huxley had used against the biblical account of the Deluge: for example, that there is no adequate account of where the water came from or how it was subsequently dispersed.[36]

Henriques was clearly surprised by the editor's *naïveté* in supporting an anti-evolutionist and Christian apologist. Yet, as indicated above, the *Jewish Chronicle* was generally pro evolution during the last two decades of the century. Myers's support of Argyll may have been prompted by political expediency, but it also underlines the increasing complexity of Jewish identity at that time. While the upwardly mobile segment of the Jewish community sought recognition as English gentlemen and women, and embraced modernity, they were becoming increasingly distant from traditional forms of Judaism. Yet religious orthodoxy was being rapidly strengthened during this period by the arrival of thousands of immigrants from Russia and Poland. Moreover, anti-Semitism was taking a firm grip, especially in Germany and France, and there was increasing concern that it would spread to Britain. The Anglo-Jewish establishment was deeply divided over how to respond to these pressures, the *Jewish Chronicle* generally supporting the view that these new, unwelcome immigrants should be sent to North America or back to their countries of origin.[37] Faced with these pressures, it might have seemed expedient for Myers to support a respected elder statesman and endorse Arygll's reactionary anti-Darwinian views.

More generally, the predominantly positive assessment of evolution by British Jews should be seen as reflecting their social need to construct a bridge between the modern world and Jewish tradition. This was the underlying strategy, whether an individual writer expressed the view that Judaism encouraged rational thought, and thus evolution, or celebrated points of convergence between evolution and Torah. Yet, a few writers, most notably Henry and Henriques, recognized that evolution posed a threat to traditional Judaism. While Henry attacked Huxley and other proselytizers for evolution in the name of Jewish tradition, Henriques sided with them and championed a progressive, anti-traditionalist version of Judaism.

[36] *JC*, 6 Feb. 1891, 6; 13 Feb. 1891, 8.

[37] Cesarani, *Jewish Chronicle*, 67–75.

9.3 The rise of Liberal Judaism

As Henriques's letters to the Jewish press show, he was a rationalist, an anti-traditionalist, and a proponent of the higher biblical criticism, who sided firmly with Huxley, science, and the theory of evolution against Argyll, biblicalism, and anti-evolutionism. Prior to Claude Montefiore, who will be discussed below, he was the principal spokesman in Britain for the progressive vision of Judaism that had earlier taken root in Germany and also attracted a large American following. More emphatically than any contemporary Anglo-Jewish writer, he asserted the incompatibility between evolution and Judaism. Yet, despite maintaining 'very advanced views on Jewish religious subjects', Henriques held several key positions in community organizations, such as the Board of Deputies and the Anglo-Jewish Association. Called to the Bar in 1853, he served on Sussex County Council, was Deputy-Lieutenant for the City of London, and unsuccessfully contested the 1881 election as a Liberal.[38] A member of the West London Reform Synagogue, he initially found little support in that synagogue for his progressive views, which included rejection of the ritual aspects of Judaism, such as the dietary laws (*kashrut*), and the replacement of Hebrew by prayers in the vernacular.

Henriques's dissidence should be seen within the context of the increasing factionization of the Jewish community during the closing years of the nineteenth century.[39] The Anglo-Jewish establishment, represented by the United Synagogue (a federation of synagogues, founded in 1870, which has often been likened to the Church of England because it adopted many Anglican customs), was being assailed by new groupings, with which it could not cope. Most prominent were the immigrants who flooded into the East End. They established their own small synagogues and Yiddish newspapers, their voices rarely heard in the *Jewish Chronicle* or *Jewish World*. The traditional, even primitive, forms of Judaism practised by these immigrants shocked many within the establishment, who were also disturbed by the growth of political radicalism among working-class Jews. Moreover, progressive, anti-traditionalist forms of Judaism (which had earlier gained large followings in Germany and North America) were attracting more supporters. Although the first Liberal synagogue in Britain was not established until 1910, the infrastructure of a progressive movement was developed some years earlier. Despite the fact that the emerging Liberal movement recruited some of its key members, such as Henriques and Montefiore, from the long-established West London Reform Synagogue, the differences between the

[38] *JC*, 22 July 1888, 7; 'Alfred G. Henriques', *JC*, 7 Aug. 1908, 7.

[39] Endelman, 'Communal solidarity'; Englander, 'Anglicized not Anglican'.

Reform and United Synagogues were not pronounced at the end of the nineteenth century (as they were later to become), and some members of the United Synagogue actively supported progressive innovation. For example, Simeon Singer, the rabbi at the New West End (United) Synagogue, was Montefiore's mentor.[40]

Henriques's progressive outlook was increasingly shared by a group of well-educated Jews who congregated round Claude Goldsmid Montefiore (1858–1936). Montefiore had been educated at Oxford, where his tutor Benjamin Jowett had introduced him to the higher forms of biblical criticism. From this elevated position he viewed the Jewish community, which he considered to be intellectually stagnant and unappreciative of the pioneering works of 'Darwin and [Bishop] Colenso', whose critical analysis of the Pentateuch had sent shock waves through the Anglican world in the early 1860s. Judaism, Montefiore believed, had turned its back not only on the higher criticism, but also on modern science, especially evolution, and on scientifically based history. He therefore predicted that unless Judaism were revivified by modern learning, Jews would become disaffected and abandon their religion. In his writings and sermons he sought to impel Judaism into modernity. In pursuing this project, he deployed the *Jewish Quarterly Review* (founded in 1888; co-edited by Israel Abrahams), the Jewish Religious Union (founded in 1902),[41] and, later, the Liberal Jewish Synagogue.

Although Montefiore displayed little awareness of the details of modern science, for him it symbolized the acme of modernism and the method of rational analysis, as reflected in one of his earliest sermons to the Jewish Religious Union. Addressing the issue of truth, he equated truth with the divine, and vice versa. Since science is a source of truth, there 'can be no opposition between Science and Religion, for Science must be part of Religion'. Moving rapidly to the issue of science's alleged conflict with Revelation, he offered a simple solution, but one that prioritized science. Taking science to be true, he concluded that any incompatible religious statement must be false and therefore rejected. '[S]cience has shown that the time, the order, and the manner of the earth's origin and man's as related to the first chapter of Genesis, or again as related to the second chapter of Genesis (for the two chapters contradict each other), are inaccurate.' The point he stated—barely argued—was that by the use of reason the truth can be discovered about God's creation. Scientific truth is not only God-given, but also superior to the truths contained in the Bible. Although the biblical accounts of creation were

[40] Abrahams (ed.), *Literary Remains of the Rev. Simeon Singer*, pp. ix–xxii.

[41] Philip Hartog, who taught chemistry at Owens' College, Manchester, contributed a paper on 'Science and religion' to a collection issued by the Jewish Religious Union.

acceptable in a pre-scientific age, he urged his readers to recognize the indubitable fact that humans and other creatures were produced by evolution. In the light of contemporary knowledge, evolution was to be preferred to special creation, and an extended history of the earth was to be accepted. For Montefiore, any other position was intellectually untenable.[42]

In his theological writings Montefiore opposed the view that the world is centred on humanity and that God serves human needs. Thus he expressed an emotional repugnance to the pre-Copernican model of the universe, which he described as 'petty and man-centred'. On that outmoded view of the universe, planets orbited the earth—and thus ourselves—and God was thought to have created the planets, stars, and animals specifically for *our* use and comfort. By contrast, the march of science had refuted this picture, and the sciences of evolution, geology, and cosmology had repeatedly demonstrated that the physical universe is immense, magnificent, and impersonal. Plants and animals had evolved through the action of physical laws, but not in order to serve human needs. This rationalistic and awesome vision of the universe, in which humankind is reduced to an infinitely small component, cohered with his theology. He portrayed God as distant, but impressive. God had fashioned the world for his own purpose, not for ours. In this grand scenario, we are 'rational beings looked after by God, aspiring to him, seeking Him, etc.' Thus, despite the vastness of the universe, we can establish a special relationship with God.[43]

The alliance between science, especially evolution, and modern biblical criticism is also apparent in the writings of Joseph Jacobs (1854–1916), a significant contributor to folklore studies and Jewish history, who also conducted the first statistical analysis of Anglo-Jewry. After reading Moral Sciences at Cambridge, he pursued studies in Germany and at University College London, where he read anthropology under Darwin's cousin, Francis Galton, whose influence pervades all of Jacobs's scientific writings. He later recalled that during his time as a student, 'Darwinism was in the air, and promised, in the suave accents of Huxley and in the more strident voice of Professor [William Kingdon] Clifford, to solve all the problems of humanity.' In 1886, when he wrote on 'Illustrious Europeans'—a very Galtonian project—he could name only eighteen English geniuses during the previous century. Yet within this select group, he identified Darwin as standing head and shoulders above the others.[44] Most interestingly, he remarked that '[George] Eliot's

[42] C. G. Montefiore, *Truth in Religion*, 3–4, 8.

[43] Lucy Cohen, *Some Recollections*, 66–7. Although this paragraph is based on a letter of Montefiore's dating from 1930, he was reflecting on his childhood views.

[44] Jacobs, 'The comparative distribution of Jewish ability'.

novels were regarded by us not so much as novels, but rather as applications of Darwinism to life and art'. *Daniel Deronda* vividly demonstrated that Jews have survived as a separate race with its own social norms. The figure of Mordecai Cohen encapsulated this vital Jewish trait, while Deronda, who only slowly discovers his Jewish identity, is inexorably drawn to the Jewish world. In his anthropometric writings, especially his *Studies in Jewish Statistics, Social, Vital and Anthropometric* (1891), Jacobs analysed the nature of the Jewish community and the racial characteristics of its people (as discussed in section 5.9). Appalled by the rising tide of anti-Semitism during the closing years of the century, and the patently perverse portrayal of Jews conveyed in the contemporary anthropological literature, he turned to science, as practised so effectively by Darwin and Galton, in order to compile a scientifically validated portrait of the Jewish people.

The scientific methods used by such scientific naturalists as Darwin, Huxley, Galton, and Clifford produced knowledge that was firmly grounded in facts. Jacobs enthusiastically adopted these methods to refute anti-Semitic stereotypes, and also applied them to analyse Jewish history and culture. Thus he claimed, perhaps somewhat incautiously, 'to have been almost the first who stepped outside [the spiritual walls of the English ghetto] . . . and regarded the position of Judaism from the standpoint of Modern Thought'. Science—'Modern Thought'—could provide a new understanding of Judaism, but in adopting the scientific perspective, Jacobs openly rejected traditional forms of self-knowledge and of biblical hermeneutics.[45] His work on Jewish history and anthropology parallels the religious writings of Claude Montefiore: both were progressive Jews who sought to bring modern thought, especially science, to bear on Judaism. Yet Jacobs clearly possessed a far deeper understanding of the methods and content of contemporary science.

One of the most interesting claims made by Jacobs in his early writings was that 'the struggle between religion and science is really a conflict between the Christian and Spinozistic developments of the God of Israel'. From this perspective, both Christianity and science were seen as offshoots of Judaism, the former having become ossified as a rigid theological system during the medieval period. Thus, in contrast to Judaism, which had generally been receptive to innovative scientific ideas, Christianity had become wedded to an outdated cosmology, and had therefore opposed such innovations as the heliocentric system (in the seventeenth century) and the theory of evolution (in the nineteenth). The other line descending from Judaism found its finest expression in Spinoza, who fused Hebrew and Hellenic traditions. While the

[45] Jacobs, *Jewish Ideals*, pp. vii–xviii, 61–83; *idem*, *Studies in Jewish Statistics*; Efron, *Defenders of the Race*, 58–90.

Greeks provided the objectivity of thought, Spinoza drew on his Jewish understanding of morality and practice. In Jacobs's view Spinoza had formulated the 'Cosmic Theism—Hellenic philosophy filtered through Hebraic faith', that underpinned modern, progressive thought, especially science.[46]

A recurrent theme within recent writings on Jewish history has been how Jews have negotiated the non-Jewish world, and particularly its progressive, modernist elements.[47] In the mid to late Victorian period, science and particularly the theory of evolution were at the centre of this modernist dilemma. Alfred Henriques appears to have been the first to take the bull by the horns, and to deploy evolution to criticize traditional Judaism. During the closing years of the century, Montefiore, Jacobs, and the rising band of progressive thinkers adopted the same strategy. In drawing the equation between modernism, science, and evolution, these progressive Jews sought to jettison many facets of Jewish tradition and biblical hermeneutics, and instead tried to force Judaism to enter the modern world. Thus, within Anglo-Jewry, the theory of evolution was evoked by progressive thinkers in arguing against traditionalists. As we saw in section 7.1.2, a contemporary modernizing faction within the Quaker community employed an identical strategy.

9.4 A robust Jewish Darwinian: Raphael Meldola

The above examples, illustrating how evolution was utilized in discourse on the nature and future of Anglo-Jewry, do not exhaust evolution's historical meanings. As in our study of Quakers (section 7.2), we need to examine whether and how Jewish naturalists utilized evolution in their scientific research. Unlike Quakers, among whom natural history was popular, few late Victorian Jews pursued the subject, the principal exceptions being Walter Rothschild, who followed his own research agenda at Tring (see section 5.1), and his younger brother Charles, neither of whom appear to have published reflections on evolution. The writings of the zoologist Marcus Hartog (1850–1924), who held the Chair of Natural History at Queen's College, Cork, deserve further attention, as he contributed to the debate over inheritance of acquired characteristics.[48] However, we shall focus on Raphael Meldola, who was an enthusiastic evolutionist, and considered that Darwin had provided the key to understanding a wide range of natural phenomena. Although Meldola is remembered principally as a chemist, on account of his work on

[46] Jacobs, *Jewish Ideals*, 24–59.
[47] E.g. Ruderman, *Jewish Thought*; Gilman, *Jew's Body*.
[48] M. Hartog, 'Spencer–Weismann controversy'.

synthetic dyes and as the Professor of Chemistry at Finsbury Technical College, he established a reputation as a naturalist and published extensively in that area. He served as secretary of the Entomological Society of London from 1878 to 1880, and was instrumental in founding in 1880 the Essex Field Club, which elected him its first President.

A grandson of the enlightened *haham* bearing the same name, Meldola may be interpreted as continuing the intellectually outward-looking tradition among Sephardim. Moreover, his mother, Matilda (Teltsel), particularly encouraged his scientific interests, and accompanied him on his early entomological field trips. In a letter written shortly after her death in 1892, he reflected on the 'history of my early life': it exhibits, he argued, 'one of the most remarkable cases of the indebtedness of son to mother for everything that I have been able to accomplish in life'.[49] Matilda's scientific and intellectual interests—she played chess with Alfred Russel Wallace when he visited the Meldola household[50]—were probably inherited from her (Ashkenazi) father, Moses Abraham, who, having been an optician, was one of the few English Jews to pursue a science-related occupation.

Even though he spent many hours on field trips, combing the Essex hedgerows butterfly net in hand, Meldola was an enthusiastic and able supporter of Darwin's theory of evolution. On retiring as President of the Essex Field Club in January 1883, he devoted his presidential address to his reflections on the life and work of Charles Darwin, who had died a few months earlier, and to assessing the achievements of Darwin's theory. He argued that natural selection was the cutting edge in the theory of evolution, and he considered that it operated not only at the level of species, but also

> upon internal organisation; minute constitutional or physiological deviations at present utterly beyond the ken of science, can be seized upon and perpetuated by this agency when of any advantage to the possessor. The survival of the fittest is utilitarianism *in excelsis.*

One of the theory's main strengths was its applicability to many areas of science, where it subsumed previously unconnected facts to a single conceptual scheme. Darwin was, moreover, a model of scientific decorum and moderation: 'He was simplicity personified, and the pretentiousness of professional dignity was quite foreign to his disposition.' Far from asserting the truth of his theory dogmatically, he had listened carefully to his critics and

[49] Raphael Meldola to Edward Poulton, 4 Feb. 1892, Meldola File, Hope Collection, Oxford University Museum.

[50] A. R. Wallace to Raphael Meldola, 14 May 1886, Wallace Correspondence, Hope Collection, Oxford University Museum.

responded with integrity to any significant points they had raised, incorporating many of his responses into the sixth (1872) edition of the *Origin*.[51]

Meldola also used his presidential address to establish in public his claim to be a protégé of Darwin. '[A]s a youth', he reminisced, 'I fell into the ranks of Darwinians.'[52] The main evidence for his personal connection with Darwin, however, consists in seventy-five extant letters that passed between Meldola and his mentor beginning in 1871, when Meldola was aged 21, and ending with Darwin's death in 1882.[53] Meldola likewise developed close friendships with Wallace and with several other leading Darwinians, including Edward Poulton, who was appointed Hope Professor of Zoology at Oxford in 1893 and shared Meldola's antipathy to Lamarckian and mutationist accounts of evolution. Commenting to Wallace on the way in which non-Darwinian ideas were being widely deployed by evolutionists at the time of the 1909 Darwin centenary, Meldola identified himself with the 'true Darwin–Wallace position', adding, 'I suppose I am too "Darwinian" for that school!'[54]—the (Cambridge) school being centred on Darwin's son Francis. Thus Meldola was not just an evolutionist, but he firmly aligned himself with the Darwin circle and, after Darwin's death, with those neo-Darwinians who remained faithful to Charles Darwin's natural selectionist programme.[55]

Much of the correspondence between Darwin and Meldola addressed the phenomenon of mimicry among insects, especially butterfly species, a topic on which Meldola published several papers. One example of mimicry that particularly interested him was of butterflies that possessed the colouring and appearance of a more aggressive local species. As Meldola, Darwin, and a number of their contemporaries recognized, the theory of evolution offered a ready explanation of this phenomenon. In adopting the physical characteristics of another species, the insect's survival could be enhanced by gaining protection from potential predators. It is clear that by 1871, if not earlier, Meldola had been attracted to this problem precisely because it required the application of natural selection and was, in turn, an impressive confirmation of the theory of evolution.[56] In a paper read before the Zoological Society in 1872, he extended this project to include protective colouring (when an insect

51 Meldola, 'Presidential address'.

52 Ibid. For biographical information on Meldola see Marchant (ed.), *Raphael Meldola*, which includes a bibliography of Meldola's publications.

53 For list of correspondence, see *Calendar*. Darwin also aided Meldola's career by heading the list of proposers for his fellowship of the Royal Society: Certificate EC/1886/10, RSL.

54 Meldola to Alfred Russel Wallace, 28 June 1909, Add. MS 46,437, fol. 146, BL.

55 Cf. St George Jackson Mivart who, after converting to Catholicism, became the enemy of the Darwinians. See Gruber, *Conscience in Conflict*.

56 Meldola, 'Mimicry in the insect world'; *idem*, 'Mimicry between butterflies of protected genera'.

adopts the colour of the surrounding environment). Here he particularly addressed examples of an insect changing colour by adapting to, say, the colour of the vegetation on which it feeds.[57]

Several of Meldola's other publications also developed from his correspondence with Darwin. For example, after informing Darwin that he was researching the problem of mimicry, Darwin forwarded him a letter that he had recently received from Fritz Müller, a German naturalist working in Brazil. So impressed was Meldola with Müller's application of Darwinian principles that he cited lengthy extracts from this letter in an 1878 paper entitled 'Entomological notes bearing on evolution'. Here he drew attention to several remarkable phenomena that were explicable on evolutionary principles. For example, he cited the case of an Indian mantis—*Gongylus Gongylodes*—that simulates the appearance of a flower. This example was, he asserted, of the 'highest interest', and it 'can, in fact, be only completely appreciated by the believer in natural selection'. A later paper on mimicry likewise developed out of a published paper that Darwin had drawn to Meldola's attention.[58]

They also discussed seasonal diamorphism (where two forms of the same species exist, exhibiting different characteristics at different seasons). At this point Darwin recommended to his young acolyte the explanation of the seasonal diamorphism of butterflies published two years earlier in August Weismann's *Studien zur Descendenz-Theorie* (1875). Although it is not clear whether Meldola had previously encountered this book, he soon proposed an English translation, a project that Darwin strongly encouraged. Meldola persuaded Darwin to write a brief introduction, but was unable to persuade him to extend this into a fuller essay comparing and contrasting Weismann's work with his own. When his translation was published in 1882, Meldola's introductory preface was sandwiched between Darwin's preface and a preface that Weismann had written for this English edition.[59] He also added a number of notes expanding on issues raised by the author. By translating Weismann's book, Meldola, then in his early thirties, publicly proclaimed himself a Darwinian.

In many publications, including his contributions to *Nature*, Meldola acted as Darwin's bulldog. For example, he dismissed as utterly misguided an anti-evolutionary tract published by the Catholic Truth Society, entitled *Science or Romance?*[60] However, he reserved his most vigorous criticisms for those who

[57] Meldola, 'On a certain class of cases of variable protective colouring in insects'.

[58] Meldola, 'Entomological notes bearing on evolution'; *idem*, 'Mimicry between butterflies of protected genera'.

[59] Weismann, *Studies in the Theory of Descent*.

[60] Meldola, 'On a certain class of cases of variable protective colouring in insects'; *idem*, 'Lamarckism *versus* Darwinism'; *idem*, 'Evolution: old and new.'

courted forms of evolutionary theory that did not deploy the classic mechanism of natural selection. Thus, he criticized George John Romanes for attacking natural selection and for proposing instead his own theory of 'physiological selection'. In Meldola's opinion, Romanes had misunderstood natural selection, and his alternative theory was scientifically and methodologically flawed.[61] As he confided to a fellow Darwinian, by propounding his theory of '*fizziological selection*', Romanes 'has done more harm to the Darwinian theory than any other writer'.[62]

From the above evidence it is clear that Meldola was not merely an evolutionist, but that he adopted a robust interpretation of evolution, and one that was often associated with materialism, irreligion, and atheism. Yet, although he may not have been a particularly observant Jew—he undertook field trips on the Sabbath—he strongly retained his identity as a Jew. For example, throughout his life he was a member of the Spanish and Portuguese Synagogue, and was later buried in the synagogue's cemetery. He was also one of the earliest Maccabæans, serving for a time as its President. As he wrote very little bearing on the relationship between science and his religion, it is difficult to determine how he envisaged the relationship between Judaism and evolution. However, with the aid of a few relevant passages, we can shed some light on this topic.

Meldola appreciated the profundity and power of scientific analysis, and claimed that in its secular, scientific approach the *Origin of Species* had been 'the first work which successfully rescued the species question from the domain of ancient mysticism and ecclesiasticism'.[63] Thus, for its successful practice, science requires a complete separation from traditional religions. Meldola was particularly appalled by the superstition and bigotry of those Christians who attacked science, especially evolution, in the name of religion. While not blind to the theory's potential difficulties, Meldola considered that such critics, who tried to hinder its progress by raising inconsequential objections, were behaving as obscurantists. By contrast, Darwin

> has exalted our conception of Nature beyond the theologies. He has taught us that there is no intermediate and direct interference with the course of natural law—he has enforced the lesson that in studying natural science we are concerned only with secondary causes.[64]

It would appear that Meldola considered that the universe is mechanistic and law-like, and that science excludes any form of divine intervention. On this

[61] *Nature*, 34 (1886), 384–5. See Romanes, 'Physiological selection'; Wallace, 'Romanes versus Darwin'. Also Lesch, 'Role of isolation'.

[62] Meldola to Edward Poulton, 17 Sept. 1889 and 15 May 1891, Meldola File, Hope Collection, Oxford University Museum.

[63] Meldola, 'Evolution: old and new'.

[64] Meldola, 'Presidential address', 91–3.

materialist account, physical effects are produced only by physical causes. The evolution of organisms—humans included—was a purely physical process. This eliminates an immanent God working on the physical world, but does not answer the question of whether Meldola accepted God as Creator—an issue that he does not broach in any of his writings that I have consulted.

Yet one extant letter does shed some light on the issue of materialism. It was written in 1886 to Edward Poulton, who clearly approved the synthesis between neo-Darwinism and Anglo-Catholicism that was proposed by the Oxford theologian Aubrey Moore.[65] Poulton had been responsible for the Meldolas hiring a servant named Judy, who died suddenly. Reporting her death to Poulton, Meldola asked playfully '[w]hether her "soul had gone aloft"'. To which he added: 'I know not as I must leave problems of that kind to the Oxford theologians who are so well endowed that they must, "by virtue of their office" know all about such things.'[66] The sceptical, teasing tone of this letter indicates that Meldola either denied the existence of the human soul or considered discussion of such issues at best unproductive and at worst pointless. Yet, unlike the Oxford theologians he chided, he did not see materialism as incompatible with religion. Like those writing in the Jewish press at the time of Tyndall's Belfast Address, materialism was not an issue. Also, like them, he was not concerned with defending the notion of divine design.

Meldola's unwavering advocacy of evolution by natural selection contrasts with the rather ambivalent attitudes of such Quakers as Bennett, Brady, and Fry, who were evolutionists but wavered over the mechanism for organic change. Among contemporary Quakers, only Silvanus Phillips Thompson (his colleague at Finsbury College) and Henry Wallis came close to Meldola in commitment to the theory, but Wallis was an amateur naturalist, and Thompson was principally a physicist who did not use Darwin's theory in his scientific research. Meldola is also unique among the Jewish community not only in pursuing a high-profile research career in natural history but also in maintaining a robust position on Darwinism.[67] In adopting a prominent role among the Darwinians, Meldola showed that although Darwin's theory was usually associated with Huxley, Tyndall, and other agnostics, a Jew could also be a robust evolutionary biologist.

[65] England, 'Natural selection, teleology, and the logos'.

[66] Raphael Meldola to Edward Poulton, 28 Dec. 1886, Meldola File, Hope Collection, Oxford University Museum.

[67] Among Meldola's other writings on evolution were 'Sexual selection' and *Evolution, Darwinian and Spencerian*.

10

Historical Comparisons and Historiographical Reflections

In a widely cited analysis, Ian Barbour articulated four 'stances' that seem to encompass all possible relationships between science and religion: Conflict, Independence, Dialogue, and Integration. The first, Conflict, applies to the well-known conflicts that surrounded Galileo and Darwin. By contrast, Independence pertains to instances where science and religion are separate and do not interact. Dialogue encompasses a 'diverse group of views', among which Barbour identified three cases: (a) where science and religion share suppositions in common, (b) where methodological parallels exist, and (c) what he calls 'nature-centred spirituality'. The fourth stance, Integration, occurs where there is considerable overlap between science and religion, so that they cease being separate or separable activities.[1] Barbour has offered a useful taxonomy that provides a language for discussing science–religion interrelations. It has also been widely deployed by commentators.[2] However, as Chris Kenny and I have argued, like all taxonomies, Barbour's lacks explanatory power.[3] Rather than simply identifying the Galileo affair as an example of Conflict, we need to ask why Galileo and the Roman Church came into conflict. Again, we fail to understand the late Stephen Jay Gould's attempt to separate science from religion unless we ask why he adopted this stance.[4] In addressing such questions, historians seek the social, political, and intellectual reasons why a particular writer pursued, for example, an Integrationist strategy. Thus, rather than resting satisfied with simply classifying science–religion relationships, we need to understand each such engagement in its historical context.

The present discussion of Quaker and Jewish responses to science is underpinned by this contextualized historiography. Yet contextualization emphasizes the variety of science–religion interactions, and shows that neither of our case studies can be reduced to any one of Barbour's four stances or,

[1] Barbour, *Religion and Science*, 77–105. See also Barbour, *Religion in an Age of Science*.

[2] E.g. Haught, *Science and Religion*.

[3] Cantor and Kenny, 'Barbour's four-fold way'.

[4] Gould, *Rock of Ages*. Without entering into the complexities of Gould's problem situation, one of his motives was to set science beyond the reach of the Creationists.

indeed, any single overarching thesis. It is also important to note that neither community was subject to a central authority that directed its members' response to science. The main authority structure within Anglo-Jewry was the *Bet Din* (the ecclesiastical court). Yet not only were there separate *Batei Din* for the Sephardi, Ashkenazi, and (later) Reform sections of the community, but their scope was limited to such religious issues as *kashrut*. In contrast, however, to continental ghetto communities, where the *Bet Din* was usually responsible for maintaining the legal system and settling disputes, English Jews looked to the civil—rather than the ecclesiastical—courts to resolve most matters of contention. Individual British rabbis likewise exerted little influence over individual members of their congregations, and, as Todd Endelman has pointed out, the rabbinate's authority was also 'weakened by the widespread recognition that it had lost much of its independent moral authority and had become subservient to the great magnates who . . . dominated communal affairs'.[5] Even the authority of the Chief Rabbi—a post only formally instigated with the appointment of Nathan Marcus Adler in 1842—was very limited. Given the voluntary nature of each individual's alignment with the institutions of Anglo-Jewry, there was no strong authority structure—and no authority figure—to legislate on formulating a response to science in general, and Darwinism in particular. Instead, attitudes to science were shaped by the factors discussed below.

At first sight it might seem likely that the comparatively strong institutional structures of Quakerism would have dictated a collective attitude to science. However, although the Yearly Meeting of the Society of Friends addressed matters of belief, practice, and discipline, it did not legislate on how Quakers should respond to science. More generally, there was a continual tension between the centralizing tendencies of organized Quakerism and the inalienable right of each Quaker to obey his or her own conscience. Although Quakers were in principle relatively free to decide how to respond to science, we shall see that their responses were likewise affected by a number of contingent factors.

Before identifying these factors, we must reflect on current historiography pertaining to science and religion. In recent years a number of writers, principally historians, have reacted against such prevalent master narratives as the conflict thesis and the equally untenable view that science and religion are necessarily in harmony. Armed with abundant counter-evidence, they have argued that no single overarching thesis can encompass all examples of science–religion interaction. This thesis has been most persuasively and sensitively argued by John Brooke, who has concluded that science and

[5] Endelman, *Jews of Georgian England*, 143.

religion have interacted in many highly complex ways: 'Serious scholarship in the history of science has revealed so extraordinarily rich and complex a relationship between science and religion in the past that general theses are difficult to sustain.'[6] While the present study fully confirms the extraordinary richness and complexity of the topic, the evidence offered in the preceding chapters will enable us to be more precise about certain modes of science–religion interaction.

As neither Quakers nor Jews were subject to dogmatic religious authorities that required obedience to a specific view of science, they were potentially free to adopt their own positions. However, their engagements with science were constrained by two types of factor: the social forces that impinged on the community (especially arising from the 'dissenting' status of the Quaker and Jewish communities within the British context), and the resources that each community could invoke in addressing the problems raised by science. Before discussing these in turn, it should be noted that these social forces and resources were often interrelated.

The initial group of factors are the external social forces that operated very differently on and in the two communities. To appreciate these differences, we need to examine the different senses of strength and insularity manifested by the Quaker and Jewish communities. From its inception, the Quaker movement not only accepted but rationalized its position with respect to the country's social, political, and religious mainstream. Quakers constituted a small, exclusive group that followed an unpopular and particularly pure religious path. Like Jesus and his disciples, they could expect hatred, abuse, and discrimination from the ungodly. Especially during the early decades, anti-Quaker feelings ran high, and often exploded into violence.[7] As with other Dissenters, Quakers adhered strongly to the values of self-sufficiency and self-determination. Dissent engendered a robust, independent attitude.[8] Although the imprisonment of Quakers and the seizure of their property decreased during the eighteenth century, as Friends outwardly aligned themselves with the middle classes, the social and mental world of early Quakerism continued to exert an influence on later generations. With its strong internal structure and the recognition that Quakers were *in* this world, but not *of* this world, Quakerism was psychologically and morally robust. Quakers stood firm in championing such unpopular causes as the abolition of slavery and pacifism. Likewise, they were insular. This insularity was expressed in their separation from other religious bodies, and they recruited principally

[6] Brooke, *Science and Religion*, 5.

[7] For the vast anti-Quaker literature, consult J. Smith, *Bibliotheca Anti-Quakeriana*.

[8] Binfield, *So Down to Prayers*, 7.

(via birthright) from traditional Quaker families. In sociological terms, there existed a high barrier between the Society of Friends and the rest of British society.[9]

Quakers engaged the non-Quaker world in many areas, such as commerce, but they did so on their own terms. They were also very active in such campaigns as the abolitionist and pacifist movements. Yet they paid little attention to many other contemporary issues, such as the controversies that raged within the Anglican Church. As noted in Chapter 7, this insularity had diverse consequences, for while Quakers could stand above the fray and watch with a superior gaze the religious controversies over Darwinism and materialism, in the later decades of the nineteenth century many Friends also recognized that the Society was intellectually moribund. While evangelicals tended to keep modernism at arm's length, progressive elements within Quakerism adopted evolution and other modern modes of thought. Yet their engagement with science was moderated by norms drawn from Quaker tradition.

Anglo-Jewry was characterized by a different type of insularity, which arose not from internal strength but from insecurity. Although the situation in Britain was very different from that in mainland Europe, where many Jewish communities were ghettoized, the boundary between the Jewish community and the rest of British society was fairly low and permeable. Although there were internal pressures to maintain religious standards, many Jews abandoned religious imperatives such as refraining from work on *shabbat* and keeping the laws of *kashrut*. At the same time, Anglo-Jewry had to struggle to uphold its place in English society. Despite some wealthy Jews joining the English gentry and aristocracy, Jews were marginalized in a country where Englishness was synonymous with Christianity, and where they were barred from holding civic positions or attending the ancient universities until the middle decades of the nineteenth century. Moreover, the taunts of Christians and the underhand activities of conversion societies proved a constant irritation. As Mayhew commented: in England the Jew 'felt he was but a sojourner, . . . he was at best but tolerated and often proscribed'.[10] Despite the relatively low level of outright hostility, the community felt insecure. Yet, throughout the period under discussion Jews also experienced the strong pull of assimilation, and, as several historians have argued, English Jews simultaneously sought to emulate their Christian neighbours while retaining some level of commitment to Judaism.

[9] Douglas, *Natural Symbols*.
[10] Mayhew, *London Labour and the London Poor*, ii. 126.

The above contrast is crucial to understanding the mores of two communities, including the relative attention that each paid to science. From the early years of the Quaker movement, some Quakers, like other Puritan writers, had sought to fathom the meaning of creation. Moreover, by the second quarter of the eighteenth century a significant number of Quakers were involved in science, especially botany. This interest arose from several factors (to be discussed further below), one of the most important being the entry of many Quakers into the reasonably affluent middle classes and the coherence between science and such Quaker values as sobriety and piety. Through Quaker schools and other educational organizations, a significant number of Friends were introduced to science, especially the observational sciences, which cohered with Quaker empiricist and anti-dogmatist leanings. Thus, while it would be incorrect to portray the Society of Friends as deeply committed to science, Quakerism allowed—and in some ways positively encouraged—the pursuit of science and of science-related careers.

By contrast, the level of scientific knowledge and activity among Anglo-Jewry was significantly lower, the disparity appearing all the greater when the sizes of the two communities are acknowledged. In general, the more cosmopolitan, socially superior but declining Sephardi community was more involved in science than were the Ashkenazim. Exclusion from the traditional seats of learning does not explain the lack of scientific activity, since the scientifically active Society of Friends was likewise excluded. More relevant was the insecurity of Anglo-Jewry, which required its members to work hard at establishing themselves both economically and socially in a generally antipathetic social climate. This need for social legitimation and for economic security led many Jews to be highly industrious, but also to participate in such leisure activities as the social season at Bath and the cheap concerts at the Vauxhall and Cremorne pleasure gardens. The Jewish élite, who were commercially successful, required their sons to enter the family business, while the rising middle classes, driven by a need to establish themselves socially and economically, set little store by education. For poorer Jews, making a living was the overriding necessity. As the editors of the Jewish periodical press noted repeatedly, the community was too involved in business and pleasure to appreciate education adequately, either Jewish or secular. Mayhew made the interesting, but possibly contentious, observation that not only did Jews express 'little love of literature', they purchased newspapers far more rarely than their Christian counterparts.[11] Science was likewise very peripheral to the community's concerns. Only during the closing decades of the nineteenth century did the first numerically significant cohort of British Jews enter

[11] Mayhew, *London Labour and the London Poor*, 127.

science, medicine, literature, and the arts—the generation that formed the Maccabæans in 1891.

The social differences between the Jewish and Quaker communities also explain many of the differences in their approaches to science. For example, the two communities exhibited very different responses to Darwin's theory of evolution. As Brooke has emphasized, while we should not underestimate the challenge that Darwin's theory posed to traditional religious beliefs, 'the relations between Darwinism and Christianity have been more diverse than the idea of continuous conflict would suggest. There is a richer, more fascinating story to be told.' Brooke therefore urges the 'careful study of local contexts'.[12] In studying 'local contexts', we see that Quaker and Jewish writers were not strongly antagonistic to Darwin's theory. Thus, although evangelical Quakers often considered that the theory posed a direct threat to the account of creation given in Genesis, moderate Friends considered that the theory cohered with such Quaker norms as the equality of the races and with the emerging emphasis on progressive revelation.

From its insular position, the Quaker community took little cognizance of the bitter controversies over evolution. The community's separateness and tacit superiority was captured by the jurist Edward Fry, who recounted:

> The publication of Darwin's *Origin of Species* had produced a profound impression; it had, as all new discoveries of nature had done, caused great uneasiness in the minds of many good people, who felt Darwin's teaching, and still more the suggestions which arose from his teaching, to be inconsistent with the teachings of the Bible and their hopes of immortality for the human race. I gave a good deal of attention, as everyone did, to those new views, and my old studies in Homology . . . made me especially interested in the doctrine of Evolution; but I did not, like so many good people, feel distressed at the influence of the Darwinian theory upon my religious beliefs.[13]

Likewise, a writer in the *Friends' Quarterly Review* for 1890 contrasted the Catholic Church's dogmatic rejection of the Copernican theory in the seventeenth century with the Quakers' response to the theory of evolution, adding: 'We have stood by the counsel of Gamaliel and [now] have little to regret.'[14]

While Quakerism could stand back and calmly watch the ructions over Darwinism within the Anglican Church and many other denominations, the predominant Jewish response was to understand this controversy in term of the contested place of Jews in a Church-dominated English society. Contrary to the dominant master narrative that postulated a conflict between science and religion, many Jewish writers did not perceive there to be a conflict

[12] Brooke, 'Darwin and Victorian Christianity', 195, 210.
[13] A. Fry, *Memoir of the Right Honourable Sir Edward Fry*, 63.
[14] Wallis, 'Darwinism', 250.

between Judaism and science. Instead, they sided with science in order to criticize Christianity, especially the evangelical Christianity spread by conversionists and harbouring anti-Semitism. This response, like the Jewish response to the Great Exhibition, manifests the insecurity of Anglo-Jewry and the concern with legitimation within a semi-hostile cultural environment.

Standing somewhat on the margins of English society, few members of the Jewish community actively participated in science, and even fewer made their careers in science. Principal among these were Emanuel Mendes da Costa, J. J. Sylvester, and Raphael Meldola, yet the first two established themselves only with great difficulty and at considerable personal sacrifice. As one contemporary noted at the time da Costa was appointed to the clerkship of the Royal Society, he had 'laboured in the vineyard of literature and curiosity to his own undoing'.[15] Likewise, Sylvester was often regarded as a flawed personality; for example, his obituarist in the *Athenaeum* described him as 'essentially a kind-hearted man, but with a quick temper and a strain of naive vanity', while the *Times* pointed to 'Defects of temper [that] sometimes obscured his real amiability of character, and injured his work as a teacher'.[16] Meldola, who launched his career in the early 1870s, was perhaps the first Anglo-Jewish scientist to manifest the considerable self-confidence that enabled him to proceed to a fully-fledged career in scientific research and teaching. At about the same time, Ellis Davidson succeeded in making a living from producing self-help manuals, many of which were on scientific topics. Most of the other British Jews who actively pursued science were amateurs and enthusiasts from wealthy families, such as the mathematician Benjamin Gompertz, the mathematician-barrister Arthur Cohen, David Salomons the electrician, and the avid collector Walter Rothschild. Unlike their Jewish counterparts, Quaker scientists were able to make their way securely in the world of science. Beginning with Peter Collinson and Silvanus Bevan in the mid-eighteenth century, a number of Quakers entered the Royal Society and other scientific bodies, contributed to their scientific proceedings, and served on their organizing committees. While some earlier Quakers had studied medicine on the Continent, in the 1730s John Fothergill was the first of many Quakers to study medicine at Edinburgh. Although John Dalton became the best-known Quaker scientist, a number of others—including Luke Howard, Robert Were Fox, Daniel Oliver, and Silvanus Phillips Thompson—made significant contributions to various scientific fields. All these Quakers manifested a quiet confidence in their scientific researches and in their dealings with fellow scientists.

[15] William Borlase to Charles Lyttleton, Apr. 1763, in Pool, *William Borlase*, 238.
[16] *Athenæum*, 20 Mar. 1897, 382–3; *Times*, 16 Mar. 1897, 9, and 20 Mar. 1897, 12.

Turning now to the resources provided by the two communities, I shall first discuss the role of tradition, and then examine the influence of conceptual resources. By 'tradition' I mean the basic historical orientation of a religious community. Quakers, for example, continually sought to locate themselves in relation to the founders of Quakerism, especially George Fox. This does not imply that subsequent Quakers simply accepted all of Fox's views; instead, they drew selectively on his writings, while acknowledging a significant degree of continuity with the fountainhead of Quakerism. Yet the founders did not provide the only historical source. Especially in the mid-seventeenth century and amidst the evangelical revival of the nineteenth, Quakers located themselves firmly in a tradition of biblical Christianity. Thus, as noted earlier, evangelicals placed Scripture above Fox's doctrine of the Inner Light, whereas moderates reversed the order. Among more religiously educated Jews, the notion of tradition meant drawing on Torah, the Talmudic commentaries, and also acknowledging the continuity of Jewish history. For example, a number of Jewish writers (and some Quakers) deployed the account of creation in Genesis to help frame their understanding of the physical universe. Again, in confronting the religiously controversial scientific theories of the mid-Victorian period, several Orthodox Jews turned to medieval Jewish commentators, especially Maimonides, who had successfully squared science with Jewish beliefs.

These traditions provided the resources that members of the community used to engage the problems generated by the development of science. Such resources were particularly numerous and strong in Quakerism, where they powerfully affected Quaker attitudes towards science. For example, Quaker antipathy towards frivolous and time-wasting activities conferred a positive sanction upon the practice of science. Likewise, the Quaker emphasis on honesty cohered well with the predominant empiricist ideology in British science, and it also proved successful in Quaker business ventures in such areas as pharmacy. Another example is the insistence of early Quakers that any natural philosophy must be Christian, not heathen—hence their rejection of Aristotelianism. Nor should we overlook the recurrent Quaker concern that Friends must not forsake their religious duty owing to the seductiveness of secular subjects, science included. In comparison with Quakers, English Jews possessed far fewer resources, and those that operated were generally less intense. One example is the tradition-sanctioned emphasis on deploying reason in both religious and scientific contexts. The Anglo-Jewish example also illustrates the ways in which science can provide a resource for religious problems. For example, in responding to the need to construct Hebrew calendars, Herschell Filipowski drew not only on the rich calendrical literature within Jewish tradition, but also on the secular writings of mathematicians and astronomers.

One of the main differences between Quaker and Jewish participation in science is the dissimilarity of attitudes towards empiricism. While Quakers emphasized the importance of sensory observations of the natural world, and were drawn to the observational sciences, Jews were more inclined to mathematics and to scientific theories. As discussed in previous chapters, this difference can be explained by the resources that each community could bring to science. In the case of Quakers, the doctrine of the Inner Light cohered with an empiricist approach to science, while the traditional antipathy towards religious systems likewise engendered an anti-theoretical attitude. By contrast, the resources that favoured empiricism were relatively weak within the Jewish community, which instead favoured higher-level abstractions, which cohered more closely with the dialectical tradition within Judaism. Yet, in neither case was the less-favoured approach to science proscribed. A number of Quakers, such as George Stewardson Brady, Alfred Bennett, and Edmund Fry, were moderately enthusiastic about Darwin's theory of evolution, although they remained somewhat ambivalent about the mechanism of natural selection, in contrast to Raphael Meldola's unqualified enthusiasm for evolution by natural selection. In some instances, however, we can also appreciate the power of cultural accommodation. In line with Anglo-Jewry's assimilationist tendencies, a number of instances have been cited of Jews who adopted design arguments, especially when writing for a predominantly Christian audience.

The crucial point is that the resources within Judaism and Quakerism were not specific to science; instead, they were of wider applicability, but could be applied selectively to science. Thus the Quaker requirement for sober living was a general principle. It did not oblige Quakers to pursue science; indeed, many did not. Rather, it could be extended, and thus sanction the practice of science. Another point worth noting is that these various resources did not provide a blueprint for the pursuit of science, but rather functioned as a disparate group of guidelines, which Quakers used in forging their attitudes to science. Moreover, these resources were historically contingent; thus some were deemed more important during certain periods of Quaker history than at others. For example, the charge of heathenism against secular natural philosophies was common during the seventeenth century—the first period of Quaker history, as discussed in Chapter 2—but was rarely made thereafter.

The above discussion focuses on some of the differences between the two communities. The similarities are also important, and arise primarily from their insularity and their separation from the Anglican-dominated educational system and from the main currents of thought in Britain. Science offered a domain where the Quaker and the Jew could liaise with Anglicans and with other Dissenters. While social and religious barriers operated in many other areas, science was a relatively open activity, and one that encouraged the participation of people from across the religious spectrum. Thus, whereas the two ancient English universities imposed religious tests, non-Anglicans were eligible to join the Royal Society and a great variety of local and national scientific societies. Quakers and Jews, whose social life was fairly circumscribed by their own religious community, could work closely with other scientists in either scientific research or in a scientific organization like the Royal Society. Thus the correspondence of Peter Collinson and Emanuel Mendes da Costa included not only their co-religionists but also the spectrum of mid-eighteenth-century naturalists, including Anglicans, Disssenters, Catholics, deists, and atheists. Their letters criss-crossed Europe and, in Collinson's case, also the Atlantic. Quakers and Jews could therefore become part of the eighteenth-century Republic of Letters.[17] As Martin Folkes remarked to da Costa in respect of his religion, 'we are all citizens of the world, and see different customs and different tastes without dislike or prejudice, as we do different names and colours'.[18] Although the notion of a Republic of Learning is particularly applicable to the eighteenth century, the scientific community of the nineteenth century was likewise a community cemented by periodicals, letters, and membership of scientific academies. Thus, in the mid-nineteenth century, John Fletcher Miller maintained a correspondence with more than 250 scientists to whom he sent his astronomical and meteorological observations and papers. No more than fifteen were fellow Quakers, the remainder including such eminent scientists as John Herschel, George Biddell Airy, and Dominique Arago.[19] Naturalists like Daniel Oliver and Nathaniel Wallich likewise engaged in an extensive international correspondence with other naturalists, of various religions, backgrounds, and commitments. Similarly, towards the end of the century, Silvanus Phillips Thompson and Raphael Meldola corresponded, respectively, with physicists and chemists, and participated in a number of scientific societies where there were few, if any, co-religionists.

It is important to stress that although science was open to Jews and Quakers, members of these religious communities tended to congregate in certain areas of science. Although some Jews pursued the different branches of natural history, mathematics proved particularly popular, whereas Quakers moved mainly into the observational sciences, such as botany and the less mathematical parts of astronomy. Yet, early Quakers adopted natural philosophies, like the iatrochemistry of van Helmont, that was commensurate

[17] See Daston, 'Ideal and reality'.
[18] Martin Folkes to da Costa, 28 Aug. 1747, in Nichols, iv. 636–7.
[19] Miller's list of correspondents, Papers of John Fletcher Miller, DH1/2, Cumbria Record Office, Whitehaven.

with their Christian principles, and they opposed the heathen theories of Aristotle. Although the scientific contributions of subsequent Quakers were generally indistinguishable from similar work pursued by other scientists, there was one area in which Quaker social concerns were paramount. Not only was the Ethnological Society dominated by 'a faction of Quakers', but these Quakers supported the monogenist theory of the human races against a substantial cohort of polygenists.[20] The only comparable example relating to a Jew was Joseph Jacobs's anthropological and social analyses of the Anglo-Jewish community, in which he sought to confute anti-Semitic stereotypes.

During the closing decades of the nineteenth century, we see a set of parallel processes occurring in the two communities. Each included dissatisfied members, who increasingly perceived that their community's long-term insularity had resulted in its failure to address the challenge of modernism, especially in the domain of science. The anti-evangelical Manchester dissidents of the early 1870s adopted this line, but in the longer term the rising tide of moderate Quakerism resulted in the success of the reformers at the 1895 Manchester Conference. Likewise, Alfred Henriques was a lonely voice in Anglo-Jewry until, at around the turn of the century, Claude Montefiore and other reformers threw down the modernist challenge to traditional forms of Judaism. One of the key points of the present study is the centrality of science in general, and Darwinism in particular, to the engagement with modernism by both Quakers and Jews. In both cases, members, many of whom were university-educated and trained in science subjects, were in the vanguard of these reform movements.

Two final historiographical reflections are in order. First, the rise of these contemporary modernist movements in both the Quaker and the Jewish communities illustrates a form of science–religion interaction that has rarely been studied. Religion is often considered to be like a large inertial body that changes slowly, if at all, and reacts imperceptibly to the challenges thrown down by science. However, Quakerism underwent a major and fairly rapid shift late in the nineteenth century, partially in response to science and other strands of modern thought. Although the bulk of Anglo-Jewry was less reactive, the same external forces produced a schism, which in this case led to the formation of Liberal Judaism. Second, in contrast to the standard portrayal of science versus religion—or scientists versus theologians—the primary interaction in both cases was between traditionalist and progressive factions within a single religious community. Thus our understanding of science–religion interactions needs to be extended beyond Barbour's four stances to include the role of science in stimulating intra-religious dialogue.

[20] J. Hunt, 'Origin of the *Anthropological Review*', 432; Stocking, 'What's in a name?'

Only by examining the role of science in religious communities does this interesting form of science–religion interaction become apparent.

Finally, although a number of Quakers and a few Jews feared that Darwin's theory of evolution would undermine religion, most members of these communities who addressed this issue in print were keen to adopt the new and challenging theory. Thus our study refutes the all too familiar assertion that during the Victorian period Darwin's theory of evolution created a major conflict with religion.

APPENDIX 1

Who is to count as a Quaker or as a Jew?

At first sight this question may seem easy to answer. However, in both cases there are a number of difficulties. Turning first to the Society of Friends, during the period covered by this study, the vast majority of members were Quakers by 'birthright'; that is, their parents were Quakers. Yet a significant proportion of 'birthright' Quakers deserted the sect or were disowned for any of a number of reasons: for example, for failing to attend meetings, for parenting an illegitimate child, or for breaking with any of a number of Quaker tenets. Prior to the 1860s, the most frequently cited reason was marriage to a non-Quaker. Elizabeth Isichei has estimated that of mid-nineteenth-century Quakers, 'between a quarter and a third of all [Quakers] who married at all' married out, and were therefore disowned.[1] This severe haemorrhage threatened the very existence of the Society, and from 1861 a number of changes were implemented, the most important being the repeal of the proscription against intermarriage.

Moreover, in each generation some who were not of Quaker parentage were attracted to the movement and, through convincement, were accepted into the Society. Prior to the 1860s, these recruits generally accounted for only a small fraction of the total Quaker population, but thereafter increasingly became the norm. Some people who were not Quakers nevertheless regularly attended meetings. However, as these attenders were not subject to Quaker discipline, they have not been considered here, except in a very few specific instances.

Since the Society of Friends has maintained impressively complete records over its long history, in most cases the answer to our question—Who was a Quaker?—can be determined by consulting the records of births, marriages, and deaths and the minutes of various Meetings held at LSF and certain other locations. The *Annual Monitor*, which commenced publication in 1813, is another valuable source. However, in a few cases—principally dating from the eighteenth century—it has not been possible to determine the issue with certainty. More problematic are those who ceased being Friends at some time during their adult lives. Owing to the difficulty of tracing specific documentary sources, it has proved impossible in some instances to determine precisely when someone ceased being a Quaker.

Where appropriate, those who left the movement or were disowned are described as 'ex-Quakers'. As several scientists of note followed this path, they cannot be entirely excluded from this study. Yet this group was far from homogeneous, since although

[1] Isichei, *Victorian Quakers*, 115. Readmissions were rare, and apply to very few of the people discussed in this study.

some ex-Quakers firmly rejected their religious upbringing,[2] others remained in close contact with the Quaker movement and even continued to attend meetings for worship. For example, the Liberal politician William Forster 'retained the deepest interest' in all aspects of Quakerism, and regularly attended Quaker meetings, after being excluded for marrying Matthew Arnold's daughter. He was even buried in the Quaker graveyard near his home in Burley-in-Wharfedale, Yorkshire.[3]

Although Anglicanism provided a refuge for many ex-Quaker scientists, some joined other sects and denominations. For example, the meteorologist Luke Howard and his son John Elliot Howard supported the evangelical wing within Quakerism during the Beacon controversy of the 1830s, but after severing their connection with the Friends, they joined the Plymouth Brethren.[4] Yet, the break was not complete, for although Luke Howard could no longer participate in formal Quaker activities, he subsequently lived near the Quaker school at Ackworth and continued to be involved in Quaker organizations, such as the Friends' Educational Society. At the other end of the religious spectrum, Unitarianism provided a haven for a number of the anti-evangelical ex-Quakers, such as Edward Bennett.

The situation in respect to Anglo-Jewry is significantly different, since, unlike Quakers, there is no clear boundary between membership of the community and non-membership. *Halachically* (i.e. according to Jewish Law), being a Jew is inherited through the maternal line. However (overlooking the rare examples of conversion), this is a necessary but not a sufficient condition for being a member of the Jewish community, since many *halachically* Jewish individuals have drifted away from Judaism and from the Jewish community, while others more emphatically signalled their position by converting to Christianity. Some converted out of conviction, some out of convenience. The most eminent Victorian Anglican of Jewish descent was Benjamin Disraeli, who, along with his mother and siblings, was baptized in July 1817, a few months before he would have been *bar mitzvah*. Although he explored his Jewish identity through his novels, and the Jewish press took a kindly interest in his career, the adult Disraeli, who was elected to the Royal Society in 1876, was not a member of the Jewish community, and therefore he is excluded from this study.[5]

[2] As Hudson Gurney wrote in his memoir of Thomas Young, who had been disowned in 1798 at the age of 24: 'His parents were . . . [among] the strictest of a sect, whose fundamental principle it is, that the perception of what is right and wrong, to its minutest ramifications, is to be looked for in the immediate influence of a supreme intelligence, and that therefore the individual is to act upon this, lead where it may, and compromise nothing. To the bent of these early impressions he [Young] was accustomed in afterlife to attribute, in some degree, the power he so eminently possessed of an imperturbable resolution to effect any object on which he was engaged, which he brought to bear on every thing he undertook': [H. Gurney], *Memoir of the Life of Thomas Young*, 6.

[3] Reid, *Life of the Rt. Hon. W. E. Forster*, i. 266; ii. 551, 566. An obituary notice even appeared as an appendix to *AM*, 1887, 207–13, a publication normally reserved for those who were members of the Society at the time of their death.

[4] Kirkwood and Lloyd (eds.), *John Eliot Howard*; Isichei, *Victorian Quakers*, 50.

[5] Endelman and Kushner (eds.), *Disraeli's Jewishness.*

Far more problematic are those Jews who may have drifted away from the community. For example, it is not clear whether the pharmacologist and medical lecturer Jonathan Pereira (1804–53) was *halachically* Jewish. His marriage in a Winchester church in 1832 suggests that, even if he was Jewish by birth, by that date he had converted to Christianity. Although he published several scientific works prior to 1832, I have erred on the side of caution and do not discuss them here. However, some Jews who married out did not convert—for example, the eighteenth-century physician Ralph Schomberg, who is probably best described as a lapsed Jew.[6] In my discussion of Jews in science, converts are omitted and also those who drifted far from the Jewish community. As our concern is with the Anglo-Jewish community, I have concentrated on those who were recognized as Jewish by other members of the community. This is, however, a necessarily imprecise delineation, and I have therefore also used, with some caution, the standard biographical dictionaries, histories of Anglo-Jewry, and the indexes to the *Transactions of the Jewish Historical Society of England*. For Victorians, I have used the Jewish periodical press.[7] As with Quakers, family names are an indicator, although not always an accurate one. I have therefore placed far more weight on such evidence as whether someone was cited by other Jews as 'our co-religionist'.

[6] Endelman, *Jews of Georgian England*, 259.

[7] I have used such standard works as Hyamson, 'Plan of a dictionary'; Roth, *History of the Jews*. Also very useful are the two volumes of Doreen Berger's *Jewish Victorian*.

APPENDIX 2

Oath and Affirmation used at graduation ceremony at Edinburgh University

Oath: 'Ego Doctoratûs in Arte Medica titulo jam donandus, serio et sanctè coram Deo cordium scrutatore, Spondeo, me in omni grati animi officio erga Academiam Edinbergenam, ad extremum vitæ halitum preservaturum. Tum porro Artem Medicam cautè, castè, et probè exercitaturum; et quoad potero omnia ad ægrotorum corporum salutem conducentia cum fide procuratorum. Quæ denique <denque?> inter medendum visa vel audita sileri conveniat, non sine gravi causa vulgatorum. Ita præsens spondente adsit Numen.'

'I, worthy of the title Doctor of Medicine, seriously and sacredly before God who sees in men's hearts, pledge that I will persevere in every duty of a worthy mind towards the University of Edinburgh until the last breath of my life. Furthermore indeed that I will exercise the Art of Medicine cautiously, purely and honorably, and, as far as I can, to take care faithfully that all [my actions] are conducive to [effecting] health in sick bodies. And finally that it behoves [me] to keep silent on all matters seen and heard during the course of healing, unless there is a pressing need to reveal these matters. Thus may the divine presence be favourable to me as I make this pledge.'

Affirmation used by Quakers: 'Ego Doctoratûs in Arte Medica titulo jam donandus, serio et solennito coram Senatu Academio, Spondeo, me in omni grati animi officio erga Academiam Edinbergenam ad extremum vitae halitum perseveratum. Tum porro Artem Medicam cautè, castè, et probè exercitaturum; et quoad potero omnia ad aegrotorum corporum salutem conducentia cum fide procuratorum. Quae denique inter medendum visa vel audita sileri conveniat, non sine gravi causa vulgatorum.'

'I, worthy of the title Doctor of Medicine, seriously and solemnly before the Academic Senate, pledge that I will persevere in every duty of a worthy mind towards the University of Edinburgh until the last breath of my life. Furthermore indeed that I will exercise the Art of Medicine cautiously, purely and honourably, and, as far as I can, to take care faithfully that all [my actions] are conducive to [effecting] health in sick bodies. And finally that it behoves [me] to keep silent on all matters seen and heard during the course of healing, unless there is a pressing need to reveal these matters.'

The above oath and affirmation were published in the *List of Graduates in Medicine in the University of Edinburgh from MDCCV to MDCCCLXVI* (Edinburgh: Neill, 1867).

See also the manuscript record of 'University of Edinburgh Lauriations and Degrees', deposited in Edinburgh University Library, which indicates that between 1772 and 1867 sixty-eight graduates subscribed to the 'Quaker version', all but a handful being verified Quakers. Quakers who graduated before 1772, including John Fothergill, appear to have taken the oath.

The published version is somewhat misleading, since the text of the oath is there dated 1803. Inspection of the manuscript version indicates, however, that this form of words was used throughout the eighteenth century, and that the date 1803 possesses no relevance.

APPENDIX 3

Quaker and Jewish Fellows of the Royal Society of London (by date of election)

NAME	Birth	Death	FRS[b]	Field	Religious history
Quaker Fellows[a]					
Penn, William	1644	1718	1681*		C 1667
Haistwell, Edward	*c.*1658	1709	1698		
Bellers, F.	1687	1750	1711		X 1711
Bellers, J.	1654	1725	1719		
Graham, George	1675	1751	1721	Instrument maker	X
Bevan, Silvanus	1691	1765	1725	Pharm.	
Robins, Benjamin	1706	1751	1727	Math.	X *c.*1723
Collinson, Peter	1693	1768	1728	Bot.	
Birch, Thomas	1705	1766	1735		X *c.*1727
Nickolls, John	*c.*1710	1745	1744*		
Fothergill, John	1712	1780	1763	Bot./Med.	
Witchell, George	1728	1786	1767	Astron.	X
Dimsdale, Thomas	1711	1800	1769	Med.	X 1741
Lettsom, John C.	1744	1815	1773	Bot.	
Beaufoy, Henry	1750	1795	1782	Pol. Econ.	X 1779
Beaufoy, Mark	1764	1828	1790	Astron.	X 1788
Young, Thomas	1773	1829	1794	Med./Phys./Bot.	X 1798
Dillwyn, Lewis W.	1778	1855	1804	Bot.	X 1807
Allen, William	1770	1843	1807	Chem./Bot.	
Willan, Robert	1757	1812	1809	Med.	
Sims, John	1749	1831	1814	Med.	X 1790
Bland, Michael	1776	1851	1816		X
Gurney, Hudson	1775	1862	1818		X 1803
Howard, Luke	1772	1864	1821	Meteor.	X *c.*1836
Dalton, John	1766	1844	1822	Chem./Meteor.	
Phillips, Richard	1778	1851	1822	Chem.	X 1811
Harford, John S.	1785	1866	1823		X 1809
Phillips, William	1773	1828	1827	Geol.	
Prichard, James	1786	1848	1827	Anthrop.	X
Lister, Joseph J. (1)	1786	1869	1832	Optics	

Continued

Continues

NAME	Birth	Death	FRS[b]	Field	Religious history
Barry, Martin	1802	1855	1840	Med./Embriol.	C *c.*1824
Miller, William A.	1817	1870	1845	Chem.	X
West, William	1792	1851	1846	Chem.	
Fox, Robert Were	1789	1877	1848	Geol.	
Miller, J. F.	1811	1856	1850	Meteor.	X *c.*1855
May, Charles	1801	1860	1854	Astron./Inst.	
Fletcher, Isaac	1827	1879	1855	Astron.	X *c.*1855
Harvey, William H.	1811	1866	1858	Bot.	X *c.*1846
Lister, Joseph	1827	1912	1860	Med.	X 1856
Oliver, Daniel	1830	1916	1863	Bot.	
Pengelly, William	1812	1894	1863	Geol.	C *c.*1850
Christy, Henry	1810	1865	1865[D]	Anthrop.	
Hanbury, Daniel	1825	1875	1867	Pharm./Bot.	
Tylor, Edward B.	1832	1917	1871	Anthrop.	X 1864
Fox, Wilson	1831	1887	1872	Med.	X
Brady, Henry B.	1835	1891	1874	Geol./Bot.	
Howard, John E.	1807	1883	1874	Pharm.	X *c.*1836
Forster, William E.	1818	1886	1875[P]		X 1850
Baker, John G.	1834	1920	1878	Bot.	
Brady, George S.	1832	1921	1882	Bot.	
Hutchinson, Jonathan	1828	1913	1882	Med.	
Fry, Edward	1827	1918	1883[P]	Bot.	
Cash, J. Theodore	1854	1936	1887	Med.	X
Thompson, Silvanus P.	1851	1916	1891	Phys.	
Lister, Arthur	1830	1908	1898	Bot.	
Head, Henry	1861	1940	1899	Neurol.	X
Lister, Joseph J. (2)	1857	1927	1900	Bot./Zoo.	
Jewish Fellows					
Samuda, I. S. de		1743	1723	Med.	
Schomberg, Meyer L.	1690	1761	1726	Med.	Dissociated in 1740s
Sarmento, J. de C.	1691	1762	1730	Med.	Dissociated in 1740s
Suasso, Alvaro		*c.*1752	1735		
Da Costa, Moses	*c.*1713	1770	1737		
Da Costa, E. Mendes	1717	1791	1747	Nat.	
Salvador, Joseph	1716	1786	1759		
Franks, Naphtali	1715	1796	1764		
Riz, David			1766		
Gompertz, Benjamin	1779	1865	1819	Math.	

Continued

Continues

NAME	Birth	Death	FRS[b]	Field	Religious history
Cohen, Francis	1788	1861	1821		Converted
Goldsmid, Isaac L.	1778	1859	1828		
Wallich, Nathaniel	1786	1854	1829	Nat.	
Montefiore, Moses H.	1784	1885	1836		
Pereira, Jonathan	1804	1853	1838	Med.	Converted?
Sylvester, James J.	1814	1897	1839	Math.	
Basevi, George	1794	1845	1843		Converted
Montefiore, Nat.	1819	1883	1849**	Med.	
Disraeli, Benjamin	1804	1881	1876[P]		Converted
Schuster, Arthur	1851	1934	1879	Phys.	Converted
Jessel, George	1824	1883	1880[P]		
Samuelson, Bernhard	1820	1905	1881		Converted
Meldola, Raphael	1849	1915	1886	Chem./Nat.	
Worms, Henry de	1840	1903	1889[P]	Phys.	Dissociated in 1886
Mond, Ludwig	1839	1909	1891	Ind. Chem.	Disinterested

[a]Quaker commitment (where known): C = Quaker by convincement and Quaker at time of death; Q = birthright Quaker known also to have been a Quaker at time of death; X = birthright Quaker who was disowned or resigned; followed by date, if known.
[b]Date of election to the Royal Society: [P] = admitted to privileged class; * = elected, but not admitted; ** = proposed, but did not proceed to election; [D] = died before election.

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