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ARNE HESSENBRUCH (ed.), **Reader's Guide to the History of Science.** London and Chicago: Fitzroy Dearborn, 2000. Pp. xxix + 934. ISBN 1-884964-29-X. £95.00 (hardback).
DOI: 10.1017/S0007087403214977

I veered between awe and being infuriated while reviewing this book. It is a mammoth work and for this the editor deserves great respect. The *Guide* is essentially an annotated bibliography to the entire history of science (with some technology and more medicine), organized into manageable chunks. There are entries for major individuals and institutions, as well as for disciplines (from chemistry to home economics), and for more general themes, such as performance, practice and progress. Each entry begins with a list of the main books and articles in the field and the text then describes the contribution made by each work. The entries are arranged alphabetically. The *Guide* is equipped with other aids to information retrieval, including a thematic list of entries, an eighty-page index, and (my particular favourite) a book index, which allows you to find all the citations to any particular work, and to see whether other works by the same author are mentioned elsewhere.

The *Guide* does not attempt to replace either the *Companion to the History of Modern Science* (London and New York, 1990), edited by Robert Olby, Geoffrey Cantor, John Christie and Jon Hodge, as a repository of introductory essays, or quick-reference works such as the *Dictionary of the History of Science* (London, 1981), edited for Macmillan by Bill Bynum, Janet Browne and Roy Porter. Rather, it offers a way for those entering a new area of research to find the most important works easily. Thus it might be used by advanced undergraduates pursuing an extended essay with only a limited supplied reading list or by graduate students just starting out. It could also be very useful to lecturers who find themselves teaching courses which extend beyond their personal expertise. In an attempt to assess comprehensiveness, I asked a few colleagues to look at the entries for their fields, and the responses were generally favourable – although 'electromagnetism' was rated more highly than 'ornithology'. Criticisms came, not for inaccuracies or omissions in the entries themselves, but in the selection of subjects to which entries were devoted. And this is one of the major reasons why I also found myself infuriated.

The *Guide* suffers from several problems. One that gradually dawns on the reader is the paucity of recent books – there are not that many from the last decade, let alone the last five years. Recent books I would have expected to be listed were not. This is presumably a product of the long gestation period for a project of this size but it does undermine the editor's desire to think of the *Guide* as 'a snapshot of the history of science at the beginning of the 21st century' (p. viii). A related problem is the decision to concentrate on books or book chapters, and not journal articles. Hessenbruch explains in his introduction that 'articles are normally included only when they are of seminal importance, or when there is no adequate treatment of a particular aspect of a subject in a book-length study' (p. viii). The contributors have interpreted this in various ways. Some were quite willing to include articles they felt important. Others limited themselves to books even if some fairly important work had appeared in articles. In general, there are few articles listed. This exacerbates the datedness of

the *Guide*, especially in recent fields where the ground-breaking articles have appeared, but the books are still in the pipeline. The exclusion of articles also reduces the usefulness of the *Guide* to those looking for a quick route into a new subject, as articles often function as a quick introduction to the later book.

My final concern is the selection of topics. There are a few amazing omissions; neither 'zoology' nor 'natural philosophy' have entries of their own, although the index reveals that both are mentioned in numerous other entries. Hessenbruch hopes that the *Guide* will help people to explore the 'riches of the writings on history of science in all its diversity', mentioning sociology of science, gender history and cultural history as important additions to the 'traditional historiography' (p. vii). The first two areas do appear to be represented well, but the coverage of cultural history is erratic. I was fascinated to find six pages on 'music and science', yet surprised that there were only two on 'literature on science'. 'Religion and science' is there, but only if you are interested in the medieval period, the Renaissance or Islam. My biggest gripe is the lack of coverage of popular science, one of the most important growth areas in history of science at the moment. Astonishingly, there is no entry for 'popular science'. The one for 'popularization' is concerned almost entirely with the contemporary phenomenon rather than its historical manifestations (and the entry for 'journals' – there is no equivalent for 'books' – concentrates on journals for experts, not for the wider public). And if I wanted to find out about the sort of sciences practised by members of the working classes, whether Adrian Desmond's London radicals or Anne Secord's Lancashire botanists, this *Guide* could not help.

I am still torn. There is a wealth of information here and my main criticisms are that it is already dated and that there are significant gaps in coverage. Given the practical considerations of publishers' lead-times and the maximum size of a realistically marketable book, this may well be the best we can get. I am left wondering if a printed book is in fact the ideal form for this sort of guide. After all, I strongly suspect that my students would have turned to the Web before they trekked over to the library to consult this *Guide*. I probably would have too. The *Guide* is undoubtedly more authoritative and reliable than the various Web resources, but I am not sure that is enough, these days.

Aileen Fyfe
National University of Ireland, Galway

David N. Livingstone, **Science, Space and Hermeneutics.** Hettner-Lectures, 5. Heidelberg: Department of Geography, University of Heidelberg, 2002. Pp. 116. ISBN 3-88570-505-2. No price given (paperback).
DOI: 10.1017/S0007087403224973

The Hettner Lectures, honouring Alfred Hettner, Professor of Geography at Heidelberg from 1899 to 1928, have been given annually since 1997 by such important human geographers as Derek Gregory, Doreen Massey and John Agnew. The 2000 Lectures by David Livingstone are noteworthy for two reasons. First, Livingstone has a considerable reputation as a historian of science: his *The Geographical Tradition* (Oxford, 1993) was an exciting contextual-historical account of his own discipline and he has also published work on the religious contexts of Darwinism in the United States and Northern Ireland. Second, for some time Livingstone has made judicious use of the resources of science studies in pressing a forceful case for the spatial understanding of scientific culture. 'The direction of intellectual influence', Livingstone says (p. 88), 'was *from* science studies *to* geography', and this must count as one of the rare documented occasions on which science studies has enriched, rather than enraged, another social scientific discipline. The publication of these lectures (totalling seventy-three pages), with an accompanying autobiographical interview, gives a compact entry into those aspects of Livingstone's thinking that bear on the work of historians and sociologists of science.

Some of Livingstone's claims have passed into common currency among many historians of science: 'Science is not a disembodied entity; it is incarnated in human beings … Science is

not some eternal essence slowly taking form in history; rather it is a social practice earthed in concrete historical and geographical circumstances' (p. 10). Yet, among geographers (as among social scientists generally), there has been considerable resistance to such sensibilities; social scientists anxious to establish their scientific bona fides have often been more keen than natural scientists to protect ideas of scientific transcendence and of a universal scientific method, and this gives a certain local edginess to Livingstone's performance.

But once he gets into his flow, Livingstone's first lecture attractively and accessibly presents a series of vignettes illustrating what one can hope to understand about science by attending to its 'places of production' (laboratories, museums, libraries, gardens and the field), its 'sites of consumption' (the bearing of local settings on how such scientific ideas as Darwinism were received) and its 'geographical biography' (the temporally changing and spatially varying genres available for writing scientific lives). The second lecture on 'Tropical hermeneutics and the climatic imagination' is possibly of less general interest to historians of science, but it is closer to a major concern of contemporary human geographers in describing the resources European travellers had available to them to make sense of exotic Others and their habitats. It is too bad that this slim book will not be easy to obtain from commercial sources, but a nice letter to Prof. Peter Meusberger at the Heidelberg Department of Geography might get a result.

Given the audience and occasion for these lectures, it would be wrong to hold them to very exacting standards of conceptual rigour. Nevertheless, Livingstone here manifests a tendency which is becoming quite common among those making the case for a geography of science: spatiality is referred to as a 'factor' (e.g. pp. 12, 16), something which should be taken account of, but which needs to be supplemented by such other 'factors' as 'cultural beliefs, social values, consensus on the worth of expertise' and so on. Livingstone argues here for the 'plausibility' of a geography of science (p. 12) – there are all kinds of interesting things that one can say about science by attending to where it is produced, evaluated and received – but he does not want to be mistaken for a 'socio-spatial reductionist', making an unsustainable case that space and place are all there is about science, just as he is seriously nervous about what he takes (despite the work of Bloor and Barnes) to be the self-refuting character of 'social constructivism' (p. 97). Hence he talks a lot about how the 'spatial' aspects of science are 'intimately interwoven' with, or 'intimately bound up with', the 'cognitive' and other factors (e.g. pp. 20, 25, 29, 34).

It all sounds admirably judicious but, in my opinion, something like a category mistake is involved in going on that way. Spatiality – in all of its aspects – is a necessary condition for there being such a thing as science (or art or the market economy or football). Space and place are like temporality or embodiment: take away any of these and there is no such thing as science (or art, the market economy or football). So the spatiality of science is not a 'factor' in the way that, say, religious affiliation or class position or national identity are factors, where you can easily imagine science being made, justified and circulated without these things being a necessary part of the story. Instead, space and place are closer to what the political philosopher Michael Oakeshott called 'modes': self-sufficient ways of apprehending the whole from a particular, and therefore non-exhaustive, point of view. And, if that is right, then there is no reason at all to be nervous about claiming too much for the scope of a geography of science, or to spend very much time arguing for its possibility or plausibility. Where else could science take place but in places, and how else could it travel but across spaces? Relevant differences and similarities between places are empirical matters, as are the means by which, and the efficiency with which, science travels across various spaces. Geographers of science like David Livingstone have got too many wonderfully intriguing, vivid and original stories to tell about science to handicap their enterprise at the outset.

Steven Shapin
University of California, San Diego

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HELAINE SELIN (ed.), **Astronomy Across Cultures: The History of Non-Western Astronomy**. Science Across Cultures: The History of Non-Western Science, 1. Dordrecht: Kluwer Academic Publishers, 2000. Pp. xxiii + 665. ISBN 0-7923-6363-9. £215.00, $345.00 (hardback).
DOI: 10.1017/S000708740323497X

There is a vast literature on the evolution of astronomy in Western cultures. But scholarship on the astronomy of non-Western cultures is scattered in publications not all of which are easily accessible. This book presents a broader view of the history of astronomy and is part of a series published by Kluwer on 'Science Across Cultures: The History of Non-Western Science'. A companion volume on the history of non-Western mathematics is already in print and volumes on medicine, nature and the environment, chemistry and alchemy, and physics and optics are in process. The series comes in response to the critical acclaim received by the *Encyclopaedia of the History of Science, Technology, and Medicine in Non-Western Cultures*, published in 1997. Helaine Selin, the editor of both the series and the *Encyclopaedia*, has done a remarkable service in offering the means to support a socio-cultural dimension in the history of science.

By using the term non-Western as a cultural designation instead of a purely geographical one, history of science gains in scope. It looks into traditions throughout the world which propose different ways of explaining and coping with the natural environment, but which during the colonial period have been ignored, dismissed and even eliminated. To a great extent they are still rejected. These traditions regard magic and divination, and religion and the sciences, as part of the same search for explanations, for arts and for techniques. Encounters of distinct traditions are subjected, throughout history, to cultural dynamics and are responsible for new thinking. These processes teach us about non-Western sciences but they also give us a better understanding of the history of Western science.

Books on the history of science usually start with the Mediterranean cultures and rely on written documentation. But for many cultures, there are practically no written sources and we must depend on engraved stones and bones, ceramics, burial sites and tombs. This is particularly true for most cultures in the southern hemisphere. In addition, we rely on informants from, and the voices of, the early European chroniclers whose religious views affected their understanding of man's relationship to the world and of astronomy. A few extant cultures reveal the strong influence of the European conquerors and colonizers, which had the exclusive objective of religious conversion. This difficulty is evidenced in all the essays in this book.

The book has twenty-one essays and a useful introduction which reveals its organic character. The book is more than a collection of essays and the main objective was not geographical coverage. The reader will find themes recurring in several essays. Thus central issues, such as how the sky provides the support for the myths of origin and creation and for the relations between religion and power, are present in most essays. Everyday life, as recognized in the elaboration of calendars and maps, also appears in most essays. A good analytical index makes it easy to compare answers to the same quest in different cultures. Some authors appear in the index, which helps to access the rich bibliography which is specific for each essay. A brief academic profile of each contributor is given before the Introduction.

Although many cultures are not contemplated in this collection, the selection illustrates the fact that different cultures dictate different priorities for which astronomical activities take place and how their results are interpreted. This is clear in the chapters on land-based cultures and island and coastal cultures, specifically Hawaii, Polynesia and the Maori of New Zealand as compared with those on the Andean and Mesoamerican cultures.

I see the series, which includes the book under review, not only as an important contribution to the history of non-Western science, but also as a most valuable resource for better understanding the dynamics of Western science. The community must be thankful to Kluwer for

offering this space for scholars in the history of non-Western science. But at the same time, the same community must regret the fact that such carefully prepared and intellectually fertile books are so expensive. Due to its high price, this valuable collection will be practically inaccessible to undergraduate and postgraduate students, and also to young, and even senior, academics. Few libraries will have the resources to acquire it.

UBIRATAN D'AMBROSIO
State University of Campinas, Brazil

CHARLES W. J. WITHERS, **Geography, Science and National Identity: Scotland since 1520.** Cambridge Studies in Historical Geography, 33. Cambridge: Cambridge University Press, 2001. Pp. xvii + 310. ISBN 0-521-64202-7. £45.00 (hardback).
DOI: 10.1017/S0007087403244976

This work seeks uniformly to address the history of geography, science and national identity – three issues that are often treated as separate topics in their own right. Withers approaches them via the historical geography of geographical knowledge, that is, a historiographical method which uses the history of science, geography and national identity to situate and spatially orientate the intellectual and social factors that have shaped Scottish geography over the past four hundred years. This makes the work specialized in the sense that the reader will have to be moderately familiar with the secondary literature in the fields mentioned above and with Scottish place names and history. To advance his methodology, Withers employs a hefty amount of archival material, cites a wide variety of secondary sources and questions several of the assumptions that form the epistemological foundation of historical geography. Such an intricate weaving of ideas makes the book highly nuanced and one must pay close attention to subject subheadings that are listed in every chapter.

After an introductory chapter that sets forth Withers's method, Chapter 2 focuses primarily on the sixteenth- and seventeenth-century chorographies (accounts of regional and local areas) and asserts that they demonstrate 'an emergent geographical consciousness' (p. 53) in Scotland. This leads Withers to argue, in Chapter 3, that during the 1680s Scottish perception of national identity became closely linked to the production of scientific knowledge. He illustrates this by discussing the career of Sir Robert Sibbald (the first Geographer Royal), the role of the universities and the application of Baconian/Newtonian empiricism. These examples set the stage for Chapter 4's treatment of the long eighteenth century. Here Withers suggests that the practice of geography should 'figure much more prominently in understanding the nature of Enlightenment knowledge' (p. 155). To demonstrate this, he cites examples taken from contemporary geography texts, periodicals, town council minutes, civil histories, atlases, treatises on education, letters, statistical surveys, paintings and other miscellaneous manuscripts.

Moving to the middle of the nineteenth century (1830–1884), Chapter 5 demonstrates that even though geography was able to maintain a strong presence in the Scottish public sphere, it failed to form sustained institutional structures or societies – thereby limiting its influence upon civic spaces and national identity. In his discussion, Withers gives specific emphasis to the *Edinburgh Journal of Natural and Geographical Science* (1829–1831), geographical textbooks and natural history societies. Chapter 6 addresses the years between 1884 and 1930 and concentrates on 'the sciences of national survey', which Withers holds to be 'that scientific work employed in this period to establish geographical knowledge' (p. 197). In this endeavour, he focuses primarily on Scotland's geographical institutions (educational and scientific), national surveys, foreign expeditions led by Scots and the push for a National Institution for Geography. Based on these examples, he concludes that this period saw geography become 'an instrument of national and imperial identity' (p. 233). The concluding chapter presents a summary and comments on several themes that spanned the periods under discussion – one being how geography, national identity and science all saw

the natural environment as something that needed to be experienced for oneself and for one's nation.

Throughout the book, Withers takes care to emphasize that seemingly defunct intellectual ideas and projects are still worthy of historical consideration. Accordingly, we hear about buildings that were never built, expeditions that ended in disaster, surveys left unpublished and instruments used in curious ways (indeed, globes seem to be popping up everywhere). Even though many of his scientific examples might initially appear to be disconnected, Withers somehow manages to link most of them to historical geography and national identity. Building on Habermasian 'public spheres' and social constructivism, he treats 'science' as a methodological episteme that inhabits all levels of society. He is therefore respectfully ambivalent about laboratory experimentation, because he sees it as only a small part of a much larger story. Such a publicly mediated position on scientific methodology allows him to place the historical practices and perceptions of several modern scientific disciplines (geology and botany in particular) under the banner of geography. This historiographical stretching of the scientific endeavour is advantageous at points because it allows him to use unique sources that are not often cited in histories of science (court masques and statistical surveys, for example). However, this stretching of modern scientific terms back onto eighteenth- and nineteenth-century practices does become forced in places – for example, in his broad use of 'earth science' (pp. 71, 163). That said, Withers's vast knowledge of Scottish primary sources does not allow him to stray too far from the historical context and enables him to present a multifaceted and challenging view of Scottish intellectual and cultural history.

M. D. Eddy
University of Durham

William R. Newman and Anthony Grafton (eds.), **Secrets of Nature: Astrology and Alchemy in Early Modern Europe**. Transformations: Studies in the History of Science and Technology. Cambridge, MA and London: MIT Press, 2001. Pp. 443. ISBN 0-262-14075-6. £34.50 (hardback).
DOI: 10.1017/S0007087403254972

This book contains valuable contributions to two fields in which there remains much scope for research. The Introduction and contributions on astrology follow what is now a relatively widely accepted approach to viewing this art as a highly practical and publicly recognized intellectual tool in early modern Europe. Whilst the stereotype of Renaissance astrology as marginal and superstitious has become easy to knock down, this volume provides some compelling case studies to substantiate the strong assertion in the Introduction that the impact of astrology in early modern Europe was comparable to the contemporary influence of economics and psychoanalysis. Defending the historical significance of alchemy has proved more complex, largely because of the 'remarkable incursion of occultist beliefs into the very framework of historiography' (p. 30) prompted especially by the influence of the ideas of Carl Gustav Jung and Mircea Eliade. The chapter by Laurence Principe and William Newman on this topic provides a useful pathway through the historiography, which will be an essential guide for new scholars in this complex field. Another thought-provoking perspective on alchemy is provided by the argument in the Introduction that the influence of the ideas of Marsilio Ficino and Agrippa von Nettesheim gave Renaissance alchemy a cosmic character that it had lacked in the Middle Ages. It would have been interesting to know whether the authors perceived similar shifts occurring in other occult sciences.

The most significant criticism which can be levelled at this volume – the incongruity of treating Renaissance astrology and alchemy together at all – is to some extent mitigated by the contributions it offers to both fields. Indeed, the question of their relationship is deftly considered from a variety of perspectives in the Introduction, but since the conclusions of the editors tend towards arguments for their independence rather than their mutual influence they do not succeed in unifying the disparate

contributions. In particular, the absence of a separate consideration of magic is surprising – astrological talismans are appended to astrology somewhat complacently – and the emphasis is very much on the influence (or lack of) astrology on alchemy. The relationship between astrology and alchemy might usefully have been considered from the point of view of collectors and libraries as well as practitioners and a closer examination of contemporary terms like 'natural magic' and 'hermetic' which imply a unified approach to occult interests would have been helpful.

As far as astrology is concerned, the chapters of this book are disappointingly focused upon well-known practitioners whose astrological interests have often been considered in greater detail elsewhere. Girolamo Cardano, with whom the first two chapters are concerned, has been treated extensively in Anthony Grafton's recent book *Cardano's Cosmos* (Cambridge, MA, 1999). H. Darrel Rutkin examines astrological motifs in the dedicatory letters of Kepler's *Astronomia* and Galileo's *Sidereus Nuncius*, comparing their approach in linking astronomical discoveries to their patron's nativities. His lengthy analysis of this point seems overly focused upon rhetorical techniques and fails to situate the prefaces in the context of wider questions of their subjects' attitudes to astrology. Kepler's astrological interests, in particular, are well known, but have yet to attract extensive scholarly research. Nicholas Clulee's chapter on John Dee is more rewarding in its engagement with some of the wider issues established in the Introduction. He provides a refreshingly clear explication of astrological and alchemical concerns in Dee's best known but most obscure and difficult text, the *Monas hieroglyphica* of 1564. As Clulee shows, Dee developed the concept of alchemy as terrestrial astrology in his construction of the monas symbol. Influenced by Trithemius, he unified astrology and alchemy in terms of a cosmological framework which encompassed the spiritual ascent of the adept.

In Clulee's chapter and that of Lauren Kassell we get a clearer sense of how alchemy fitted into general concepts of natural magic. Kassell's discussion of the alchemical pursuits, magical interests and medical practice of the astrologer-physician and self-styled magus Simon Forman offers an interesting but necessarily cautious survey of their interconnections. Her chapter is particularly valuable for its insights into Forman's reading practices and his blend of alchemy with notions of the Fall, and for its unpicking of the various threads of his hermetic philosophy. Finally, Didier Kahn's chapter on the incident of the Rosicrucian placards sheds new light on the controversies surrounding the Rosicrucian movement in early modern France, thereby directing scholarship away from a misguided historiographical tradition. Although it is a pity that this volume as a whole fails to engage with more general considerations concerning the place of the occult sciences in early modern culture, it provides by contrast many examples of close reading, especially with regard to astrological practice, and useful corrections to previous historiography of alchemy and Rosicrucianism.

SOPHIE PAGE
Cambridge University

CHRISTINE STEVENSON, **Medicine and Magnificence: British Hospital and Asylum Architecture, 1660–1815.** New Haven and London: Yale University Press for the Paul Mellon Centre for Studies in British Art, 2000. Pp. viii + 312. ISBN 0-300-08536-2. £30.00 (hardback).
DOI: 10.1017/S0007087403264979

If eighteenth-century physicians could do extremely well for themselves, as surviving portraits in the 'grand manner' testify, the role of magnificence in hospital and asylum architecture has not received quite the same attention. The term 'magnificence' is carefully chosen. Part of the aim of this fascinating study is to unravel the critique of 'magnificence', with its changing overtones of luxury, waste, unnecessary ostentation and unchristian uselessness, as opposed to the proper display of due status. This debate interacted with changing notions of medical treatment and of sources of contagion, infection and miasmatic pollution,

when it began to be recognized that hospitals all too often killed most of those for whom they were supposed to care.

The author traces the development of ideas about the function of hospital architecture. The focus is on Britain but there is reference, frequently, to developments in France, Italy and, occasionally, further afield. Early hospitals were for the poor, who were generally expected to die anyway and who could not be looked after in the private houses where one had a better chance of surviving. Such charitable institutions did not need to be in any way luxurious, though it was recognized that 'expansiveness' could mean greater healthiness, light and cleanliness. Three key early institutions are analysed: Bethlem asylum for lunatics and the two great pensioner establishments at Chelsea and at Greenwich. All three were built on palatial lines and designed for show. Chelsea and Greenwich both demonstrated an investment in national honour and served a useful recruiting function: professional soldiers and sailors would be provided for in their old age (though it was well known that pensioners were liable to be impressed in time of need, as were some five hundred 'invalids' for Anson's voyage in 1740). Greenwich and Chelsea had long blocks of housing cells or box beds, linked by spacious galleries and colonnades to the dining hall and chapel. At Bethlem, Londoners joked about the supposed grubbiness of their palaces, whereas pauper hospitals were built which were fit for kings.

The scale and appearance of these buildings had of course a major impact on the surrounding urban space, an impact metaphorically extended through books and prints, thus helping to make the hospital visible to distant audiences. Books of course also emphasized that such buildings were public not private, and that therefore their beauties were not selfishly concealed but spoke to the nation at large.

The author then discusses the anxieties in the early part of the eighteenth century about luxury, false taste and Christian modesty in asylum design. A shift in perception, that asylums should actually look like what they are, is traced through changing façades and the use of lunette windows, where neither the inmates could see out nor the tourists see in. The new wave of foundations in the mid-eighteenth century is examined, and especially that of Edinburgh, where medical politics were played out in the construction of the Infirmary. By the 1770s the author argues there were new ways of writing about hospital buildings, with the development of a medicalized rhetoric about buildings which focused on the way that specific forms encouraged the flow of air. A general 'airiness' became defined as 'ventilation', where architectural form could positively hinder cross-infection. H or U plans became common, though there were many variations. There follows a discussion on 'air' and its relation to diseases peculiar to closed populations such as those in hospitals, prisons or on board ship. This leads on to island hospitals, either literally or in ships, and the important naval hospitals at Haslar near Portsmouth, and at Plymouth, with their so-called pavilion design, which Florence Nightingale would later promote. After discussing contemporary architects' views about ornament, art and usefulness, the final chapter deals with William Strutt's approach to rational planning in the Derby Infirmary. This had a different, much more compact plan, but efficient ventilation was effected through small wards, careful separation between areas, improved toilets and a revolutionary central heating system.

This brief outline does not do justice to the number of themes and the richness of discussion by a writer wholly in command of two disciplines. It is a history of architecture written with deep knowledge and understanding of medical and scientific history, and of how architectural means were or were not, as the case might be, directed towards achieving medical ends. It is not a complete history of hospitals in the 'long eighteenth century', but it is valuable in focusing the argument on 'magnificence', in showing how vital naval designs were, and in indicating how crucial patronage could be in advancing particular designs. The interchange of medical ideas with France is brought out well, and here one could add the speed with which for example texts on scurvy were translated,

wars notwithstanding. It chronicles shifts in perception about useful luxury and useless beggarliness, and shows how appropriate ornament, attractively laid-out grounds and fresh air might be deemed to contribute to recovery. Although at times discursive, the author is rightly cautious about retrospective readings: did hospitals actually open the windows so carefully designed and positioned? Some of the many excellent plans and illustrations show they sometimes did. Altogether it fills an important gap in the literature of eighteenth-century medicine.

SOPHIE FORGAN
University of Teesside

MARCO BERETTA, **Imaging a Career in Science: The Iconography of Antoine Laurent Lavoisier**. Bologna Studies in Scientific Heritage, 1. Uppsala Studies in History of Science, 29. Canton, MA: Science History Publications, 2001. Pp. xvii + 126. ISBN 0-88135-294-2. $29.95 (hardback).
DOI: 10.1017/S0007087403274975

For serious history rather than 'heritage', pictures have often seemed optional extras; and reproducing pictures in books or articles is far more troublesome in terms of copyright clearance and fees than one would ever expect. We make the effort for illustrations of scientific importance – but portraits are another matter, and their inclusion may seem truckling – or if it is a series of formal bearded worthies, or group photographs outside laboratories, rather boring. Those who have written for the *New DNB* know how many people from the past worth resurrecting seem to have no authentic surviving portrait. Only for the real scientific stars do we readily find engraved portraits at the front of their published works, or photographs accompanying their obituary notices; and even then one portrait, or a detail of head and shoulders from it, is often endlessly reproduced though it is at best a likeness at a time and place. We get used to one standard image: the elderly Darwin and Einstein, the youthful Davy – sometimes with the tools of his trade, like Faraday gesticulating with a magnet.

Marco Beretta has taken the unpromising case of Lavoisier to illustrate what can be learned from the close study of portraits. Here the classic image is David's great portrait of Lavoisier (at the age of forty-five) and his wife, magnificently dressed although surrounded by carefully disposed apparatus as though in a laboratory. He is in black, she in white; she bends over him, he looks up at her; and his elegant leg projects forward, disturbing the heavy folds of the red tablecloth. Although, as Beretta points out, one would expect that an eminent and wealthy man of Lavoisier's time would have had his portrait painted several times, this (with the sketches made by his wife of work in progress in the laboratory) was supposed to be the only authentic likeness that we have, and although Lavoisier's career was in public administration, this is clearly the image of a man of science – or indeed a scientific team. Whereas in a famous portrait of Descartes, founder of modern philosophy, the great man's leg projects and his foot rests on a volume of Aristotle, Lavoisier's is near a great glass globe.

Beretta reproduces and discusses various other supposed portraits, some of which must be misattributed, but he finds good reason for recognizing as genuine the young Lavoisier, a portrait probably by Greuze of about 1766. Another by Brossard of 1784 seemed puzzling because the sitter is holding electrical apparatus, but Beretta uses this to authenticate the portrait, because at this time Lavoisier was performing electrical experiments. His detective work extends to the David portrait, where he identifies the pieces of apparatus and their iconographical significance, for this is a portrait of a man who described himself as carrying out a scientific revolution through experiments and their interpretation. Similarly, careful examination of Mme Lavoisier's drawings enables the identification or reconstruction of apparatus, and also illuminates for us the use of assistants. David was not after all alone in portraying the great man, though his stunning picture no doubt put the rest in the shade and gave us our icon.

Posthumous idolization brought a new iconography, and particularly interesting is the

tantalizingly incomplete record of the exhibition held in German-occupied Paris in 1943, where things since lost were displayed and the uneasy context was Wurtz's remark that 'chemistry is a French science: its founder was Lavoisier of immortal fame'. Also fascinating is a German version of the Gillray laughing-gas cartoon, where Davy and Rumford are administrating the gas to a farting Napoleon, who appears also to be identified in the caption with Lavoisier. French chemistry had come over the Rhine with the French army: chemistry and nationalism have intimate connections, made evident here visually and concretely – Barrias's bronze statue of Lavoisier, erected in 1900 at the Madeleine in Paris, was destroyed by the Nazis. This is then not only an absorbing exercise in iconography, with a full catalogue, but an essay on the frontier of science and fine art which will stimulate us all to be more observant.

David Knight
University of Durham

David L. Cowen, **Pharmacopoeias and Related Literature in Britain and America, 1618–1847**. Variorum Collected Studies Series, CS700. Aldershot: Ashgate, 2001. Pp. ix + 296. ISBN 0-86078-842-3. £55.00 (hardback).
DOI: 10.1017/S0007087403284971

David Cowen's *Pharmacopoeias and Related Literature* represents an informative collection of articles dedicated to the history of a much neglected genre of medical literature. The book consists of thirteen pieces that were published from the 1950s to the 1980s. Within the scope of pharmacological literature, Cowen includes pharmacopoeias, dispensatories, herbals, surgical compendia/conspectuses, veterinary works and domestic medical literature. The first two-thirds of the book treat British publications and the last third turns its attention to America. Although he does address pharmacological sources published between 1618 and 1847, he pays special attention to titles that appeared during the long eighteenth century. As he admits in the preface, the material sometimes overlaps – but such is the case with any collection of this nature.

A large part of the British section focuses on Scotland, and specifically on the genesis and subsequent transformations of the Edinburgh Pharmacopoeia (1699–1864). Since the Royal College of Physicians (Edinburgh) revised the work just about once every decade, Cowen takes care to highlight how different methodologies and personalities influenced additions and deletions in the various editions. Key names mentioned in this discussion are Sir Robert Sibbald, Sir John Pringle, William Cullen and Joseph Black. After a similar, but smaller, treatment of Edinburgh's dispensatory, Cowen proceeds to chart the spread and influence of pharmacological literature published in London, Edinburgh and Dublin. This discussion is aided by a thirty-page bibliography, twelve title-page reproductions and seven distribution maps. Additionally, there is a fourteen-page table that charts the publication of British pharmacopoeial literature (1677–1871) in the Low Countries, Germany, Switzerland, Italy, France, Portugal, North America, Spain, Austria, India and Madagascar. These lists and illustrations alone make the book an excellent reference work and soothe the sting inflicted by the book's price tag.

The last third of the book focuses on North America. The first selection in this section gives a general overview of the eighteenth- and nineteenth-century pharmacopeial literature published in or imported to the United States. It then addresses the Boston editions of Nicolas Culpepper's herbal/pharmacopoeia and the early (1815) pharmacopoeia of the New York Public Hospital. It goes on to discuss the veterinary works and domestic medical books written by German-Americans during the eighteenth and nineteenth centuries. Cowen demonstrates that this last category includes a wide variety of titles that were read by the German-speaking communities in Pennsylvania, South Carolina and Georgia. The book ends with a helpful index that lists the names of significant persons, publications, ideas and archives.

In addition to the thematic arrangement of the book, Cowen is keen to emphasize several points. I will mention three. First of all, he

advances his thesis that pharmacological literature represents an advanced stage of scientific organization and can therefore be used to gauge the professional accomplishment of medical communities. Related to this point, Cowen's intimate knowledge of the subject then allows him to argue that post-seventeenth-century Anglophone pharmacological literature was significantly shaped by the practice of chemistry and natural history. To illustrate this position, he gives several examples of how Linnaeus's taxonomy and Laviosier's nomenclature affected various editions of the Edinburgh Pharmacopoeia. Finally, Cowen repeatedly demonstrates the rich rewards of publication history. In addition to the tables and charts mentioned above, he addresses intellectual property rights, the perception of British ideas in America and Europe and the complex world of medical translation.

M. D. EDDY
University of Durham

COLIN A. RUSSELL, **Michael Faraday: Physics and Faith.** Oxford Portraits in Science. New York: Oxford University Press, 2000. Pp. 124. ISBN 0-19-511763-8. £15.20, $24.00 (hardback).

ANN FULLICK, **Michael Faraday.** Groundbreakers. Oxford: Heinemann Library, 2000. Pp. 48. ISBN 0-431-10443-3. £11.25 (hardback).

DOI: 10.1017/S0007087403294978

Faraday has been badly treated by his biographers. Indeed the last decent biography was that by S. P. Thompson published in 1898. A large number have been published since, but they have added nothing new, or used dubious concepts such as genius, or proposed somewhat offbeat theses. The latter category includes L. P. Williams's ponderous biography of 1965 in which he argued that Faraday was influenced by German metaphysics and was secretly committed to Boscovichian atomism and that both these guided, if not determined, the course of his experimental work. This thesis has received little support. Part of the problem was that in the mid-1960s it was not clear how experimentation could construct knowledge outside a theoretical framework. (L. P. Williams, 'Faraday and his biographers', *Bulletin of the History of Chemistry* (1991), **11**, 9–17 admitted candidly that this was the case, but failed to draw the obvious conclusion in regard to the argument in his book by then more than a quarter of a century old.) However, the pioneering work of David Gooding during the past two decades, especially, but not exclusively on Faraday, showed how scientific knowledge, including novel theories, could be constructed from experiments. Gooding emphasized the tacit knowledge, practices, technologies and manipulations needed to develop new knowledge of the world in their social, cultural and religious contexts.

In the work undertaken on Faraday in the 1960s and 1970s there was something more at play and this was class. Historians, who generally come from a middle-class university-educated background, seemed then unable to comprehend how Faraday, the son of a dissenting blacksmith without benefit of university education, could have reached the pinnacle of scientific attainment without being merely the conduit for pre-existing ideas with no originality of his own. It is only in recent years that it has been possible to come to grips with the historical problems that these issues raise. A good start has been made with Gooding's work, Geoffrey Cantor's excellent study of Faraday's Sandemanianism, my edition of Faraday's correspondence which emphasizes Faraday's important role in society, very close textual studies by scholars such as Gooding, Steinle, Romo and Doncel as well as Tweney's insightful cognitive psychological approach to Faraday's work.

In the past, without access to the tools and knowledge that modern historical research has provided, it was perhaps appropriate to write short potted biographies of Faraday. There were a large number of them, many written especially around the time of the celebrations surrounding the 1931 centenary of his discovery of electromagnetic induction. These books have certain things in common: a rags-to-riches

(or at least eminence) story, the lone scientist discovering the laws of nature in his basement laboratory, the technological importance of the subsequent application of his discoveries and, in those texts written by authors with a Christian turn of mind, the combination of a devout Christian and a first-rate scientist in the same person. Such texts were influential. The British Prime Minister between 1979 and 1990, who grew up in the 1930s and studied chemistry at Oxford in the 1940s, must have come across them since she said that Faraday was her hero and suggested that his life showed that one could become a great scientist without going to university. This seems to be the reverse of the way some historians treated Faraday in the 1960s and 1970s and it is perhaps fortunate that we now have Higher Education Funding Councils rather than the Bookbinding Funding Council.

What is now inexcusable is that similar short biographies, signally failing to take on board recent historical work, continue to appear. These two by Russell and by Fullick are the latest in the line, although Russell's is by far the worst. Judging by her British Library catalogue entries Fullick is a science writer whose work is aimed at secondary-school students. Faraday has recently returned to the English National Curriculum and this accounts for the recent plethora of television programmes and school texts on him. According to the blurb on Russell's book he is a chemist who has worked on the history of science and technology at the Open University. The series 'Oxford Portraits of Science', of which this is part, is edited by Owen Gingerich, an astronomer at Harvard University, who has worked on Renaissance astronomy, particularly Copernicus. The series claims to be aimed at 'young adults', which presumably means undergraduate or advanced school science students in the United States. While it is admirable to write texts for school and university students, I do have problems with the execution in these cases and particularly with Russell's volume. While in a short text there is need for compression and simplification, there is no need for the patronizing tone that Russell adopts with tropes such as that there 'can be little doubt that life in these parts was tough and grim' (p. 18). Fullick, on the other hand, does seem to hit the right level with her book, although some features could be better.

Both biographies have no theme, follow closely the patterns established by the 1930s biographies and repeat almost every well-known anecdote about Faraday that the authors (especially Russell) can find, ignoring recent work showing that most of them were fabricated by Victorian myth-makers. It is not clear what sources Fullick used as she does not cite a single study on Faraday and restricts her bibliography to four general books, three of which, self-servingly, were published by Heinemann Library. Russell does cite some (but by no means all) recent books on Faraday in his inadequate and inaccurate bibliography. However, if he has read them he has not understood them. For instance, his discussion of Faraday's electromagnetic rotations experiments of September 1821 is extraordinarily garbled and includes the bizarre statement 'Faraday was not aware of all the activity in Europe on the subject of electromagnetism' (p. 63). It is possible that there may have been some work in Moldavia of which Faraday was not aware, but his writings, as Gooding has conclusively proved, show him to have been one of the best-informed people on the subject in Britain. But instead of referring to Gooding, the only author Russell refers to in the entire text is Trevor Levere, who is not noted primarily as a Faraday scholar. A practising scientist would not be allowed to get away with this kind of cavalier treatment of references.

What is even worse about these books, and quite spectacularly so in Russell's case, is the large number of factual errors. Fullick's are on the whole quite minor: she is a bit confused as to where Faraday was born (pp. 4 and 7), and is hazy on the applied scientific work that Faraday undertook (p. 18) and on the effects of his illness (p. 34). But there are so many serious errors in Russell's book that by the time I finished listing them I had compiled a nine-page typescript. Whether these errors represent

carelessness or something else is impossible to tell – one does not, for instance, quite know what to make of Russell having Darwin's *Origin of Species* published in 1861 (p. 115). His statement that all British marriages had to be licensed by an Anglican minister is a particularly egregious error (pp. 44–5); couples in Scotland would have been surprised. Young science students deserve better than this.

How did such a book as Russell's come to be written and published by a firm like OUP? So far as I have been able to ascertain no expert on Faraday read the text to comment on its content. This seems to me to be a serious lapse in refereeing for an academic publisher, but one which, judging by some other books that I have reviewed recently, is part of a wider trend in the lowering of standards by university presses.

For all its problems, Fullick is by far the better of the two books. At least her readership will not 'know', as Russell's readers will, that on Christmas Day 1821, after completing an experiment, Faraday's wife 'Sarah Faraday was summoned to witness the triumph, despite her protestations that their first Christmas goose would be burned' (p. 65). Cooked goose and burnt offerings indeed.

FRANK A. J. L. JAMES
Royal Institution

WILLIAM J. ASTORE, **Observing God: Thomas Dick, Evangelicalism, and Popular Science in Victorian Britain and America**. Aldershot: Ashgate, 2001. Pp. ix + 303. ISBN 0-7546-0202-8. £45.00 (hardback).
DOI: 10.1017/S0007087403304972

Adultery may be a sin, but it seems to have been the making of Thomas Dick, the 'Christian philosopher'. Dick was brought up an evangelical in the Secession Church of Scotland, was converted to astronomy at the age of eight by the vision of a falling meteor and, having ambitions beyond the family hand-loom weaving enterprise, took up school teaching to support himself through Edinburgh University and theological training college. As a minister, he hoped to have a position of respect in the community, and the opportunity to continue his astronomical interests. If all had gone well, the rest of the story might have been rather uninteresting.

Within two years of his ordination and marriage, however, he had been excommunicated and defrocked, for adultery with a servant. His reputation was in tatters, and though he was subsequently readmitted to the church, he could not return to the ministry. William Astore convincingly argues that in this experience lie the roots of Dick's later emphasis on the role of the 'Christian philosopher'. This was the title of his first book (1823), and also the title by which Dick himself came to be known as his reputation grew. Becoming known as a 'Christian philosopher' was an effort of self-fashioning and an attempt to regain status. The scandal was, of course, hushed up in contemporary biographies.

This Scottish evangelical became one of the most widely read writers on astronomy and education in the first half of the nineteenth century. Astore's book is an important contribution to recent scholarship showing that evangelicals did not routinely ignore the sciences, and that science and religion, for many people, remained perfectly complementary well into the late nineteenth century. Although Dick did not succeed in convincing everyone that ministers should pay more attention in their sermons to the works of God, or that philosophers who studied nature should have equal status to the ministers who studied the words of God, he did succeed in presenting himself as a learned Christian astronomer. His books introduced many readers to the basics of astronomy, which he always placed in a Christian context, and laid a particular emphasis on the aesthetic appreciation of God's works.

At a time when some other writers were presenting astronomy in a secular or even atheistic light, Dick's combination of Christianity and astronomy was widely welcomed, particularly by evangelicals throughout Britain. He argued that the notorious nebular hypothesis was actually quite in keeping with a vision of God as ever-creating, directing the world progressively towards a millennium. Dick is perhaps best known to historians of astronomy

for his support for the plurality of worlds yet, as Astore shows, Dick was far from alone, and his position was utterly consistent with his religious views. In Astore's presentation, it is William Whewell (opponent of that other Scottish evangelical, David Brewster) who appears as the odd one out.

One of the strengths of Astore's work is his consideration of Dick's reception in America. Astore places Dick in a British publishing context, explaining the vagaries of the book trade which left this successful author almost penniless at the end of his life and forced to sell his telescopes to support his five orphaned grandchildren. But it is in the two chapters dealing with America that we really feel the influence Dick gained. In America he was a revered figure. His books were regarded as classics, were issued in 'collected editions', and appeared in Sunday school and Mechanics' Institute libraries with great regularity. Equally, it was an American university which awarded Dick an honorary doctorate. Astore shows how Dick's combination of evangelicalism, abolitionism and pacifism fitted beautifully into Northern antebellum society, helped by the increasing enthusiasm for astronomy in the middle of the century, and the conviction in America that astronomy was a moral subject as much as a scientific one.

Science and religion is the main thrust of Astore's book, but he also makes a case for rewriting the history of science education and popularization to include a wider range of actors than the usual liberal Whig reformers. Dick was committed to the cause of popular education, and had set up a literary and scientific institute and given courses of lectures on astronomy in the 1810s. Where he differed from later secular reformers, of course, was his insistence that Christian morality was essential to such enterprises, as were the lessons which could be learned about God from His works. Astore includes a fascinating analysis of the similarities between Dick and George Combe on issues of popular education, despite their rather different religious positions.

This is not written as a biography of Dick, but as an analysis of the role of popular astronomy within British and American life, particularly for evangelicals. The story occupies the same time span as Herschel's mapping of the southern hemisphere and Nichol's support for the nebular hypothesis, yet Astore provides us with a fascinating alternative picture of Victorian astronomy.

AILEEN FYFE
National University of Ireland, Galway

M. CHISHOLM, **Such Silver Currents: The Story of William and Lucy Clifford 1845–1929**. Cambridge: Lutterworth Press, 2002. Pp. x+198. ISBN 0-7188-3017-2. £17.50 (paperback). DOI: 10.1017/S0007087403314979

The author and her husband set up a Clifford Research Group some years ago, and this double biography is the principal outcome to date. The main new source for the story is a large assembly of letters held by descendants and called 'The Valehouse Collection'; several other archives have been used, and some interesting photographs and likenesses are reproduced.

The novelist and playwright had survived her mathematician and philosopher husband by half a century at her death in 1929, so the bulk of the information concerns her. The author records her novels and plays and their varying successes, and describes the impressive range of literary figures in her circle. One of them was Sir Frederick Macmillan, the head of the publishing house of William's books who now took some of hers also and used her as a reader; for some reason their letters to the house (British Library, Additional Manuscripts 54932) have not been cited. Others' reactions to her are also recorded; Virginia Woolf's typical bitchiness achieves pornography (p. 119).

William is the prime focus of this review. His talent emerged strongly and quickly enough that in 1874, his 29th year, he was elected an FRS as 'distinguished for his acquaintance with the Metaphysics and Geometrical & Physical Science & as original investigator in the same' (Royal Society Archives). Would that this book had conveyed the range and content of his work, but the survey, written in part with the

author's husband, is too slight to be useful and in places faulty. For example, William's notion of the biquaternion is said to describe 'four-dimensional space' (p. 160) whereas it is the algebraic representation of the operation to transform a 'motor' (his name for a vector with an associated rotation) to another motor, all in three dimensions though indeed using another mathematical parameter.

Adulation and hindsight dominate over examination and insight. William's views on curved space are held to herald relativity theory (p. 39) but no evidence of the required conception of space–time is presented and in any case much of the line of thought was already present in an essay by Bernhard Riemann, which William translated into English in 1873 (p. 39).

The discussion of the impact of William's own algebra is largely confined to an 'Afterword' by Roger Penrose, who correctly points to its influence on Paul Dirac among others, but the preceding history involving figures such as Rudolf Lipschitz and Elie Cartan is missing. So also is the remarkable effect of his graphical representation of his algebra (p. 49) during the 1880s, when A. B. Kempe was led by it to an extraordinary theory of multisets (to use the modern name) which itself soon set C. S. Pierce on the track of his existential graphs.

William was also known for his philosophical writings. These are noted, though he is characterized both as an atheist and also an agnostic (pp. 35, 67) – an important distinction, or else a change in stance, worth discussing for a member of the Metaphysical Club. The book ends with bibliographies for both husband and wife. The list of his books includes German translations, with one misidentified, and most German words appallingly misrendered. Several of his mathematical papers are missing (and the Riemann translation is given the wrong volume number in *Nature*), and no reprint details in his *Mathematical Papers* (1882) are afforded. His many contributions to the *Educational Times* are omitted entirely, reflecting the silence of the narrative.

Ivor Grattan-Guinness
Middlesex University at Enfield

Andrew Berry (ed.), **Infinite Tropics: An Alfred Russel Wallace Anthology.** With a preface by Stephen Jay Gould. London and New York: Verso, 2002. Pp. xvii + 430. ISBN 1-85984-652-1. £19.00, $27.00 (hardback).

Jane R. Camerini (ed.), **The Alfred Russel Wallace Reader: A Selection of Writings from the Field.** Foreword by David Quammen. Center Books in Natural History. Baltimore and London: Johns Hopkins University Press, 2002. Pp. xix + 221. ISBN 0-8018-6789-4. £13.00 (paperback).

DOI: 10.1017/S0007087403324975

Alfred Russel Wallace can no longer be convincingly characterized as the 'forgotten naturalist'. These two anthologies are representative of a recent run of publications which place him centre stage as a polymath with wide-ranging interests and achievements. This historiographical shift is significant, as Wallace had long been confined to a supporting role as the 'other man' in the development of the theory of natural selection. For in February 1858, while suffering with fever on a Moluccan island, Wallace had a 'sudden flash of insight' that spurred Darwin to publicize his own clandestine research *On the Origin of Species*. Wallace famously stood aside while Darwin asserted his prior claim to the discovery and as a result was cast for posterity as the unfortunate also-ran who provided a neat twist in this well-known tale.

This limited treatment of the life and work of the 'forgotten naturalist' is now increasingly uncommon but it raises an important point. How does one approach Alfred Russel Wallace? He is, in many ways, unclassifiable; as Jane Camerini rightly observes in her new anthology, singular labels cannot adequately summarize one who was by turns a natural scientist, geographer and travel writer, social critic, spiritualist and intellectual (p. 2). Indeed, his writing career spanned seventy years and produced twenty-one books and roughly eight hundred published essays, reviews and letters, totalling over ten thousand pages in print. This immense body of work overstepped disciplinary boundaries to address a remarkable

range of subjects, from entomology, ornithology, anthropology, biology, bio-geography, astronomy, geology and glaciology to anti-vaccination, women's rights, spiritualism, museum design, conservation, pacifism, industrial relations, land nationalization and extra-terrestrial life. Such intellectual diversity was tangential to a restless lifestyle, for alongside twenty thousand miles of 'applied' travels in Amazonia and the Malay Archipelago, Wallace settled in eighteen different locations in England and Wales alone.

Undoubtedly a life of such variety presents a daunting academic prospect, hard to interpret within the confines of a single study. For this reason Alfred Russel Wallace is a perfect subject for anthology, as a selection of autobiographical accounts of experiences and ideas can emphasize their colour, variety and development, and diminish the need for limits and classifications. Fittingly, the sheer diversity of Wallace's life and work has recently provided the scope for two very different collections.

Andrew Berry's *Infinite Tropics* is an outstanding overview of Wallace's intellectual world. The collection maps the range of his interests with extracts from over a hundred of his books, articles and published letters, thus adopting a similar approach to Charles Smith's *Alfred Russel Wallace: An Anthology of his Shorter Writings* (Oxford, 1991). Berry's purpose is to sample the complete variety of Wallace's work – scientific, social, political and spiritual. To this end, Wallace's most succinct summaries of his views have been presented in five thematic sections: 'Science', 'Humans', 'Spiritualism and metaphysics', 'Travel' and 'Social issues'. The result is a comprehensive and balanced representation of all facets of Wallace's world view, which is a particularly valuable perspective in the light of the literature's presentist focus on his scientific achievements. In fact, *Infinite Tropics* illustrates how science, socialism and spiritualism are interconnected pieces of Wallace's 'personal jigsaw puzzle' (p. 251) and all are essential to a proper view of the man and his work. His less orthodox interests in marginal science accordingly receive their share of attention as vital elements in the creation of a 'fully fledged theist' (p. 223). Importantly, Berry's wide-ranging approach emphasizes, crucially, Wallace's seemingly relentless curiosity, his quirky yet incisive mind, his love of polemics, his attraction to grand theories and his ability to synthesize (and sometimes twist) data into a sophisticated intellectual scheme. Visionary or crank, Wallace was certainly an intriguing thinker whose writings include ideas that appear ahead of their time (socialism, environmentalism, anti-racism) and beliefs that remain the subject of controversy (spiritualism).

The anthology opens with a lively and readable biographical study of Wallace based on his detailed two-volume autobiography. From here, Wallace's ideas are presented in his own words, with editorial interruption limited to pithy links which critically contextualize and clarify the extracts with a nice ironic touch. Historiographical opinion on matters of controversy is woven into the thoroughly referenced text, and Berry has advanced hypotheses of his own on key questions (such as why Wallace sent the 'Ternate' paper of 1858 to Darwin rather than directly to a journal). The extracts flow well from general theoretical outlines to deeper empirical expositions, with clarity and logic assured by Wallace's idiosyncratic writing style. Specialist information aside, *Infinite Tropics* also directly addresses matters of popular curiosity, such as the Wallace–Darwin relationship and their exact points of agreement and disagreement. The collection also usefully draws attention to less publicized angles of his work, such as conservation, public health and education and pacifism. Yet, despite the necessary dissection of Wallace's body of work into such topical sections, by the end of this collection his complex and overarching thought system emerges as a coherent whole. Andrew Berry has produced an impressive and accessible anthology, of which its subject (himself an accomplished popularizer) may well have been proud.

In contrast to the sweeping overview of *Infinite Tropics*, Jane Camerini's *Alfred Russel Wallace Reader* concentrates upon his writings from the field. Her selection seeks to capture

the day-to-day experiences frequently bypassed by a literature traditionally focused upon the theoretical outcomes of Wallace's travels. This is a worthwhile endeavour, for it emphasizes the effects of travel and location upon intellectual development and practical expertise. After all, as David Quammen notes in the Foreword, it was in the field that Wallace 'showed his greatest skills and percipience' (p. xv). Moreover, his numerous travel writings reveal an emotion and passion that remain firmly buried elsewhere, even in his unpublished family correspondence.

The collection has been created with insight and sensitivity, and includes excerpts from Wallace's books, articles and letters. Highlights include extracts from his US travel journal and an early ethnological essay, 'The South Wales Farmer' (1843), which illustrates his nascent interest in anthropology and burgeoning sense of social and political injustice while surveying in rural Wales during the turbulent 1840s. Yet it is Wallace's writings from the Malay Archipelago which really stand out, for here this objective observer of nature is poetic, engaging with concepts such as beauty and mortality through vivid prose and touching description. The reproduction of whole extracts, unabbreviated, allows one to become truly engrossed in the musings of this lone naturalist. This sense of involvement is especially important as the collection is aimed at a general audience. To this end, Camerini provides clearly written introductions that carefully place the writings in their broad social, political and intellectual context and explain the basics of scientific theory and practice.

In keeping with this clarity, Wallace's writings from the field are presented in four chronological chapters neatly organized by location: 'Wales', 'The Amazon', 'The Malay Archipelago' and 'The World'. Unfortunately the contextual depth and thematic continuity apparent through most of the book fade in the latter part, where half a century's worth of writings on an immense range of topics is crammed into one chapter, 'The World'. The 'from the field' theme also falls by the wayside here as, with the exception of Swiss botanizing holidays and an American lecture tour, Wallace did not travel extensively in the period from 1862 to 1913. That said, it is to Camerini's credit that she does not sidestep his interest in spiritual and mental phenomena during this period. Her perceptive commentary succeeds in bringing out the collection's recurring themes, which is no easy task when one considers the range and complexity of Wallace's work. In fact, it is this extraordinary variety that makes anthologies such as these a useful introduction to Wallace and a welcome addition to the literature.

Christine Garwood
The Open University

Nancy Leys Stepan, **Picturing Tropical Nature.** Picturing History. London: Reaktion Books, 2001. Pp. 283. ISBN 1-86189-084-2. £25.00 (hardback).
DOI: 10.1017/S0007087403334971

The latest book in Reaktion's 'Picturing History' series develops the argument that 'tropical nature was an imaginative construct as much as it was an empirical description of the world' (p. 11) through a series of selected case studies of visual images of tropical nature. Having set the scene with a survey of Alexander von Humboldt's influential vision of the tropical world, Stepan focuses mainly on the period after 1860, looking especially at natural history (notably the work of Alfred Russel Wallace), anthropology (more particularly the photographic representation of racial type) and tropical medicine (especially the picturing of tropical disease around the beginning of the twentieth century). Geographically, the book focuses mainly on Brazil, as represented not simply by Europeans and Americans, but by Brazilians themselves.

The main strength of the book lies in its case studies of images of race and disease from the 1860s to the 1920s. Stepan's main methodological principle is contextual: images for her must always be interpreted in historical terms, which means situating them in appropriate social, political, commercial and intellectual contexts. Particularly relevant to readers of this

journal is the account of Louis Agassiz's racial photography in Brazil in 1865, in which Stepan argues that the photographs of the mixed-race inhabitants of Manaus effectively undermined Agassiz's claims about the fixity of racial type. (The book reproduces several photos of awkwardly posed subjects now in albums in the Peabody Museum, Harvard, alongside a beguiling studio portrait of the young William James, who accompanied Agassiz on his expedition.) Stepan also discusses a set of portraits from the archives of the Oswaldo Cruz institute for medical research in Rio de Janeiro, addressing the different ways in which racial hybridity was figured by the Brazilian intelligentsia itself. There follow two chapters on the iconography of tropical disease, taking in a range of forms of visualization, including maps, diagrams, photographs and engravings. Stepan rightly emphasizes the continuities between older traditions of medical climatology and the newer laboratory-based tropical medicine, as well as specific aspects of the visual rhetoric associated with the development of microbiology in the work of Manson and others.

A further strength of the book is its attention to the ways in which the inhabitants of the tropics have themselves negotiated visions of 'tropical nature'. In the Brazilian context, for example, the language of tropicality has been appropriated by scientists, intellectuals, artists, politicians and architects in different ways at different times – as, for example, more recently in Gilberto Freyre's sociological writings or composer Caetano Veloso's *tropicalismo*. Stepan's detailed account of the Brazilian debate over Chagas's disease during the 1920s foregrounds the complex ways in which visual representations of the diseased body – and indeed, the discourse of tropical medicine itself – were mobilized well beyond Europe and North America. And her discussion of the work of the celebrated Brazilian landscape architect Roberto Burle Marx brings to current debates over the genealogy of ideas of the tropics an appreciation of the complex and directly material ways in which these notions may be produced and transformed – in this case, through interventions in the urban landscape of Rio de Janeiro. Burle Marx's tropical modernism, argues Stepan, offers an alternative to sterile oppositions between nature and culture, the organic and the conceptual, and (we might add) the indigenous and the cosmopolitan.

What one finds in Burle Marx's gardens – a negotiation between a universalizing concept of modernity and a more ecological sense of place – in a sense brings us back to Humboldt. While Stepan tends to treat Humboldt as a romantic, an exponent of an older, more lyrical tropical aesthetic, it is possible to see the author of *Kosmos* as articulating a similar duality between the global and the local in a register appropriate to his own times. On the one hand, the tropics are visualized as a space of radical difference, a highly distinct assemblage of natural forms. On the other hand (as Michael Dettelbach has shown), the tropics are described by Humboldt as a privileged site for the study of universal natural laws; in other words, a space differentiated by the intensity, not the innate qualities, of the processes which operate within its bounds. Seen in this context, Humboldt's account of tropical nature seems at the same time both ancient and modern, both romantic and scientific, both local and global. That may explain why his vision is still of interest to geographers and others today.

Picturing Tropical Nature is mainly concerned with showing how visual representations are selective and partial versions of reality, reinforcing certain codings of tropical nature (as in stereotypical treatments of the tropical rainforest, for example). Notwithstanding her concern with processes of representation, Stepan is reluctant to cede too much power to the visual. Indeed, she suggests that the complexity and subtlety of some concepts cannot readily be pictured. Commenting on the disjunction between text and images in Alfred Russel Wallace's writings, for example, she argues that 'it is important to be aware that there are limitations to visual images – that they may, as a system of communication, be inadequate to our perceptions, or less adequate than words, or incomplete without words' (p. 82). Stepan's account of the work of Burle Marx, however, shows us another aspect to the visual,

and the ways it can offer powerful new ways of understanding and experiencing the world.

FELIX DRIVER
Royal Holloway, University of London

PETER HAMILTON and ROGER HARGREAVES, **The Beautiful and the Damned: The Creation of Identity in Nineteenth-Century Photography.** Aldershot: Lund Humphries in association with the National Portrait Gallery, 2001. Pp. vi + 122. ISBN 0-85331-821-2. £25.00 (hardback).
DOI: 10.1017/S0007087403344978

This ambitious and fascinating volume explores the development of portrait photography as a cultural tool, showing how social, scientific and celebrity portraiture interlocked with the nineteenth-century compulsion to classify and order and, as the authors suggest, provided new ways of commodifying social identity. It emanates from an exhibition of the same title staged at the National Portrait Gallery (NPG) in London in 2001. The two authors are attached to the Open University and the NPG respectively.

In essence this is a history of looking, not making. It ranges from daguerreotypes as costly private keepsakes early in the nineteenth century, through the visual restructuring of the bourgeoisie brought about by *cartes de visites*, to the systems of surveillance developed by Bertillon and others late in the century. It is mostly concerned with European movements with a slight preponderance towards France, with a welcome nod here and there to America. Star photographers naturally make an appearance, such as Antoine Claudet and Julia Cameron, and offer opportunity for some splendid reproductions of their work. But the main intent is to trace the growth and impact of an industry through its less well known practitioners. Dissemination via printed partworks and albums like the Literary and Scientific Series published by Maull and Polyblank and then the London Stereoscopic Company is comprehensively addressed, for example, as are the business aspects of studio photography and the manner in which fame and the new medium drew together as a commercial enterprise. The text is beautifully illustrated – or rather, the images are more than mere illustrations for they constitute an integral part of the story.

The two authors are alert to the kinds of question *BJHS* readers might pose about these visual resources and dwell at satisfying length on the eagerness of the emerging middle classes to memorialize their identity or record their emotional investment in social institutions such as the family or nation. Roger Hargreaves discusses social and celebrity photography in the opening chapter. Royalty cultivated popular support by representing themselves as 'ordinary' figures who shared the tastes and values of their subjects. The growing cult of personality is revealed in both its aspects – the positive attributes of beauty, talent, fame or wealth set against the ugly, the criminal or the outsider. Sad little photographs of dead children appear side by side with portraits of people in fancy dress or in nothing at all. Hargreaves gives a judicious, thought-provoking account of the rising public appetite for images of the most noteworthy individuals of the day and the blurring of boundaries between public and private. He proposes that the increasing visibility of certain persons through the medium of photography, and its knock-on effect as line reproductions in illustrated magazines, encouraged ordinary members of the middle classes to appear before the cameras in similar fashion. What is increasingly apparent is the manner in which the defining features of modern celebrity were rapidly mapped out and the key relationships between would-be celebrities, the producers of their images and the public at large were established. Personalities such as Florence Nightingale, Charles Dickens, Charles Darwin and the ubiquitous Alfred, Lord Tennyson were among this first generation of photographically mediated personalities. Group portraits served a slightly different function from such emergent tropes of individuality and character, best described as the dominant visual code for establishing institutional identity. The photograph reproduced on p. 53 shows twenty-three uniformed and

moustachioed attendants of the NPG around the year 1900. They are nameless but exude corporate unity.

Under the heading 'Policing the face', Peter Hamilton tackles the shift from social portraiture to the use of photography in new systems of discipline, control and treatment. Drawing on Gilman and others, he argues that photography of the face became an important adjunct to the power structures of nineteenth-century societies. At one level, this is unexceptional. Photography was used to highlight the existence of various types and categories of people, such as criminals, lunatics, prostitutes and indigenous peoples. At another level, the possibility of creating a documentary record, a collection of visual specimens on paper, as it were, soon became a leading motif, and a concern with establishing what was expected to be a complete, objective and comprehensive social inventory rose to the fore. If cameras, as was thought, could generate objective knowledge then photography might arguably play a role in the management of society in general. Yet the adaptation or integration of this form of visual knowledge into the systematic structures of science (or the law, commerce or medicine) was not straightforward. Although a useful tool for Bertillon, who is here given the full attention he deserves, especially in recording the criminal face, there was apparently little systematization of records in the Paris préfecture de police. It took several decades, for instance, for the convention of full-face and profile shots to emerge. By the 1890s French policemen were able to generate cards, one for each criminal suspect, carrying significant body measurements and two photographs that Bertillon called a *portrait-parle* (talking portrait). Yet rather as Gilman pointed out in relation to James Crichton-Browne concerning the series of photographs of the inmates of the Wakefield asylum, it remains unknown precisely how these photographs were arranged or used. These kinds of issue are fully explored with reference to the nineteenth-century positivist vision of science and the rise of the concept of scientific objectivity. All in all, this intelligently argued and well-constructed volume is a delight, both in the reading and in the encounter with its stimulating visual sources.

Janet Browne
Wellcome Trust Centre for the History of Medicine at University College London

Bernadette Bensaude-Vincent and Christine Blondel (eds.), **Des Savants face à l'occulte 1870–1940**. Sciences et société. Paris: Editions la découverte, 2002. Pp. 233. ISBN 2-7071-3616-6. FF 114.79, €17.50 (paperback).
DOI: 10.1017/S0007087403354974

Recently, I heard a well-known scholar repeat in a seminar the old notion that the *grand partage* between science and non-science (and science and philosophy) took place with Galileo and since then scientists never looked back. Nowadays, however, very few hold this opinion, and indeed HPS undergraduates learn in the first months of their course that it is anachronistic to talk about 'science' before the nineteenth century. No historian of science is any longer surprised by Galileo's horoscopes, Kepler's professional interest in astrology or Newton's esoteric writings. However, the interest and involvement of scientists in the occult in more recent times, when the demarcation between science and non-science was supposed to be clearly established, opens up another series of interesting issues.

Bernadette Bensaude-Vincent and Christine Blondel's edited volume investigates various episodes of scientists' involvement with mediums, sleep-walkers, spirits, ghosts and the like in the period between 1870 and 1940. These dates reveal at once that the setting is France, as they correspond to the French Third Republic. Although not made explicit in the title, this was a choice, for the editors warn the reader that some scientists in other countries, such as the United Kingdom, Germany, Italy, Spain and Russia, also showed a keen interest in the occult (pp. 5–6). That the phenomenon was international does come out in many parts of the book, for instance in the description of the international career of the medium Eusapia Palladino, who in France convinced the Nobel-prizewinners Pierre Curie and Charles Richet of her powers (see Blondel's Chapter 7).

Sometimes the French setting is a crucial part of the argument, as in the case study on Jean Martin Charcot's research on 'magnetic sleepwalkers' (Chapter 4). Edelman argues that Charcot's explanation of somnambulism and of religious ecstasy in terms of hysteria was successful (also) because it was perfectly in line with the anti-clericalism of the Third Republic. In this essay it is also emphasized that methodologically spiritism was not significantly different from the 'conventional' sciences. This point is stressed elsewhere as well: for instance in Fuentès's essay on Camille Flammarion, who struggled to make spiritism a recognized science, and in Pierssens's essay on the role played by literature in the negation of scientific status to the occult sciences.

Other chapters point to methodological difficulties that the occult sciences faced. For evidence that their experiences were not reproducible, see Bensaude-Vincent's chapter on radiesthesia, and Le Maléfan's account of how Charles Richet was convinced of the reality of the phantom revealing himself in Carmen Villa in Algiers. Moreover, mediums as a rule did not agree to modify their experimental conditions. These methodological limitations seem to be problematic only if the occult sciences were to be equated with the physical sciences. The point is that many scientists tried to do precisely that. There were attempts to take instrumental measurements of the 'force' emanating from Eusapia Palladino, which was judged to be magnetic, electric or radioactive (p. 156). Similarly, Bensaude-Vincent argues that the study of radiesthesia was modelled on early twentieth-century physics and on the example of the wireless telegraph (p. 208).

The issue of reproducibility was less pressing for psychologists. In *L'Automatisme psychologique* (Paris, 1889) Pierre Janet studied the case of the 'magnetic somnambulist' Léonie Leboulanger and concluded that she was affected by a 'multiple-personality hysteria' (Carroy's chapter on Léonie's participation in the unearthing of the truth about the Dreyfus case, p. 130). What Janet's conclusions share with the attempts of physicists and physiologists is that they were all aimed at reducing obscure phenomena to phenomena that could be explained by the official sciences.

Beyond the methodological question, there is the question of the object of study, which I personally find more intriguing. Many scientists discussed in this volume tried to validate the reality of occult phenomena by explaining them in the terms of the science of the time. For the enemies of the occult sciences, the best strategy was to prove that those phenomena did not exist at all. As Méhust shows, they often thought that the people who had the expertise to unmask mediums and sleepwalkers were the illusionists, rather than the scientists.

The social strength of the sciences largely lies in the fact that there has been an equation between scientific objects and real objects. What is real for science is considered real *tout-court*. In this volume, we can see a few instances of the complex and contradictory negotiations around the scientificity or reality of objects and phenomena. As Pierre Lagrange and Patrizia d'Andrea discuss in Chapter 1, the actors do not simply and clearly place themselves on either side of the *grand partage* between science and non-science. The demarcation between science and non-science has not been and cannot be established once and for all, and it does not depend on purely epistemological factors. *Des Savants face à l'occulte* thus contributes very interesting case studies and arguments in the debate about the distinction between science and other cultural forms.

Cristina Chimisso
The Open University

Klaus Hentschel, **Mapping the Spectrum: Techniques of Visual Representation in Research and Teaching.** Oxford: Oxford University Press, 2002. Pp. xiii + 562. ISBN 0-19-850953-7. £75.00 (hardback).
DOI: 10.1017/S0007087403364970

This is a fascinating and satisfying book. It is a hefty tome incorporating some 140 illustrations (four of them colour plates), copious footnotes and a leisurely, multi-threaded analysis dominated by abundant historical examples. Its subject is spectrum analysis, and

especially the representation of spectra through the nineteenth and early twentieth centuries.

The Introduction notes that historians of science are trained to work, analyse, interpret and deconstruct written texts and to produce their own texts in turn. Except for the subject of astronomy, Hentschel argues, most historians of science have devoted too little attention to non-textual sources. The book redresses the balance by linking together seemingly disparate tools, studies and perspectives under the theme of visual representation. This unconventional perspective makes for interesting reading, because it valorizes what might previously have been seen as incidental or irrelevant traits, and employs new criteria for analysis. Thus a discussion of the differences in prismatic and diffraction-grating spectra focuses not on disputes about the standardization of a wavelength scale, or on the different instrumental practices of spectroscopic subcommunities, but on the difficulty of recording, visually recognizing and making use of the patterns of spectral lines.

The book is also interesting in that it avoids the intellectual locales most familiar and appealing to historians of science, focusing not on cases of contention and controversy but on the routine practice of the spectroscopist and teacher of spectroscopy. Spectrum analysis was one of the busier branches of physical science in the last four decades of the nineteenth century and involved a changing assortment of specialists. By emphasizing routine practice, the author highlights the fact that many practitioners – the engravers, lithographers and photographers active in the scientific printing industry, for example – remain shadowy figures. There are, even so, some well-known exemplars here such as John Herschel, Norman Lockyer, E. C. Pickering, Henry Rowland and Hermann Wilhelm Vogel. Many of them were engaged in astronomical and photographic, as well as spectroscopic, research.

Hentschel argues that a preponderance of spectroscopists had a lifelong interest in the visual arts. He discusses some extended case studies, where archives have made documentation possible (some twenty-nine archival locations are listed). These cases include E. C. Pickering's courses at Harvard, and those of Sarah Whiting at Wellesley College. The analysis covers America, Britain, Germany and France well. Many other brief anecdotal observations are carefully referenced and suggest the fruitfulness of this approach and its potential for further analysis.

The terrain explored includes methods of recording, including visual, photographic and photoelectric; forms of spectral representation, including maps of emission-line positions and absorption; and printing technologies for scientific illustration such as hand sketches, woodcuts, engravings and lithographs. Hentschel devotes considerable space to the 'mapping metaphor' and investigates the 'rhetorics' of spectra, discussing their claimed objectivity and information capacity, their omissions and simplifications, and implicit forms of classification and ranking.

The book devotes a chapter to the passing on of this largely undocumented visual knowledge to succeeding generations of spectroscopists. The tacit knowledge of spectroscopy was often taught by laboratory experiments, training in pattern recognition and, for more dedicated students, practice in developing the subtle aesthetics of spectral recording and depiction.

These emerging routines of research and teaching created new specialist communities. Hentschel, in common with other recent work especially in optics and modern spectroscopy, identifies his spectroscopists as non-professional, interdisciplinary practitioners or 'research-technologists'. He shows that many of these practitioners were sensitive to visual aesthetics, which was evinced by their parallel work in photography, art or printing. Occasionally, the demonstration of the importance of this visual dimension can seem slightly strained; for example William Abney, a pioneer of scientific photography, was a promiscuous dabbler in optical methods, and a promoter of quantitative techniques at least as much as graphical ones. Hentschel rightly argues, though, that conventional biography tends to underplay or fails even to report the 'marginal' visual interests of physical scientists.

The text concentrates on the period between the first solar spectrum map made by Fraunhofer and the Bohr model, i.e. between the 1810s and the 1910s. Hentschel's main thesis – that visual representation in spectroscopy amounted to an enduring visual culture – seems harder to demonstrate beyond the early twentieth century. Thereafter, the phenomenology of spectra was replaced by theoretical explanations. The rise of quantification in spectrochemical analysis and spectrophotometry, combined with photoelectric recording methods, led to the submergence of visual modes of representation. By the mid-twentieth century, indeed, new spectroscopies such as infrared analysis relegated spectral information to punched cards and computer memories.

The 'Epilogue' contrasts the book's approach with other explanatory frameworks in history, philosophy and sociology of science. Hentschel makes a number of intriguing observations and points the way for further studies. There are only occasional points lacking clarity (for instance Figure 10.2 on p. 440, seeking to plot the rise and fall of 'iconic' and 'symbolic' representations).

The text is beautifully produced, seemingly free of typos and with wide-ranging and readable footnotes. The illustrations are all of high quality. Bafflingly, however, the excellent bibliography and name and company indexes are not complemented with a subject index.

The book makes valuable reading both for its analytical perspectives and for the historical tapestry of individuals and techniques that it interrelates.

Sean Johnston
University of Glasgow Crichton Campus

Michael Thad Allen and Gabrielle Hecht (eds.), **Technologies of Power. Essays in Honor of Thomas Parke Hughes and Agatha Chipley Hughes**. Cambridge, MA and London: MIT Press, 2001. Pp. xx + 339. ISBN 0-262-51124-X. £16.95 (paperback).
DOI: 10.1017/S0007087403374977

Historians of technology have long understood that an understanding of power is necessary in articulating the social character of technological change. After all, if a new technology did not offer the possibility of some useful kind of power, who would bother to make it or acquire it? Indeed, a major task facing historians of technology is to map both the changing and the unchanging power relations that characterize situations in which technologies change or are used in new ways. Thus editors Michael Thad Allen and Gabrielle Hecht aim to explore not just how technology has served as an 'instrument of power', but also how it can reflect, strengthen, enact or transform power relationships (p. 1).

The essays collected here are a tribute to a partnership that contributed much to our understanding of the power–technology relationship. John Staudenmaier's Preface outlines the conceptual innovations of Tom Hughes: technological momentum, the institutional dynamics of creativity and the evolution of technological systems; and the less public role of Agatha Chipley Hughes (died 1997) in bringing a broader human texture to his engineer-centred analyses. Explanation of the Hughesian corpus is important since quite a few contributors to *Technologies of Power* studied or worked with Thomas Hughes. Further themes of his work are apparent in several chapters, especially the intimately localized political shaping of technology that illustrates how it does not operate as an autonomous agent of social power.

In this vein, Allen and Hecht enjoin readers to move beyond long-running attempts to rebut simple-minded forms of technological determinism of the sort so persistently uttered by politicians, industrialists and technophiles. Rather we should consider both why so many authorities have maintained that publics have no choice about what form technologies should take, and what kinds of interests are served by the propagation of such a narrow view. In focusing thus on cultural–political debates on technology, Allen and Hecht do not engage with theoretical analyses of power, as instanced in Marger and Olsen's differentiation between the political 'power over' and the phenomenological 'power to', nor with Barry Barnes's examination of the complex relationship between power and authority. Nor do the editors

follow Langdon Winner's suggestion, in *The Whale and the Reactor* (Chicago, 1986), that we explore how political assumptions and interests have been hardwired into technologies of the past and present. Nevertheless, the editors do have clear pluralist sympathies, and allow their contributors a free rein to pursue themes of particular interest to them.

Allusion to Winner's thesis is made in Bernie Carlson's chapter on the telephone as a political instrument. Focusing on the USA in the period between 1875 and 1880, Carlson shows not only the interconnected power struggles over the formation of both telegraph and telephone networks, but also that the genesis of the telephone was closely bound up with the formation of the American 'middle class'. Focusing on the same country, Eric Schatzberg explores how political machinations explain the contingent choices of American cities between the two main systems of supplying electric street-car transportation in the following two decades. Amy Slaton and Janet Abbate's historical survey of US standards in building components and in the globalization of the Internet pursues a theme familiar to historians of science: that the selection and implementation of technical standards are both bound up closely with struggles over the balance of disciplinary power.

The next few chapters broaden out the thematic discussion to European contexts. Edmund Todd's piece on 'Engineering politics' is a relatively conventional Hughesian account of how three technocratic German engineers with a keen eye to political expediency developed distinct power supply systems from 1900 to 1936. By contrast, Michael Thad Allen's piece on 'Modernity and the Holocaust' is an altogether more radical piece that by itself probably justifies purchase of this book. He ably deconstructs divergent interpretations that describe the infamous Nazi death camps as either the epitome of modernist technocratic rationality run out of control or an anti-modernist reaction against technological progress. Allen shows instead that the Third Reich sought technological means for its genocidal policies, but never enacted them in a fully industrialized practice. For example, several attempts by Auschwitz's managers to implement a factory production line of murder eventually collapsed in 1944, leaving them to indulge in the same sort of orgy of 'pychopathic improvisation' (p. 203) with which they had started two years earlier.

After that show-stopper chapter, ensuing studies by Rau on the British origins of operational research, Hecht on the mutable 'Frenchness' of different kinds of nuclear power technology and Weinberger on Swedish neutrality policy in technological alliances seem comparatively muted. And one might ask why no chapters were devoted to the contentious power-laden uses of technology in colonial and post-colonial contexts, such as the Green Revolution in cereal biotechnology from which death and much impoverishment have arguably resulted. Then again, what is evident from Allen's chapter, and to some extent parallelled in Hecht's, is that technologies are not always effective means for gaining or enacting power – thereby seeming to undermine one of the book's starting assumptions. And from this perspective, it would have been useful for the editors to include an epilogue that explored the limits to technologically engendered power thus illustrated in this book.

While not being a definitive study of the topic, this book is a valuable starting point for future discussions of the historical relationship between technology and power.

Graeme Gooday
University of Leeds

Ursula Klein (ed.), **Tools and Modes of Representation in the Laboratory Sciences.** Boston Studies in the Philosophy of Science, 222. Dordrecht, Boston and London: Kluwer Academic Publishers, 2001. Pp. xv + 259. ISBN 1-4020-0100-2. £59.00, $89.00, €95.00 (hardback).
DOI: 10.1017/S0007087403384973

Issues of modelling and visual representation are currently subjects of intensive discussion among historians and philosophers of science. Only a handful of the fourteen studies comprising this interesting anthology can be discussed

in any detail here. They originate from talks presented at a conference entitled 'Types of paper tools and traditions of representations in the history of chemistry', organized by the editor Ursula Klein at the Max Planck Institute for History of Science in 1999. Not surprisingly, then, Klein's own concept of paper tools dominates the first part of the book. Probably as a result of the conference, these tools are defined much less narrowly than mere 'visible marks which can be manipulated on paper to create representations of a scientific object' (p. 28). They are understood as 'material devices in the broadest sense of being exterior to mental processes, visible and maneuverable', with the most important distinction from laboratory instruments being that 'they do not interact physically with the object under investigation' (ibid.). Paper tools do not exclude periodic systems printed on plastic (as Scerri seems to assume (p. 163) only to overly inflate it then to mean all theoretical tools), nor even three-dimensional atomic models – thus perhaps stretching the term too far. The creative power of the concept is aptly illustrated, however, both in Klein's paper on Berzelius's chemical formulae and in Christopher Ritter's study of Alexander Crum Brown's graphical formulae as an interesting hybrid of type and structural forms.

While the reviewer finds Klein's description of the genesis and motivation behind Berzelius's formulae most helpful, he pointedly disagrees when it comes to their classification. Her suggestion to speak of 'iconic symbols' is a misnomer, since it overrates a 'certain graphic suggestiveness', a 'minimal isomorphy' of Berzelius's formulae with the postulated objects they stand for (namely the scale-invariant proportions of elements in chemical reactions). On the contrary, the effectiveness of Berzelius's formulae as a symbolic language lies precisely in that it allows mental operations to be done with discrete proportions of substances, very much as in algebra, with which – indicatively enough – Berzelius himself compared his new devices (see p. 17).

In the second part of the anthology, three-dimensional models are discussed by Eric Francoeur and Mary Jo Nye. Francoeur's emphasis is on the practice of molecular modelling, both with space-filling and with skeletal modelling kits. As the best paper of the lot, it goes straight to the nitty-gritty of chemical practice with these 3D models, describing their strengths and weaknesses, and thus broadening Latour's limiting notion of 'inscription device' as an intrinsically two-dimensional trace. When it comes to Pauling's actual practice with such models, Nye's paper is superficial, but its strength lies in capturing his use of such models in lectures and other public performances. She describes how, and to some extent why, his deployments of models (such as his famous protein models) served as highly effective rhetorical and pedagogical devices.

Another canonical device is the periodic system of chemical elements (PSE). Bernadette Bensaude-Vincent, well known for her studies on Mendeleev, summarizes findings by Mazurs, van Spronsen and herself on the development of the periodic table since the nineteenth century, reminding us that Mendeleev himself wavered between many different tabular and graphic representations of the PSE. For Eric Scerri, the periodic table is even 'the ultimate paper tool in chemistry' (p. 163), a claim he supports by some remarks on the prehistory of the PSE in Döbereiner's and Gmelin's systems.

Even though many papers are merely summaries of more expansive publications elsewhere, this volume constitutes a useful panoply of studies on the function of tables, graphs, diagrams, pictures, formulae, mathematical equations and 3D models in chemistry. By tackling such intriguing guiding questions (cf. p. vii) as the pros and cons of competing modes of representation, the theoretical baggage or commitment to realism hidden within their syntactic and semiotic rules of construction, and the usage of these different devices in research practice, expositions of findings and teaching, this anthology will also be interesting – though not always easily digestible – to readers coming from other fields of science studies.

KLAUS HENTSCHEL
University of Hamburg

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SUNGOOK HONG, **Wireless: From Marconi's Black-Box to the Audion.** Transformations: Studies in the History of Science and Technology. Cambridge, MA and London: MIT Press, 2001. Pp. xv + 248. ISBN 0-262-08298-5. £23.95 (hardback).
DOI: 10.1017/S000708740339497X

Hong has made an interesting contribution to the Marconi story, to the early days of radio and to the rewriting of history. Recently attitudes to the interpretation of invention and discovery, innovation and utilization, and ideas concerning the societal and technological determinants of technological change have been revised and restructured. Hong has approached a well-worked subject from a variety of modern viewpoints. Four major characters, two theories and two styles of engineering emerge. Lodge, Marconi, Fleming and de Forest competed for fortune and history's favours, Maxwell's electromagnetism and electron theory simplified the issues and practical and scientific styles of engineering resulted in a fruitful combination.

Six chapters and an epilogue develop the subject chronologically; scientific, personal, technological and social themes provide focus; and Hong has produced a valuable analysis. However, his arguments relating science with engineering, and his claims about the existence of different styles of engineering which appear from time to time are not wholly convincing, for the episodic nature of the work did not allow him to gather together the threads of his case into a coherent whole. A better arrangement of this material would have allowed this compelling case study to cast a new light on the various approaches to the history of technology.

Some chapters are particularly good. In Chapter 1, 'Hertzian optics and wireless telegraphy', and Chapter 2, 'The inventing of wireless telegraphy: Marconi versus Lodge', Hong's study of the beginnings of radio and the contrast drawn between those who saw radio to be optics and those who visualized a system of telegraphy set up a valid descriptive tool. Hong's contrasts between the scientific British 'Maxwellians' drawn to optical parallels and the practical Marconi whose end view was telegraphic signalling are original. Chapters 5 and 6, 'Transforming an effect into an artifact: the thermionic valve' and 'The audion and the continuous wave', were clear in their description of contemporary science and how this was transformed into working devices. However, Hong is somewhat optimistic in seeking a single development process – constructing artefacts, for those of us who have done this, is more complex than he suggests. Fleming's contribution to Marconi's successes were clearly recounted and analysed in the middle chapters of the book but the arguments concerning 'styles' are somewhat contrived, being more interpretative than evidential. Here lies the weakness of an episodic treatment. For if Hong had dissected out the pros and cons of his arguments concerning ideas such as 'effects to artefacts', 'styles of science and engineering' and so on, then the coherence of the whole would have been enhanced.

Yet Hong's stories are good, he builds interesting arguments concerning the complex nature of the science/engineering, invention/development and untrained/trained nexuses, and there is much that is original. However, the sense of the episodic remained throughout the book, and echoed as a puzzle. However, the echo died when Hong's previously published papers were compared with the book. For the work as published is, in fact, largely a compilation of previous papers which relate to the subject of Marconi and the audion. Indeed, in some parts the comparison is exact; in others, there are some minor changes in fact and treatment. There are discrepancies in dates and distances, and in treatment the titles of sections are altered without major changes in the body of the text. Of course, such differences as these should be explained but no explanations are given. Some appear to be corrections to errors in the papers, but others seem to relate to changes in Hong's view of the history of technology.

It was not possible to subject the papers as well as the book to a detailed scrutiny but both papers and book are readable and insightful. However, they are very similar in content and analysis and lead to the same conclusions.

There is an honourable tradition of 'collected papers', but had the book been acknowledged as such in the beginning, much reading and time might have been saved. Authors owe to their readers the courtesy of detailing the provenance of the work.

So we have, in effect, a compilation which is a good although not fully coherent read. There are some interesting omissions (crystal rectifiers, for example, appear only once) and the book should have been provided with better diagrams. Yet its style is clear, unpretentious and enjoyable; its index is good; its references and bibliography are extensive, accurate and wide-ranging. It can be recommended to historians of science and technology, and has sufficient connective tissue to render its ideas more accessible than the individual papers. The whole is slightly better than the sum of its parts.

Colin A. Hempstead
University of Teesside

Reinhard Siegmund-Schultze, **Rockefeller and the Internationalization of Mathematics between the Two World Wars: Documents and Studies for the Social History of Mathematics in the 20th Century.** Science Networks – Historical Studies, 25. Basel, Boston and Berlin: Birkhäuser Verlag, 2001. Pp. xiii + 341. ISBN 3-7643-6468-8. $94.95 (hardback).
DOI: 10.1017/S0007087403404974

While historians have recently begun to explore the history of twentieth-century mathematics, it will be some time before a satisfying synthetic account is available. Since the task of mastering the technical understanding of the myriad mathematical specialities of the last century would be an immense one, historians have either declined to discuss the topic, even provisionally, or chosen a restricted institutional focus. Ivor Grattan-Guinness's otherwise very useful *Fontana History of the Mathematical Sciences* (London, 1997) is an example of the former approach. Siegmund-Schultze's study of American philanthropy in inter-war Europe is an example of the latter.

The International Education Board was founded in 1923 to distribute Rockefeller funds and was dissolved after five effective years in 1928. Much of the Board's work was then taken over by the Rockefeller Foundation proper. Both are discussed here. An incoming tide of money transformed European mathematical organization, and spread American values under a guise of internationalism. Siegmund-Schultze's particular interest is the effect of philanthropic support on aspects of mathematical communication (such as travelling grants, fellowships, new journals and the establishment of interdisciplinary links) and there is much to be learned from his account of these institutional changes. Comparisons could be drawn with existing studies of inter-war philanthropy in the physical and life sciences, such as Pnina Abir-Am's essays or Robert Kohler's *Partners in Science* (Chicago, 1991). The drama of the narrative, however, can be found in the turning of the tide in 1933, with the rise to power of the Nazi Party in Germany and, as the tide receded, the institutional links created by Rockefeller philanthropy carrying mathematicians west. The big arc is the transfer of mathematical leadership from the old to the new world, and from Göttingen and Paris to Massachusetts and California.

The contract between European mathematicians and Rockefeller brought immediate material benefits to the former, although some lasted longer than others. When Wickliffe Rose visited G. H. Hardy on his tour of 1923, the English mathematician did not let the philanthropist leave until the funds for the new *Journal of the London Mathematical Society* had been committed. The physicists at Göttingen had already won an enlargement of their institute, by playing the 'international card' (p. 144), when Augustus Trowbridge visited in October 1925. The result was a new Mathematical Institute, opened in November 1929. This building was designed with comfort in mind. The historian of mathematics Otto Neugebauer, who was 'mainly responsible for the construction of the building', stated explicitly the intention, which can be related to other tensions in Weimar society, that the new

building would not just be 'functional but also comfortable … We hope and believe that the new institute does not contribute to the often prophesied 'mechanization' of science but offers instead a working place *to be liked* for teaching and learning, and, above all a place for pure science' (emphasis in original, p. 154). Within a few years, institute staff, such as Richard Courant, would be persecuted as non-Aryan.

The other major Rockefeller initiative, the establishment of the Institut Henri Poincaré, may have modernized mathematics at the Sorbonne – at least to the extent of bolstering an existing commitment to stochastics – but it did little to promote the Rockefeller ideals of internationalism or better communication. (A useful contrast is drawn between the programme of the Paris-based Institut and the provincial reformism of the Bourbaki Group.) Perhaps the most interesting evidence Siegmund-Schultze presents concerns the prejudices held by the visiting Rockefeller representatives: European countries were divided into culturally 'backward' or 'advanced', and scientifically 'backward' or 'advanced'. Trowbridge, he notes, was a 'firm believer in the ideals of the American business culture', which created for him a connection 'between economic prosperity (strength of currencies) and the need of "saving" or "developing" the respective cultures within the Western hemisphere of Europe' (p. 62). Estimates of mathematical strengths were translated into cartographic form – a resource I will certainly use as a teaching aid and one reproduced here in colour.

Siegmund-Schultze has chosen a potentially profound theme, and *Rockefeller and the Internationalization of Mathematics between the Two World Wars* should be welcomed as a component of the important project of bringing twentieth-century mathematics into the scope of historical understanding. It should be read, as a companion piece, by anyone studying either inter-war philanthropy or the lives and work of émigré scientists. But it is also a bit of curate's egg. The format is confusing, with endnotes marked by multiple '+'s as well as footnotes. It has 150 pages of appendices, which reproduce correspondence. These letters are presumably intended to be a teaching resource, but they are not really rich enough to deserve reproduction in full and remain undigested.

Jon Agar
University College London

Jeannette Ewin, **Fine Wines and Fish Oils: The Life of Hugh Macdonald Sinclair**. Oxford: Oxford University Press, 2001. Pp. xx + 338. ISBN 0-19-262927-1. £25.00 (hardback).
DOI: 10.1017/S0007087403414970

By the time of his death at 80 in 1990, Hugh Macdonald Sinclair had amassed an impressive archive. It includes documents concerning his student days at Oxford University and University College Hospital, London in the 1920s and 1930s, and his early career at Oxford's biochemistry department. Also preserved are records of Sinclair's wartime Oxford Nutrition Survey, and post-war nutritional surveys in Europe. Further files cover his years as reader in nutrition at Oxford and director of a nutrition laboratory which was closed in 1957, and his subsequent attempts to raise funds for an independent institute. These efforts met with little success, but Sinclair used his decaying mansion in Oxfordshire as a base for a limited research programme. His papers include personal material such as childhood correspondence with his father and notes exchanged with his mother, with whom he lived until she died in 1969. After his readership was terminated and his laboratory closed, Sinclair continued to tutor medical students at Magdalen College, and later lectured at Reading. The trustees of his estate endowed a chair of nutrition at Reading University, which also took charge of Sinclair's archive. The survey records are now of great interest for researchers interested in the foetal and childhood origins of disease.

Sinclair's pre-war research concerned vitamin B1, while in the 1950s his laboratory covered a wider range of nutrients. His first paper on essential fatty acids (EFAs) appeared in 1953, and three years later he published a long letter in the *Lancet*, arguing that modern processed food was deficient in EFAs and

responsible for the rising incidence of atherosclerosis, heart disease and other conditions. He argued against relaxing wartime controls on the extraction rate of flour. A switch from 'national' to white flour would further reduce EFA intake. He spent the rest of his life championing the importance of EFAs. Sinclair's pioneering views were recognised after David Horrobin, one of his colleagues at Magdalan in the 1960s, published a book on EFAs in 1982, which gave credence to many of the claims made in the *Lancet*. Horrobin had established a company to market therapeutic agents based on lipid biochemistry in 1979, and after Sinclair's death gave a grant to Jeanette Ewin, a retired nutritionist, for the preparation of Sinclair's biography.

Ewin demolishes several myths that Sinclair generated about his career. She shows there is no evidence to support Sinclair's claim that he was interested in EFAs during the 1930s. Likewise, the events that dashed Sinclair's hopes for a permanent Oxford University Institute of Human Nutrition hardly amounted to a 'stab in the back' as he suggested. This is no simple hagiography. Ewin presents Sinclair as vain, jealous and paranoid. Nevertheless, she has failed to make the best use of her material. She is unaware of relevant secondary literature and her reliance upon Sinclair's archive and a limited range of other sources leads to weak analyses, omissions and blunders. Her understanding of the broader scientific, institutional and professional development of nutrition science, and her attempts to contextualize, are poor. Even the standard history of vitamins is garbled. Her remark about the Nutrition Society being a 'collection of food producers and manufacturers' in 1942 is puzzling. Beyond the immediate reaction to Sinclair's letter in the *Lancet*, she has little to say about the history of dietary and other theories of the origins of degenerative disease. She praises Sinclair for his view that nutrition was a legitimate subject for scientific investigation in its own right, but makes no attempt to compare these views with those of his contemporaries in the field. The most striking mistake is the statement that the American nutrition scientist Wilbur Atwater invited Sinclair to visit the US in 1943 – Atwater died in 1907. An important omission concerns Sinclair's involvement with the BMA's Nutrition Committee between 1947 and 1950, which published a report containing estimates of dietary requirements used by the National Food Survey for the next twenty years. These figures were based upon scales devised by Sinclair for the Oxford Nutrition Survey.

Ewin presents her material mainly chronologically. She sometimes moves haphazardly from documents relating to Sinclair's negotiations with the university and funding bodies, to long extracts of unconnected correspondence with his mother. Worst of all, the material from the Sinclair archive is not properly referenced; the dates of many documents referred to are not even given in the text. It is surprising that Oxford University Press should publish a volume failing to meet such normal standards of academic writing.

No doubt one aim of the project was to make the life of the benefactor of the Hugh Sinclair Unit at Reading University more accessible to students, visitors and the wider community of nutrition scientists. However, had the author more fully digested her sources, and effectively contextualized Sinclair's life, she could have produced a more satisfying account, from the point of view of historians, and also provided more nutritious 'food for thought' for students and practitioners in the field.

David F. Smith
University of Aberdeen

Carl Djerassi, **This Man's Pill: Reflections on the 50th Birthday of the Pill**. Oxford: Oxford University Press, 2001. Pp. xi + 308. ISBN 0-19-850872-7. £12.99, $22.50 (hardback).
DOI: 10.1017/S0007087403424977

Carl Djerassi's memoir examines the effect that his role in the development of the pill has had in society and on his life. He presents the reader with a series of vignettes, exploring episodes such as the resistance to the introduction of the pill in the 1960s and 1970s, and contemplating the way the pill enabled him to become an art collector. This is not an academic text in the

history of science or medicine, nor should it be judged as such. It is a personal account of the far-reaching effects of one particular scientific discovery and as such will be of interest to a general audience and to those interested in the public understanding of science, the nature of scientific discovery and the history of the pill. For a historian its value lies in the account Djerassi gives of the 'birth' of the pill. In this respect, the book is a rich primary source.

Djerassi begins by explaining why, for him, 2001 marked the pill's 50th birthday. As he points out, its birth can be counted from a number of different markers, depending on which stage of the pill's development and availability is deemed most important, and on which nation is celebrating. On 15 October 1951 Djerassi's laboratory completed the first synthesis of a steroid that would become the contraceptive pill's main active component. What follows is an enlightening account of the commercial background to the pill and the industries and individuals involved in its development. It is these early chapters of the book which are of most interest to the historian of science.

In the succeeding chapters, the author reflects on the changes the pill has wrought in his life. He is at pains to point out that he did not make money directly from the pill, but that he did invest in the stock of his company. From the money thus gained he first began to buy art work and then went on to set up a community for artists on his property in the Santa Cruz Mountains. Djerassi also wrote fiction and plays which aimed to bring scientific issues, particularly those concerning reproduction, to a wider audience. Without the pill, he argues, he would never have become engaged in any of these other fields but would have remained an industrial chemist. The author is undoubtedly an expert in his field, and provides fascinating insights into many of the social, economic and political issues surrounding human reproduction, particularly in his chapter on the uptake of the pill in Japan.

The book is at times disarmingly honest and touching, especially when Djerassi reflects on the suicide of his daughter. It is intended, like Djerassi's science-in-fiction series, to be didactic and he expresses concern that didacticism can be boring. He need not have worried; whatever else *This Man's Pill* may be, it is never boring. However, the didactic element can be stifling. Djerassi assumes that testosterone makes men men and that oestrogen and progesterone make women women. Yet as Anne Fausto-Sterling, in *Sexing the Body* (New York, 2000), and Nelly Oudshoorn, in *Beyond the Natural Body* (London and New York, 1994), have ably demonstrated, the so-called sex hormones have far wider roles to play within the human body. And if oestrogen is the female hormone, then why are stallions' testicles such a rich source? For a deeper analysis of the pill we must instead read Lara Mark's *Sexual Chemistry* (New Haven and London, 2001). That said, Djerassi's book is both useful and enjoyable.

Helen Blackman
Cambridge University

John Peyton, **Solly Zuckerman: A Scientist out of the Ordinary**. With a foreword by Roy Jenkins. London: John Murray, 2001. Pp. xviii + 252. ISBN 0-7195-6283-X. £22.50 (hardback).
DOI: 10.1017/S0007087403434973

Solly Zuckerman's three careers as academic, administrator and Whitehall scientific advisor ranged widely across the canvas of twentieth-century British science. His academic career included research at Oxford, an extended tenure as professor of anatomy at the University of Birmingham and involvement in the early history of the University of East Anglia, especially in its commitment to environmental science. As an administrator he took on significant challenges as Secretary of the Zoological Society, a job which entailed responsibility for the management of London Zoo at a time when the institution was struggling. Zuckerman was also the quintessential Whitehall scientist of his era, advising senior allied commanders during the Second World War, sitting on innumerable committees and later acting as chief scientific advisor first to the Ministry of

Defence (MoD) and then to the government as a whole. At the MoD he challenged the prevailing NATO strategy of massive retaliation and was later offered, but refused, the post of Minister of Disarmament in Harold Wilson's first administration. If these multiple careers do not in themselves present a daunting challenge to any potential biographer there are also two extensive volumes of autobiography, amounting to nearly one thousand pages, and over nine hundred boxes of archival material to contend with.

John Peyton, MP for Yeovil from 1951 to 1983, former Conservative minister and a friend (and admirer) of Zuckerman, rises to this challenge. He seeks to provide a more coherent picture of a complex biographical subject than is offered in Zuckerman's own writing. First, Peyton asks how it was that, after leaving South Africa at the age of 22 and arriving in London as an unknown student of anatomy, Zuckerman was able to move to the heart of the British establishment, reaching a position where he could invite Roy Jenkins 'to a country dinner *à cinq* with the Queen and Prince Philip' (p. xii). Second, Peyton attempts to make clear why Zuckerman deserves to be remembered for his multiple professional achievements, so justifying the statement of Robert McNamara (sometime US Secretary of Defense) that he 'was huge … he has no counterpart in your country or mine today' (p. 9). To address these questions Peyton draws extensively on the recollections of Zuckerman's family, friends, colleagues and collaborators as well as the extensive archival material held at the University of East Anglia, letters in private hands and of course Zuckerman's own published work (although the text itself lacks detailed footnotes to these sources). The result is an account which succeeds much better in fulfilling its first aim than it does its second. Zuckerman's success, it emerges, was based on a formidable capacity for work, and an ability to convince others that he could solve their problems by bringing his scientific intellect to bear, even when they lay far outside his own existing specific expertise and his conclusions challenged conventional wisdom. He was also an able, if sometimes abrasive, administrator and proved especially adept at choosing his patrons. Professional success and long and enduring friendships with leading scientists, politicians, artists and members of the royal family (his correspondence with the Duke of Edinburgh was one of the sources) appear, however, to have been achieved at the expense of his immediate family to whose needs he appears to have been peculiarly insensitive.

Peyton's attempts to secure Zuckerman's place in posterity are less convincing, ironically because the sheer range of his contributions leaves little space to place any of them in a sufficiently detailed context for them to be fully assessed. This will not be such a problem for those, like Peyton, who lived through the events under consideration or for historians already familiar with the cast of characters and the issues involved. Those lacking this background will find it harder to be convinced on the basis of the evidence presented here. This more than anything else marks the book out as an 'insider's' biography which will provide future scholars with much useful material on how he was seen by his contemporaries. Such work has the potential to shed much more light on the man himself and the many aspects of British science with which he was involved than is achieved by this present study.

Sally M. Horrocks
University of Leicester

John C. Greene, **Debating Darwin: Adventures of a Scholar.** Claremont: Regina Books, 1999. Pp. vi + 288. ISBN 0-941690-85-7. No price given (hardback).
DOI: 10.1017/S000708740344497X

This thoughtful and beautifully written book by John C. Greene is partly memoir, partly correspondence and partly selected extracts from previously published articles on evolutionary history that mostly date from the 1980s and 1990s. It is well worth serious contemplation. Greene is noted as one of the greatest contributors to modern historical reflection on the course of evolutionary theory in the West. His *Death of Adam* (Iowa, 1959) marked a turning point in the way scholars

would come to think about Darwin and the other figures who played a role in the so-called Darwinian revolution; his *Darwin and the Modern World View* (Baton Rouge, 1963) principally addressed important questions of progress and teleology in biology; and *Science, Ideology and World View* (Berkeley, 1981) ran, rather wonderfully, from Huxley to Huxley, displaying the interactions of science and systems of thought in evolutionary writings from Darwin's period to the modern synthesis of the 1930s. In all these he offered illuminating suggestions about the nature of biology, and the way it has intermeshed with shifting ideologies, especially religion, humanism and ethics, and uncovered the paradoxes arising from attempts to erect new visions of human duty and destiny on the basis of a supposedly value-free neo-Darwinism.

Several of these critiques did not go down too well with surviving founders of the modern synthesis. Greene was drawn into defending his views in private correspondence first with Theodosius Dobzhansky during the late 1950s and then with Ernst Mayr in the 1980s. *Debating Darwin* prints some of Greene's correspondence with Dobzhansky, which turns out to be a highly interesting selection dealing mainly with the possible theologies that a biologist might entertain, and a large proportion of his correspondence with Mayr on the nature of Darwinism. Some of the early letters have previously been published but the value of the new collection is that the correspondence with Mayr is here continued through to 1997, and letters from both parties are now accompanied by annotations and retrospective comments and explanation. The two men significantly differ in their views. If ever one wished to follow a record of debate between major players in modern history of biology, I can strongly recommend this volume. Mayr and Greene display in bold relief the extent to which their divergent backgrounds, training and interests shape the conclusions they draw from the historical record. It was obvious to Greene that Darwin was an evolutionary theist. It was obvious to Mayr that Darwin was a formidable philosopher who demolished false ideologies and replaced them with daring new concepts of nature. The correspondence is courteous and probing throughout, despite an epistolary coolness in 1980 brought about by Mayr's slashing attack on Greene's 'The history of evolutionary ideas revisited' (*Revue de synthèse*, 4th series, no. 3, Juillet–Septembre 1986, 201–28 and 229–36). Both are reprinted in this volume.

That coolness came about when Greene moved away from Charles Darwin as an individual thinker to focus on the neo-Darwinians, men such as Julian Huxley, George Gaylord Simpson, Cyril Darlington and Mayr himself, who as a group self-consciously created the synthesis that they hoped would lead biology into a bright new future of populations and genes. Mayr plainly felt that Greene's shift of attention was motivated by concern about the intellectual validity of humanism. 'Let us go back to God,' Mayr jibes, 'then we can refer all objections to Him' (p. 222). Greene nevertheless insists in the letters that evolutionary scientists were attaching the prestige of science to world views that went beyond anything that science could traditionally verify or falsify. Mayr vehemently denied that scientists were trying to do anything of the sort. After this frank exchange of views, which is well worth study, the correspondence has continued to the present day with neither man showing any inclination to adopt the other's point of view, nor yet willing to give up the dialogue. While perhaps presenting only edited highlights of this private material, and not nearly as much or as uncensored as a researcher would ultimately hope to handle in an archive, the letters provide perspectives that have as yet only been possible to surmise. To see the letters in context with those articles that occasioned the sharpest exchanges is helpful.

Greene also provides some pleasant introductory remarks about his course through life. Relaxed and self-reflective in style, they indicate that he could, if he wished, craft an intriguing autobiography, not least for his foray into the preoccupations of history faculties during the pre- and post-war years. He describes the rise of his conviction (innovative for its day) that

Judeo-Christianity had played a positive, as well as a negative, part in shaping modern science, and how he backed into his first encounter with Darwin while halfway through writing the manuscript of the *Death of Adam*, when the 1959 Darwin celebrations fortuitously appeared on the horizon. He criticizes biologists for making words like adaptation, strategy, progress and so forth mean what they want them to mean, and speaks freely about his commitment to the history of ideas as a method for exploring the past. I particularly liked this latter aspect of the book, for Greene reveals how sincerely such commitments were once held – and can still be held – and defends them with intelligent resolve. His account of Christianized Aristotelianism in Cuvier's work, for instance, is instructive. Broad philosophical concepts are seldom, if ever, refuted, he says. They may go out of fashion for long periods but they have a way of cropping up again in changed situations. *Debating Darwin* deserves to be read as an account of one man's journey through the history of science, and that man's careful analysis and defence of the way his views developed, as well as for its insights into the maturation of Darwin's century.

JANET BROWNE
Wellcome Trust Centre for the History of Medicine at University College London

JORDAN GOODMAN and VIVIEN WALSH, **The Story of Taxol: Nature and Politics in the Pursuit of an Anti-Cancer Drug**. Cambridge: Cambridge University Press, 2001. Pp. xiii + 282. £18.95, $27.95 (hardback).
DOI: 10.1017/S0007087403454976

The heroes of this political, economic and environmental history of an anti-cancer drug are a tree and a molecule. Taxol, the molecule, first hit the headlines in the early 1990s, as a natural miracle drug for ovarian and breast cancer. It had been identified and located three decades earlier in the bark of the Pacific yew tree, *Taxus brevifolia*, as part of a joint plant-screening programme of the Cancer Chemotherapy National Service Centre (CCNSC) at the National Cancer Institute (NCI) and the US Department of Agriculture (USDA). Drawing on actor-network theory in a pleasantly inoffensive way, Goodman and Walsh tell the story of the networks that connected tree and molecule, extending from the laboratories of the NCI into the old-growth forests of the Pacific Northwest, to the boardrooms of the pharmaceutical industry, and to Capitol Hill.

The official history of the molecule begins with a bark sample from a Pacific yew tree that the botanist Arthur Barclay had collected for the NSDA on a field trip in 1962. The sample showed activity in the screening tests of the CCNSCI, and in 1964 the chemist Monroe Wall and his colleagues at the Research Triangle Institute started their search for the active principle. In 1971 Wall and his co-worker, Mansukh Wani, published the structure of the molecule, which they called taxol. In the following years, the molecule moved step by step through the test procedures of the NCI, first animal experiments and later clinical trials. In 1994 two groups of chemists reported that they had succeeded in synthesizing the molecule.

The main problem that the NCI faced during taxol's journey through the testing procedure was to secure its supply from yew-tree bark. The forest did not always cooperate with the requests of the researchers. During several summers, for example, the authorities closed the forest for bark collectors in order to reduce the risk of fires. In 1991, the NCI passed on such problems to the drug manufacturer, Bristol-Myers Squibb, along with research data and the responsibility for further clinical trials, allowing the company to market and sell the drug. The molecule moved completely from the public into the private domain when Bristol-Myers Squibb in 1992 was allowed to register the name Taxol® as a trademark, introducing a new name for the generic molecule, paclitaxel.

Not part of the official histories of taxol was what Goodman and Walsh call 'the changing politics of the forest' (p. 138). In the early 1960s the main objective of the large US national forests in the north-west was to produce revenue. The focus was on large timber trees, such

as the Douglas fir, while *Taxus brevifolia* was seen as a weed tree that was occasionally turned into fence posts but more often burned when the old-growth forests were cleared. Goodman and Walsh show convincingly how different actors since the 1970s used *Taxus brevifolia* and the miracle cancer drug hidden in its bark in debates over the future of the forest environment. While the national media wrote about a conflict between environmentalists and cancer research, the actors involved with the forests argued, as Goodman and Walsh show, that *Taxus brevifolia* was actually underused, and that the problem was wastage and mismanagement of old-growth forests.

The bond between the anti-cancer drug and the Pacific yew tree was severed in 1993, when Bristol-Myers Squibb decided to produce taxol in a semi-synthetic process in a factory in Ireland, using needles of other *Taxus* species from all over the world rather than having to rely on *Taxus brevifolia* bark. This highly readable book will continue to remind its readers that paclitaxel once was taxol, and that it was linked to the forest as much as to the laboratory.

CARSTEN TIMMERMANN
University of Manchester

MICHAEL FRIEDMAN, **Dynamics of Reason: The 1999 Kant Lectures at Stanford University.** Stanford, CA: CSLI Publications, 2001. Pp. xiv + 141. ISBN 1-57586-292-1. £12.50, $19.50 (paperback).
DOI: 10.1017/S0007087403464972

This book is concerned with the nature of science, and the proper relationship between science and philosophy. It is primarily a work of philosophy, but the position presented is one which claims to both grow from historical study and have implications for the study of the history of science. This concern is one of the central issues of the book, and the one on which I will focus in this review.

Friedman's position is a development of both Kant and Kuhn. Kant claimed that certain beliefs are essential if our empirical beliefs are to be possible. Kuhn developed a theory on which science was distinguished from other disciplines by its consensus on the basic rules of the game, and by occasional revolutionary upheavals as the rules were changed. Friedman claims that there are a-priori parts of scientific theories that make the empirical parts thinkable but that they change during revolutions.

In a period of normal science, between the changes, Friedman sees science as an exemplar of communicative rationality. All people within the field agree on the important issues, and on the evidence needed to make a decision. At times of revolutionary change this breaks down.

In philosophy, according to Friedman, there is no agreement on solutions or methods. Rather, there is agreement on which problems and contributions to those problems must be taken seriously. Thus philosophy cannot be made part of science.

During a revolution, however, philosophy can be very useful to science. A scientist who frames his revolutionary change in terms of a serious contribution to an important problem has a rational claim to be taken seriously. He argues that Einstein worked in exactly this way while developing relativity.

As a guiding theory in history of science, Friedman's account suggests that the relationship between science and philosophy is close only at times of revolution, but that it is essential then. Indeed, the development of philosophy could explain why scientific revolutions occurred when they did. While the account of relativity seems quite convincing to a non-specialist, Friedman's attempt to extend the account to other parts of science, such as the chemical revolution and the acceptance of evolution, is less detailed. However, examining the issues through this lens might well provide new insights into these episodes.

DAVID CHART
University of Cambridge

RODDEY REID and SHARON TRAWEEK (eds.), **Doing Science + Culture: How Cultural and Interdisciplinary Studies are Changing the Way We Look at Science and Medicine**. New York

and London: Routledge, 2000. Pp. viii + 339. ISBN 0-415-92112-0. £16.99 (paperback).
DOI: 10.1017/S0007087403474979

Like many other edited volumes, this collection of essays started life as a series of conference papers. Some redrafting, polishing and a few discussion groups later, and we have a very reasonably priced paperback that shows how interdisciplinary studies (i.e. women's studies, queer studies, science studies, cultural studies) are influencing research into science and medicine carried out by historians, anthropologists, sociologists and scholars of literature and communication.

Traditionalists who usually recoil in horror @ the overuse(s) of unnecessary punctu/ation and unfamiliar, postmodernist jargon should not be put off from delving deeper into this work. A good deal of the discussion is frank, informative and oriented towards day-to-day matters of simply doing research, in a practical handbook for the confused academic. Reid and Traweek should find a ready market for this work amongst researchers who are simply curious about what the cultural study of science entails, as well as those who are grappling to legitimate their own interdisciplinary approach to research. And at only £16.99 it is surely destined to become a set text for many undergraduate and postgraduate courses.

Doing Science + Culture is split into three distinct sections, each containing three or four chapters. The first section deals with the movement of people and ideas about knowledge or scientific practices, both within and across borders of nation states and regions. Section two provides a more personal insight into the rationale behind several quite different research projects. The thought processes each author went through at various periods of his/her study and the obstacles s/he had to negotiate are set out clearly. In the final section, details are provided about new courses or modules that adopt these approaches to looking at science and/or medicine and have been set up at various universities in the United States. Once again, neither departmental and institutional politics nor logistical nitty-gritty are left out. These pages are likely to be well thumbed in library copies.

Readers can judge for themselves whether Reid and Traweek's insistence on 'jamming together … elements that are usually kept quite separate' (p. 15) has produced either a hotchpotch of mismatched essays or a fine example of how disparate elements can be brought together as exemplars of cross-disciplinary scholarship. I personally found the collection to be somewhere in between these two extremes, becoming genuinely drawn into some chapters, while glossing over a couple of others that bordered on the self-indulgent. The eleven chapters are all highly self-reflective, with authors taking a 'this is how I see the question', or 'this is the way I did it' approach, rather than hiding behind hypothetical situations or theoretical arguments versed by others. That is not to say that the book is lacking in references. End-of-chapter notes are used to expand upon arguments and mention supporting studies and each contribution is rounded off with a comprehensive list of further reading which will be a valuable resource for any would-be cultural studies student or diligent scholar.

One potential criticism of *Doing Science + Culture* has to be its unashamed North American focus. While Europe and Japan get a look-in during the first three chapters, investigating globalized viewpoints, the subsequent case studies of research methodologies and undergraduate teaching logistics draw entirely on the experiences of US-based researchers. Appreciation of attempts to integrate cultural, gender and science studies into the curriculum at universities across the Atlantic (or Pacific) is sadly lacking. This would have added a valuable dimension to a work that prides itself on boundary-crossing, and should perhaps be borne in mind if and/or when a second edition is planned.

PAULA GOULD
Chester

JAMIE C. KASSLER, **Music, Science, Philosophy: Models in the Universe of Thought.** Variorum Collected Studies Series, CS713.

Aldershot: Ashgate, 2001. Pp. xvi + 301. ISBN 0-86078-862-8. £55.00 (hardback).
DOI: 10.1017/S0007087403484975

This volume is an invaluable resource for scholars who want to learn more about the role of musical models in philosophical and scientific thought from Pythagoras to Popper. Kassler has been publishing on aspects of this challenging subject for some thirty years, her most recent book being *Inner Music: Hobbes, Hooke and North on Internal Character* (London, 1995). Kassler's work has always been essential reading for specialists but it is to be hoped that this collection of articles and chapters originally published between 1973 and 1999 will introduce a wider audience to her exploration of how music's technological and theoretical constructs have contributed to the growth of scientific and philosophical knowledge.

As Kassler explains in her Preface, the volume is organized as a mirror image of its title: Part 1 addresses music's contribution to 'Philosophy', notably its relevance to debates in epistemology, logic and probability; Part 2 concentrates on 'Science', which in this case means examples of seventeenth-century English natural philosophy; and Part 3 provides instances of how the philosophy and theory of 'Music', now classified under musicology, have in turn been influenced by other domains, especially the cognitive sciences. This reflexive structure underscores the main theme of the book, which is the interrelatedness of knowledge, exemplified through case studies of the diverse ways that music has served as a means of explaining and understanding the world, at least within the Western intellectual tradition.

This broad remit is mapped out in the first chapter, in which music's dual nature, both as an organizing principle (embodied in Apollo, god of reason and harmony), and as a manifestation of disorder (Dionysus, god of passions and excess), is shown to have influenced Western philosophers seeking to understand the dynamic structure of the universe even into our own times. Readers of this journal familiar with competing theories of matter, of stories about the mechanization and (re-)enchantment of the world, may be surprised to discover how often musical models have aided philosophers and scientists in their attempts to conceptualize the generative and operational principles at work in nature.

Since the eighteenth century the flow appears to have been mostly in the opposite direction, with representations of music being based either on mechanics (i.e. pieces of music may be decomposed, recomposed or generated out of a finite number of elements), as in William Jones's late eighteenth-century theory of music (Chapters 2, 8), or developmental biology (i.e. unfolding purposively out of a single inner principle), as in Heinrich Schenker's early twentieth-century theory of tonality (Chapter 9). Yet, as Kassler shows particularly effectively in her central section, musical analogues have also served as a means of grasping what is not yet fully knowable through prevailing scientific methods, especially when new experimental sciences are being created, or the boundaries between existing disciplines are being redrawn (Chapter 7).

Thus in the seventeenth century William Harvey, for example, used the description of the blood as dancing like an animal to help him introduce the concept of the ovum into embryology, 'a technical model for the processes involved in making new life as well as making a new science' (Chapter 4, p. 69). The same strategy was adopted by Thomas Willis, who used his understanding of how a hydraulic organ works as an analogue for the human *hydraulis* (Chapter 5). Since a mechanical organ could play pre-programmed tunes, and also be used to create new compositions, it proved a singularly useful model for developing physiological theories of mind–body interaction, and even mental processes themselves. Comparable nineteenth-century examples discussed here are William Stanley Jevons's piano-like logic machine (Chapter 3), and John Hughlings Jackson's metaphor of the 'organ of mind' based on the symbol of a piano accordion (Chapter 10).

The book coheres well, especially through its emphasis on instrumental techniques, but it is

not designed to be read at a single sitting. Like a collection of brilliant Chopin mazurkas, the chapters are best sampled one or two at a time, in different combinations, with appreciation being enhanced through repetition. Unfortunately there is no general bibliography, and Kassler has not chosen to situate her work within the wider scholarly discourse on music, science and philosophy that has developed over the period her essays cover. For that you should look to collections like Paolo Gozza's *Number to Sound: The Musical Way to the Scientific Revolution* (Dordrecht, 2000) or his *La Musica nella Rivoluzione Scientifica del Seicento* (Bologna, 1989).

PENELOPE GOUK
University of Manchester

STEPHEN HILGARTNER, **Science on Stage: Expert Advice as Public Drama**. Writing Science. Stanford: Stanford University Press, 2000. Pp. xv + 214. ISBN 0-8047-3646-4. £11.95, $18.95 (paperback).
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'Eat fruits, vegetables and whole grains! Minimize intake of smoked and salt-cured food! Limit alcohol!' Citizens of industrialized, western nations are increasingly confronted with such recommendations in health insurance brochures, on food packaging and in television advertising. This book investigates the production, presentation and reception of the scientific literature that forms the basis of such health campaigns. It offers a comparative analysis of three reports on nutrition and on dietary recommendations which the United States' National Academy of Sciences (NAS) elaborated and partly published during the 1980s. Inspired by Erving Goffman's sociology of roles, it focuses on the implicit and explicit 'dramaturgy' of these texts, the 'stage management' they imply and the 'performances' of its multiple authors.

After an introductory chapter the analysis begins by asking what is an Academy report and who writes it. By definition, Academy reports do not have single authors. A whole team of experts, assistants, consultants and reviewers works collectively at establishing texts of this genre. In the case of the nutrition recommendations the book investigates, the committees in charge consisted of nine to fifteen Academy members. All committees were affiliated with the Assembly of Life Sciences in the National Research Council (NRC), the operating arm of the NAS. According to Hilgartner, there are two decisive strategies in producing credible Academy reports: first, to transform a whole network of actors and a variety of arguments into a 'single voice' (p. 51); second, to separate clearly all documents referring to the actual process of discussing and drafting the reports from the final report itself. The 'Academy routinely denies outsiders access to these internal documents, which it retains in a closed part of its archives for at least the first 25 years after a report's publication' (p. 57). According to Hilgartner, this kind of information control is the central means the NAS uses to (re-)produce its scientific and cultural authority. To use the theatre metaphor that the book relies on, we could say that the NAS carefully orchestrates both its front-stage and its backstage activities.

In 1985, the theatrical self-presentation of the NAS was challenged by the debates and discussions provoked by the draft of the tenth edition of the *Recommended Dietary Allowances* (*RDA*). Parts of this draft unintentionally became public before the responsible committee and its supporting team could make the final revisions. Hilgartner sees this episode as a breakdown of the 'modes of collective information control' (p. 71) the Academy normally uses to secure its cultural and scientific authority. He stresses the sociological interest in this kind of 'accident' in the routine functioning of the NAS. He explains that such breakdowns show the 'disorderly and contentious process' (p. 80) that is behind the public statements of the Academy. Not only did the members of the responsible *RDA* committee debate with the reviewers as to the content of the recommendation. In addition, the chair of the *RDA* committee, Henry Kamin, struggled with the chair of the NRC, Frank Press, on the question of whether or not to publish the recommendations. In addition, the media coverage of the

ongoing debates had an impact on Academy members, independent experts and concerned citizens. In other words, '[t]eam members stepped out of their authorized roles' (p. 72) and made the controversy public. In such moments, the otherwise 'unobservable backstage' (p. 66) of the Academy theatre becomes at least partly accessible to analysis.

The third chapter discusses the effectiveness of different forms of publicly attacking Academy reports. Surprisingly it turns out that criticizing the Academy's performance in its entirety is less effective than charging that 'popularizers have distorted a more nuanced message' (p. 112). The fourth chapter analyses the way in which the NAS defends itself when its character as a trustworthy advisor to the government and a responsible guardian of the cultural authority of science is questioned. Hilgartner comes back to the debates provoked by the leaking of the 1985 draft of the *RDA* to the public. The target of his analysis is now the public explanation given by Frank Press of why the publication of the report had to be postponed, and the open letter written by the chair of the *RDA* committee, Henry Kamin, as a reaction to Press's decision. (Both texts are reproduced in the appendix of the book.) In this part of the study, Hilgartner gives his dramaturgical method an interesting twist. In order to show that the letter of the NRC chairman is a 'carefully crafted piece of real life political theater' (p. 116), this text becomes literally represented in the form of a short theatre piece. By means of an original montage of quotations (interrupted by 'stage descriptions' and the comments of a fictional 'chorus'), Hilgartner shows how Press embedded his dismissal of the 1985 draft in a narrative about the conservation of social order. Using a similarly creative procedure, Hilgartner offers also evidence that Kamin's response staged a very different drama. Kamin presented what in his eyes was a battle between science and non-science as a melodrama between the good and the bad. In this version, the draft's inconsistencies appeared as a result of the careful and conscious work of the scientists involved. Kamin argued that not publishing the report makes this work the victim of policymakers, constituencies and special interest groups.

One of the main goals of this book is to offer 'a fresh look at scientific writing' (p. 19). Hilgartner's 'dramaturgical perspective on written documents' (p. 17) is indeed illuminating because, consistent with John R. Searle, it enables a better understanding not only of what texts 'say' but also of what they 'do'. Theatre is, however, more than just the dramatic script. It also requires 'scaffolding, sets, lighting, costumes' (p. 11). So too the Academy needs much material work before facing the public. But Hilgartner is not interested in the actual theatre machinery. His focus is on texts. His study thus only begins to explore the use of the theatre metaphor in science and technology studies.

HENNING SCHMIDGEN
Max Planck Institute for the History of Science, Berlin

JAY A. LABINGER and HARRY COLLINS, **The One Culture? A Conversation about Science**. Chicago and London: University of Chicago Press, 2001. Pp. xi + 329. ISBN 0-226-46723-6. £11.00, $17.00 (paperback).

JAMES ROBERT BROWN, **Who Rules in Science? An Opinionated Guide to the Wars**. Cambridge, MA and London: Harvard University Press, 2001. Pp. xiii + 236. ISBN 0-674-00652-6. £17.95, $26.00 (hardback).

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I was mentally prepared to prefer *The One Culture?* to *Who Rules in Science* as an attempt to mediate the now decade-old 'Science Wars'. As it turns out, however, the single-authored book by one of the few Platonists left in the philosophy of science is much preferable to the collaborative effort of humanists and scientists to reach rapprochement. I shall begin by briefly explaining my disappointment with Labinger and Collins, and then proceed to engage with the substantive issues raised by Brown.

The One Culture? beautifully executes a plan that is fundamentally flawed. The plan is to resolve the Science Wars by bringing together some 'reasonable' people on both sides to discuss the nature of their differences. Thus,

alongside Collins and Labinger, we have Trevor Pinch, Peter Dear, Pinch and Dear's local scientist (David Mermin), along with Michael Lynch, Steven Shapin, Steven Weinberg and two worthy British science communicators, Jane Gregory and Steve Miller. Except for some discordant interjections from Alan Sokal and Jean Bricmont, everyone is on their best behaviour, politely correcting misunderstandings and offering mini-lectures on the background knowledge, much of it historically informed, that is needed to understand their respective standpoints.

By the end, I was left with a feeling of intellectual claustrophobia, since most of the contributors appear to assume that the Science Wars could be resolved simply by the combatants coming to appreciate the integrity of their research interests and practices. To his credit, Shapin provides a more symptomatic reading of the Science Wars as reflecting the larger changes that science is undergoing in today's society. Unfortunately, everyone else seems to be engaged in an elaborate face-saving exercise that makes sense only if people like those included in this volume are likely to decide the future course of science and science studies. Nevertheless, even those who share my profound scepticism at that prospect will find here a wealth of information relating to the motives and visions that animate the particular contributors.

In contrast, *Who Rules in Science?* offers a salutary broadening of the issues. For the last dozen years, Brown, now Professor in the Philosophy of Science at the University of Toronto, has been known as an amiable but orthodox textbook-writer, specializing in physics and mathematics. Here, however, Brown overlays the introductory textbook format with a politically inspired discussion of the Science Wars. The result will give students a vivid sense of where, how and why such rarefied topics as relativism, constructivism, realism and rationalism matter to today's politics of science. Although Brown and I stand on opposite sides of the epistemological spectrum, I would have his book replace that tired warhorse, Alan Chalmers' *What Is This Thing Called Science?*, which over the years has lost the original left-realist political baggage that Brown now seeks to recover.

Brown begins at a point my constructivist comrades would wish to ignore, namely Sokal's complaint that science studies has incapacitated the left from contributing to progressive social change, which has traditionally presupposed a realist view of science. Sokal's complaint is legitimate, but it should not be overblown. It is certainly true that most of science studies is radical merely by accident, since the field's practitioners studiously claim to be describing, not prescribing for, science. However, Sokal's complaint is historically informed by Marxism, which is the twentieth century's most important, but by no means only, pro-science politics of social reform. Ernst Mach and John Dewey wedded a roughly constructivist view of science with equally reformist politics, albeit in ways that Marxists always held under suspicion. Unfortunately, as *The One Culture?* demonstrates, constructivists have largely refused to engage with politics at all, and so Brown and Sokal are given a wide berth to bang the leftist drum to a realist tune.

There is much to make of this situation. Brown mercifully omits commenting on the fact that British science studies was started by scientists with Marxist inclinations whose vision was betrayed once the field became professionalized or that the field has flourished in an increasingly privatized science policy environment precisely because it leaves prescriptions to clients. At the same time, however, Brown fails to see that the explicit construction of conventions to demarcate, say, science or physical space – a practice the logical positivists acquired from Henri Poincaré – was intended as a bulwark against simply letting tradition dictate these things, be it brought about by natural or social selection.

While we nowadays tend to equate constructivism with relativism, it is worth recalling that in the Lamarck-inflected early twentieth century, relativism would have been more closely aligned with naturalism. Indeed, constructivism questioned the presumptive validity of past social practice, a position that united relativists and naturalists. Instead, constructivists sought

some independent ground for determining future practice. It is in light of this difference in context that logical positivist adherence to Kant's distinction between a-priori and a-posteriori knowledge should be understood. Empowered by Einstein's revolution in physical geometry, the positivists used a demystified and socialized understanding of the a priori as 'convention' to counteract the entrenched prejudices already embedded in a-posteriori forms of knowledge. Moreover, unlike Brown, they followed Kant in refusing to refer to some objective reality that could trump all alternatives.

Politically speaking, this means that constructivists do have a politics of science, one that is potentially progressive. However, it is intimately tied to the institutions that are designed to control the flow of knowledge claims. To his credit, and unlike many of his fellow realists, Brown takes the matter seriously. Indeed, he discusses several institutional variants. But here I must confess unease with his view that science for the people need not be by the people. Brown's account of democratic politics distinguishes too sharply between its 'direct' and its 'representative' versions, which leads him to suggest that our representatives are experts who can judge on our behalf. He too quickly abandons the real virtue of democracy, which is that the representatives are subject to regular elections, and hence are accountable for the consequences of their decisions. The positivists and their more politicized Popperian cousins would have immediately spotted this problem, but at least Brown has had the good sense to raise it.

Steve Fuller
University of Warwick