SCIENCE IN THE
NINETEENTH-CENTURY
PERIODICAL

Reading the Magazine of Nature

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CHAPTER I

Introduction

Gowan Dawson, Richard Noakes, and Jonathan R. Topham

In an early essay, the physicist James Clerk Maxwell pondered the intelligibility of the universe, contrasting the reassuring image of the book of nature with an intriguing, if somewhat disturbing alternative, the magazine of nature:

Perhaps the 'book', as it has been called, of nature is regularly paged; if so, no doubt the introductory parts will explain those that follow, and the methods taught in the first chapters will be taken for granted and used as illustrations in the more advanced parts of the course; but if it is not a 'book' at all, but a magazine, nothing is more foolish to suppose than that one part can throw light on another.

This epistemological reflection is both suggestive and rather surprising. If nature is like a book, Maxwell suggests, or better, a well-constructed textbook, then the explanation of its several parts will form a unified and coherent whole. However, this assumption is far from self-evident, and may well be false. Nature may instead be like a magazine. Just as a magazine contains a miscellany of unrelated articles, argues Maxwell, so the various parts of nature may be unrelated to each other. What is surprising about Maxwell's claim that on this basis it would be 'foolish to suppose ... that one part can throw light on another' is that he was later outstandingly successful in exploiting such relationships in his research. Using mechanical models of the ether he spectacularly illuminated the analogies between electricity, magnetism, and light. In much the same way, as this book will show, important relationships can be found between the disparate articles which make up a magazine.

Science, technology, and medicine permeated the content of general periodicals in nineteenth-century Britain, appearing not only in avowedly scientific articles, but also in other forms of narrative including fictional representations, glancing asides in political reports, and caricatures and allusions in comic magazines. From the perspective of readers, science was omnipresent, and general periodicals probably played a far greater role than
books in shaping the public understanding of new scientific discoveries, theories, and practices. The object of this collection of essays is to analyse the representation of science, technology, and medicine, as well as the inter-penetration of science and literature, in the general periodical press in nineteenth-century Britain. Employing a highly interdisciplinary approach, the following chapters address not only the reception of scientific ideas in the general press, but also examine the creation of non-specialist forms of scientific discourse within periodical formats, and the ways in which they interacted with the assortment of other kinds of articles found in nineteenth-century periodicals.

The prevalence of science in such periodicals as the *Cornhill Magazine*, the *Illustrated London News*, or *Punch* has far-reaching implications for literary scholars and historians of science alike. In an age in which the natural sciences became increasingly demarcated from other fields of learning, and from a self-consciously 'literary' sphere, periodicals frequently served to re-incorporate them in a wider culture. Whether in homiletic form in the sermons of the *Wesleyan-Methodist Magazine* or in political form in leading articles of the *The Times*, the cultural significance of the sciences was widely debated in the periodical press. Moreover, the variety or even *bricolage* of their formats made periodicals unusually open to different subjects and genres being juxtaposed, and most readers were not as fastidious as Maxwell about the analogies thus suggested. Indeed, editors and writers were often fully aware of the opportunities for conceptual and linguistic interchange. Novelists, essayists, politicians, and scientists alike found periodicals a common ground for such borrowings. Moreover, with the bounds of the sciences constantly under re-negotiation, non-specialist periodicals presented an invaluable medium for the exploration of new, heterodox, or disputed sciences.

While books are generally intended to be of lasting, if not timeless, value, periodicals are designedly ephemeral: in Margaret Beetham's phrase, literally 'date-stamped'. For the historical scholar, it is, paradoxically, the very time-sensitive nature of periodicals that gives them their permanent value. Of course nineteenth-century books were often written in response to other books, but the fine texture of debate was embodied far more completely in the periodicals. Day by day, week by week, month by month, periodicals addressing widely diverging reading audiences contained implicit and explicit dialogues concerning the sciences. Such interchanges, occurring both within and between periodicals, represent a remarkable, almost overwhelming, body of evidence for the cultural history of science in nineteenth-century Britain. Books were also secondary to periodicals in other significant ways. It was in periodicals, for instance, that many of the best-known works of the nineteenth century first appeared, ranging from a considerable proportion of the novels to such scientific classics as John Tyndall's *Fragments of Science* (1871). In addition, those works first published as books were often primarily known through their representations in periodicals, whether in reviews, extracts, abstracts, advertisements, correspondence, or passing comments. As James Secord observes, the achievement of stability in the process of 'literary replication' was far from straightforward: the meanings of paragraphs and epigrams extracted in periodicals often differed widely from those intended by the producers of the original books.

The pervasiveness of science in nineteenth-century periodicals has long been recognized. In 1958, Alvar Ellegård's ground-breaking *Darwin and the General Reader* demonstrated that evolutionary ideas were widely canvassed in the non-scientific press. However, while Ellegård's use of a broad range of periodical sources (he examined 115 titles) remains an achievement not subsequently matched, his approach rested on the assumption that periodicals can be taken, by and large, as representative of the ideas and beliefs of their readers, and thus, with some qualifications, of the population at large. This approach ignores the variety of ways in which periodicals were produced and read. As Secord has recently shown, for instance, newspapers and magazines sometimes functioned as foils for readers' own developing views: they might read them 'not to agree with them, but to think with them'. More fundamentally, periodicals themselves embodied forms of debate. Whether in the interplay of different contributions or in letters pages, they presented a space which, however tightly bounded, allowed for a variety of opinions to be expressed. Ellegård's attempt to codify public opinion by a statistical analysis of press reaction, classified according to five possible positions on each of three 'parts' of Darwinism, obscures such debate. Indeed, by focusing on those articles overtly concerned with evolution, Ellegård inevitably overlooked many apparently non-scientific articles which also engaged with Darwin's theory. Examining the entire contents of a periodical allows the historian to gain a more subtle, nuanced, and often very different picture of how Darwinism emerged, or indeed was submerged, in cultural discourse of the time.

This notion of the interplay of scientific and other subjects in periodical literature is central to Robert Young's well-known thesis, adumbrated in the late 1960s, that for the first eight decades of the nineteenth century British periodical literature reflected a 'common intellectual context' in which the sciences were fully integrated. A major problem with Young's thesis, however, is that it implies a progressive transition from a unified
intellectual culture to something resembling C.P. Snow's 'two cultures'. It has little to say concerning the complex changes in notions of the 'literary' and the 'scientific' which occurred over the course of the period, or to the manner in which these changes related to the transformations that took place in the forms of, and audiences for, periodical literature. Indeed, Young focused exclusively on a small number of the highbrow magazines and quarterlies indexed by the Wellesley Index to Victorian Periodicals, and, while he attributed the putative break-up of the 'common context' partly to 'the growth of general periodicals of a markedly lower intellectual standard', he otherwise disregarded the continual development over the century of new periodical forms addressed to an increasing range of reading audiences.

While the quarterlies undoubtedly represented the leading medium of discussion and debate among the wealthy middle classes and those in positions of cultural power in the early nineteenth century, there were already signs of strain in this 'common context'. As Richard Yeo has shown, Jürgen Habermas's notion of the bourgeois public sphere is helpful here. Such a sphere developed in eighteenth-century Britain, France, and Germany, as the cultural forum of a newly self-conscious 'public'. While effectively open only to the bourgeoisie and the landed aristocracy, it relied on a notion that men of differing ranks could discourse within it on all subjects on equal terms, through the authenticating token of Enlightenment rationality. The bourgeois public sphere existed, characteristically, in the physical space of the coffee house and in the virtual space of the periodical, where the writer and reader were notionally interchangeable. By the early nineteenth century, however, this notion of a unified public was becoming increasingly tenuous. In particular, the emergence from the 1790s of a self-consciously counter-cultural radical press and the strain placed on synthetic writing by the specialization of knowledge, made it increasingly difficult to maintain the notion of a unitary public sphere. Moreover, as Yeo has shown, science exacerbated these tensions. Divergent and threatening notions of science were prevalent in the radical press and elsewhere, and there was increasing conflict between 'the needs and interests of the lay public and the specialists' in terms of periodical writing on science.

The breakdown of the bourgeois public sphere in early nineteenth-century Britain exposes the inadequacy of Young's exclusive focus on highbrow periodicals. In order to negotiate the increasing diversity of reading audiences for science we need to study the full range of periodical types. As Jon Klancher suggests in his ground-breaking study of early nineteenth-century periodicals, reading audiences are not 'simply distinct sectors of the cultural sphere' that can be considered in isolation; rather, they develop and are maintained in relation to each other. Ultimately, a more extensive familiarity with the periodical press is needed even in order to grasp how the 'intellectual' audience envisaged by Young was redefined during the course of the century. To date, most attention in this regard has been devoted to the rise of the radical press - work which has done much to show that the production of science for fashionable or specialist readers was profoundly informed by the presence of other audiences. However, other important reading audiences remain neglected. Take, for instance, Charles Timperley's calculation that of some 318 periodical titles (other than newspapers) issued in London on 16 December 1837, some fifty-two (16 per cent) were religious, and many of the seventy-one left unclassified (22 per cent) were 'very cheap periodicals, addressed chiefly to children'. The large circulation of religious and children's magazines suggest areas particularly worthy of consideration, but many other reading audiences also demand attention.

A renewed interest in the full range of nineteenth-century writing on science has been a hallmark of the recent historiography of science popularization and science in popular culture. In their 1994 re-appraisal of the field, Roger Cooter and Stephen Pumfrey urged that future work should be 'more permeable to the greater plurality of the sites for the making and reproduction of scientific knowledge', asserting the need to scrutinize 'popular prose and non-scientific texts for (or as) signs of orthodox and unorthodox scientific authority' and to explore the histories of scientific metaphors in popular writing. In particular, Bernard Lightman and others have pointed up the importance of widely circulated scientific writings produced by professional popularizers who 'offered different ways of speaking about nature' to the emergent scientific professionals of the late century. Similar perspectives have also emerged from recent work in literary studies. As scholars such as Gillian Beer, George Levine, and Sally Shuttleworth have shown, many literary writers of the nineteenth century actively engaged with scientific themes in essays, fiction, and poetry. Much of this writing first appeared in the non-specialist periodicals which are the focus of the present book.

Periodical studies have also developed apace. Thanks to John North's monumental Waterloo Directory, the vast output of the periodical press - North records some 125,000 newspaper and periodical titles in nineteenth-century England alone - has come under increasing bibliographical control. Other resources, notably Alvin Sullivan's British Literary Magazines (1983–4) and J. Don Vann and Rosemary VanArsdel's Victorian
interventions in the creation of the science of infant development were made in mid-century literary magazines and highbrow reviews. Even after the psychological journal Mind had broached the subject, the debate continued to range across a number of non-specialist periodicals. Shuttleworth also shows the difficulties encountered by George Henry Lewes, James Sully, and others in attempting to negotiate the different demands of non-specialist and specialist periodicals, and considers the implications of such writing for scientific reputation. Geoffrey Cantor, in chapter 9, explores how periodicals transmitted the narratives of free-standing scientific biographies to far wider audiences, transforming their meaning by immersing them in radically different contexts. One of the peculiarities of periodicals is that they contain within a single work a whole range of generic forms, and Cantor also investigates the manner in which the different genres of biographical writing were handled. In chapter 10, Graeme Gooday explores the changing literary forms in which the new technologies of industrial and domestic electricity were handled in the periodicals of the late nineteenth century. He argues that the development of new journalistic media – notably W. T. Stead's campaigning Review of Reviews (1890) – contributed to the emergence of a 'futurist romance' of electricity, which was to displace the 'technical-didactic exegesis' of the older reviews.

In this introduction we set these detailed case studies within two larger perspectives. First, we survey the increasing range of periodicals in the period and consider the significance of their changing forms and audiences for a wider understanding of the place of science in nineteenth-century culture. Secondly, we consider some of the key historiographical questions entailed in using periodicals in this way.

'CHARTING THE GOLDEN STREAM': SCIENCE IN THE NINETEENTH-CENTURY PERIODICAL

In his History of Nineteenth Century Literature (1896), George Saintsbury reflected that no literary phenomenon was 'so distinctive and characteristic' of the era as 'the development ... of periodical literature'. Since the late seventeenth century, periodicals had been regarded as a potent device for developing the literary marketplace, providing metropolitan publishers with a conduit through which to advertise other literary wares to provincial booksellers and far-flung readers. However, with the increasing commercialization of the book trade in the eighteenth century, and with the emergence of new reading audiences and the mechanization of book manufacture in the early nineteenth century, periodicals took on a new
significance. In an unpredictable market, periodicals allowed publishers to develop relationships with particular groups of readers while at the same time avoiding the financial risks of capital-intensive book production. Their periodicity allowed producers to respond readily both to readers’ comments and to sales figures in order to match commodity and consumer more effectively. The periodical was thus the perfect vehicle for sounding out and consolidating the diverse reading audiences of the growing and increasingly entrepreneurial literary marketplace. As a result, the number of titles trebled in the first three decades of the new century, and the types of periodical also rapidly increased.

To some contemporaries, periodicals seemed almost to be replacing books. In 1823, Hazlitt famously addressed the complaint that his was ‘a Critical age; and that no great works of Genius appear[ed], because so much [was] said and written about them’.21 The dominance of periodical literature has also been widely recognized by historians. Lee Erickson, for instance, considers that ‘the periodical became the dominant publishing format’ during the first half of the nineteenth century, and Mark Parker argues that literary magazines were the ‘preeminent literary form of the 1820s and 1830s in Britain’.22 Yet the basic parameters of this new market for periodicals remain largely unexplored. Figures from the Waterloo Directory suggest there was a sustained if uneven increase in the number of periodical titles over the course of the century, with the exception of a final decline, which may be a result of the method of sampling (fig. 1.1). The number of periodicals apparently increased at an ever-faster rate as the century progressed, although the greatest proportionate increases occurred in the early part of the century (particularly in the late 1810s/early 1820s and in the early 1830s). Comparing this pattern to figures derived from the Nineteenth-Century Short-Title Catalogue seems to confirm that from the 1820s, and more especially from the 1830s, the number of periodical titles grew at a faster rate than the number of book titles (fig. 1.2).

When complete, the Waterloo Directory may enable us to generate data about the shifting genres and periodicities of periodical publication, and the changing patterns of periodical prices. To date, however, there is no modern study which, like Walter Graham’s English Literary Periodicals (1930), seeks to provide a comprehensive assessment of the main phases of periodical publication. Yet the rise and fall of periodical forms clearly impinged heavily on the ways in which the sciences were encountered and discussed in nineteenth-century Britain. In this section we sketch some of the key

Figure 1.1: Patterns of periodical publication in nineteenth-century Britain

2. The figures given here are taken from the first of the five planned series of the directory, which, it should be noted, is something of a subject bias. Each series of the directory is planned to provide a comprehensive listing of, or access to an additional subject. In each series of the directory, a subject bias is likely to be inherited, or additional subject bias may be built in. In each series of the directory, a subject bias is likely to be inherited, or additional subject bias may be built in.
Introduction

and in its contributors. The point was well encapsulated by the Gentleman’s Magazine, reflecting on the role of literature in the wake of the political unrest of 1819:

since the establishment of the great Quarterly Journals, every subject of any moment to the Publick is sure to be most elaborately discussed, in a proper scientific-technical form, by men of rank in life, and high acquisitions, who are above dependence on their professional situations ... Things of this very high character can only be executed by persons resident in large cities, and who can have access, upon particular subjects, to documents, not of a general kind.24

The Edinburgh was founded by an ambitious group of young men influenced by the academic specialisms of the Scottish universities, which featured prominently in the review. Several of the editorial coterie had been former members of the Academy of Physics—a student scientific society—and they gave particular emphasis to the natural sciences, as well as to moral philosophy and political economy.25 By contrast, traditional theological and classical lore, together with the mechanical arts and antiquities beloved of the new middle classes, were notably absent. In addition, the Edinburgh viewed medical subjects as generally suitable only for the specialist writers and readers of the medical journals.26

By the 1820s, the natural sciences were becoming increasingly problematical for the quarterly. Marilyn Butler observes that the Edinburgh, like its competitor the Quarterly (f. 1809), began to reflect an ‘ordered separation between literature, especially poetry, and independent or reformist or scientific thinking’ that was in train by this period. Likewise, Richard Yeo argues that by the 1830s ‘it was clear that there was no longer a single educated readership’, and writers in the quarters had to contend with the ‘problem of speaking to both experts and general readers’ on scientific subjects. It was also difficult to identify suitable books for review on scientific subjects or to find reviewers who could write in a suitable manner for a non-scientific audience. Nevertheless, around one tenth of articles in the Edinburgh and Quarterly in the 1830s were devoted to scientific subjects, and other articles often broached scientific themes.27 Moreover, gentlemen of science like David Brewster and William Whewell who wrote at length in the reviews clearly saw them as important platforms for addressing a non-specialist but culturally powerful public. Such literary performances were of a piece with the conversational interventions gentlemen of science were expected to make in London’s fashionable salons, and fulfilled important functions in making the claims of science heard amongst the ruling élite.28

At the same time, the quarterlies began to provide a platform for emergent

phases of this history, considering how the shifting material and cultural forms of periodicals modified not only how the sciences were represented, but also the audiences to which they were addressed.

Science in early nineteenth-century periodicals

The nineteenth century began with the inception of one of the most commanding new periodical genres, namely, the quarterly review journal, initiated by the Edinburgh Review (f. 1802). Far more selective in its reviewing, and also far more opinionated and partisan than the monthly reviews of the previous century, the Edinburgh ‘plainly set out to break the mould of existing journal culture’.29 In contrast to the encyclopaedic ambitions and open ethos of the Monthly Review (f. 1749) or the Analytical Review (f. 1788), the new review prided itself on its discrimination, both in its subject matter

Figure 1.2. Comparative trends of book and periodical publication in nineteenth-century Britain.

The data (displayed as five-year moving averages) are derived from the Waterloo Directory and the Nineteenth-Century Short-Title Catalogue, Series I & II, 1801-1876 (NSTC), CD-ROM (Newcastle-upon-Tyne: Aveva Publications, 1996). The NSTC is a union-catalogue of the ‘British books’ in a number of leading research libraries, including all books, periodicals, and pamphlets published in Britain, its colonies and the United States of America; all books in English wherever published; and all translations from English. As a union-catalogue, it does not pretend to be a complete record of publication; while at the same time it contains many foreign publications not germane for our comparison. Thus, we have not only excluded serials from our calculations, but have also followed Simon Eliot in excluding all books not published in London, Oxford, Cambridge, Edinburgh, or Dublin, trusting that these leading publishing centres will give a reasonable reflection of the patterns of British book publishing. See Simon Eliot, Some Patterns and Trends in British Publishing, 1800–1940 (London: Bibliographical Society, 1994); and Eliot, Patterns and Trends and the NSTC: Some Initial Observations’, Publishing History 42 (1997): 79–80, and 43 (1998): 71–112.
men of letters, such as Thomas Carlyle, to explore new developments in specialist knowledge using 'the touchstone of a general humanism'.

The breakdown of the ideal of a bourgeois public sphere and the developing sense of distinct literary and scientific spheres was, if anything, more evident in the monthly magazines. Conceived as storehouses ('magazines') of learning and information, the eighteenth-century miscellanies of the sort typified by the Gentleman's Magazine had welcomed contributions from readers on subjects ranging from natural history to the practical arts, and from meteorology to agriculture. The Enlightenment project of amassing observations and experiments flourished in such magazines, as Roy Porter has illustrated in relation to medical subjects. Advertising a reprint of its half-century run in 1782, the magazine claimed: 'There has scarce a new Subject been started, a new Invention introduced, or a Discovery of any Kind, either by Land or Sea, of which a satisfactory Account is not to be found in the Gentleman's Magazine.'

In the years following the Napoleonic wars, however, this situation rapidly changed, as the older style of miscellany was replaced by self-consciously literary magazines and a growing body of commercial science periodicals appeared. The first of the new magazines, Blackwood's Edinburgh Magazine (f. 1817), began in a strictly traditional form, including separate sections devoted to 'Original Communications', 'Select Extracts', 'Literary and Scientific Intelligence', and a 'Monthly Register' of news, commercial and agricultural reports, and births, deaths, and marriages. At the start of the second volume, however, its publisher radically revised the format, removing the traditional sections (with the exception of the 'Monthly Register', which continued — increasingly intermittently — until 1831) and paying handsomely for contributions that were self-consciously original literary creations. This approach to the monthly magazine was soon adopted by other publishers. In January 1820 the London Magazine was started in deliberate imitation of Blackwood's, and the following year the New Monthly Magazine (f. 1824) took on a markedly more literary form. Other existing titles, including the Monthly Magazine (which had been one of the most scientific of the monthlies) and the European Magazine, soon followed suit.

The Gentleman's Magazine maintained its traditional format as a 'living encyclopedia', yet it also contained fewer original scientific observations. Roy Porter has noted that from the 1820s in particular 'there was a dramatic decline in the exchange of medical advice, inquiries, remedies', and that it 'ceased to play any important role in instructing the laity in medical self-help or as a medical talking-shop'; instead, the magazine carried 'reports on what the medical profession was doing, viewed as an organized profession'. In 1817, reports of scientific discoveries and technical innovations began to appear as brief paragraphs in a separate section, often in extracts from other publications. The implication was that readers were consumers of scientific news more than active participants in scientific discovery. An 1820 preface was more explicit, arguing that, especially in such turbulent times, journals like the Gentleman's Magazine should suppress erroneous ideas brought forward by partly educated men who believed that 'one man ha[d] an equal right with another to attention'. The magazines were to act 'as Clerks of the Market, to prevent the Literary Public Stomach from being seriously injured by eating unwholesome food'.

The transformation of the monthly magazine into a primarily literary genre did not occur in isolation. While a number of commercial scientific, medical, and technical magazines had been in existence since the later part of the eighteenth century, the period following the Napoleonic wars witnessed a rapid increase in their number and range. Whereas in 1815 there had been approximately ten such magazines, by 1830 the number had trebled; in the same time period the number of society publications had remained around ten. The existing commercial journals, like the Botanical Magazine (f. 1787), the Repertory of Arts (f. 1794), the Philosophical Magazine (f. 1798), and the Medical and Physical Journal (f. 1799) were supplemented by a number of competitors, like the Botanical Cabinet (f. 1817), the London Journal of Arts (f. 1820), the Edinburgh Philosophical Journal (f. 1819), and the Medico-Chirurgical Review (f. 1820). In addition, however, a wider range of specialized subject journals appeared, ranging from the Phrenological Journal (f. 1820) to the Gardener's Magazine (f. 1826), and the Veterinarian (f. 1828) to the Magazine of Natural History (f. 1829). Such magazines opened their pages to original observations from readers in much the way that the Enlightenment miscellanies had; however, their audiences were now clearly fractured along disciplinary lines. Furthermore, a number of the new genres of scientific, technical, and medical periodical which originated at this period emphasized socio-cultural divisions — perhaps most strikingly those which, like the Lancet and the Mechanics' Magazine, emulated the new cheap weekly miscellanies of the 1820s.

The demise of the traditional Enlightenment miscellany and the development of the new specialized genres of the scientific and literary magazine require much more detailed analysis than can be given here. However, it is not our intention to replace Young's 'fragmentation of the common context' in the 1870s with an alternative fragmentation in the 1820s. Historians have long recognized that this period witnessed the development
of specialized scientific disciplines with increasingly technical vocabularies and a developing emphasis on trained experts, and the generic innovations of British periodicals in the years following the Napoleonic wars certainly contributed to the disintegration of an Enlightenment ideal of the bourgeois public sphere. Yet not only the quarterlies, but also the new literary monthlies and other forms of periodical intended for those who were not scientific specialists, manifestly continued to engage with the sciences in a range of important ways, as this book illustrates. Moreover, as the cultural status of the sciences rose in the course of the century, literary magazines carried increasing numbers of articles on scientific subjects, often written by leading practitioners. In assessing the ebb and flow in the representation of the sciences in the periodicals of nineteenth-century Britain, close attention must be paid to the constantly shifting genres of periodical publication.

A striking instance of this is the development in the post-war period of the weekly literary journal of belles-lettres, typified by Henry Colbourn’s *Literary Gazette* (f. 1817). A sixteen-page shilling weekly, the *Gazette* had the advantage of being able to provide readers with literary and other news on a more immediate basis than the monthlies. The new possibilities it raised for the reporting and discussion of science were increasingly exploited in succeeding decades. On William Edward Parry’s return from his first Arctic voyage in 1820, for instance, the *Gazette*’s editor, William Jordan, boarded the ships as they came up the Thames, penning an account which boosted the sale of the journal by five hundred copies. Later, following the founding of the British Association for the Advancement of Science in 1831, Jordan travelled in person to the peripatetic annual meetings to report on the sessions.

The *Literary Gazette* was the first periodical after *The Times* to be printed using steam presses. The effects of industrialization were felt increasingly in the years after 1815, as stereotype, machine-made paper, and case binding all began to be used in periodical manufacture. Such transformations were fundamental to the production of the penny periodicals in the 1830s. However, the advent of the first cheap periodicals in the 1820s owed more to the growing market for cheap print, signalled by the runaway success from 1816 of the separate two-penny edition of William Cobbett’s *Political Register* (f. 1802). Early radical journals, like Thomas Wooler’s *Black Dwarf* (f. 1817), tended to eschew scientific matters as not being germane to the immediate political exigencies, although they were often permeated by a discourse of natural law, and frequently used scientific imagery. However, some more extreme publications, like Richard Carlile’s atheist *Republican* (f. 1819), explicitly used materialist sciences to iconoclastic effect.

The repressive legislation introduced in 1819 did much to silence the cheap radical press during the 1820s, but the format of the cheap two-penny weekly of sixteen octavo pages was soon pressed into service by small-time entrepreneurs – including Cobbett’s erstwhile collaborators – to reach a wider market. At a time when all but a small minority were priced out of the market for most new books and periodicals, the cheap weekly miscellanies like the *Mirror of Literature* (f. 1822) came as a great boon, and were bought in unprecedented numbers. Combining readers’ contributions of the type found in the * Gentleman’s Magazine* with topical articles, extracts from fashionable books and the new monthly magazines, and innovative wood-engravings, the new genre incorporated science in a range of different ways, as shown in chapter 2. By the 1830s, however, a self-consciously ‘popular’ science came to predominate, intended for rational recreation, rather than for practical use or debate. Such an approach was adopted by the penny weeklies, such as the *Penny Magazine* (f. 1832) and *Saturday Magazine* (f. 1832), which were produced in response to the resurgence of the radical press during the Reform Crisis.

The specialization of periodical literature in which the scientific and literary monthlies partook was part of a larger development: the emergence of what the Victorians called ‘class journalism’, directed to the ever-increasing range of specialized reading audiences. Particularly prominent were the many religious magazines which were founded in the early decades of the nineteenth century, the cheapest of which – the *Evangelical Magazine* (f. 1793) and the *Wesleyan-Methodist Magazine* (f. 1778) – were (as chapter 3 shows) by far the most widely circulated periodicals of the period. Some religious magazines – notably the early *Christian Observer* (f. 1802) – emulated the traditional magazines in providing regular reports of the meetings of Europe’s scientific societies. More commonly, the science content of religious magazines was overtly directed towards practical devotion, but science nevertheless featured in dedicated articles, missionary reports, obituaries, sermons, and book reviews.

In the growing middle-class leisure market of the eighteenth century, a number of monthly magazines had been directed to ladies, but the new century saw the market expand further. To varying degrees, these ladies’ magazines incorporated entertaining and instructive articles on scientific subjects, most particularly natural history. Yet, as Cynthia White has argued, and others have confirmed, there was a ‘sudden reversal of the trend which promised [women] wider participation in social affairs’ in the 1820s, with women’s magazines subsequently being dominated by an ideology of domesticity. Ann Shteir has shown that this transition
was marked in the way that both the *Lady's Magazine* (f. 1770) and the *Lady's Monthly Museum* (f. 1798) handled science, and points suggestively to the fact that this transition was coincident with the movement of ‘scientific teaching and learning…away from general interest magazines into specialist publications’.1 The early nineteenth century also saw the first sustained monthly magazines for children and youths. Such periodicals reached amongst the largest reading audiences of the period, their success rooted in their explicitly religious objectives, and in their use of religious distribution networks. They commonly included scientific articles as part of their fare of rational entertainment, and also sought to inculcate a pious approach to scientific reading in their moral tales, homilies, and other articles.42

**Science in mid-nineteenth-century periodicals**

The middle of the nineteenth century saw enormous growth and development in the British periodical press.43 This expansion had many causes. First, demand rose from increasingly literate and leisurely reading audiences for what Patricia Anderson calls ‘new and varied sources of knowledge and amusement’.44 Secondly, technological developments offered desired ways of catering for this growing and diversifying taste, both with the development of increasingly efficient printing machines, and with the rapid expansion of Britain’s railway network which greatly aided distribution of printed matter.45 Thirdly, changes in taxation massively reduced costs. Following the significant reduction of duties on newspapers in 1836, their subsequent repeal in 1853 and 1855 fostered a sharp growth in the number of new titles and made newspapers more accessible to working- and middle-class readerships.46 Moreover, the abolition of taxes on paper and rags in 1860 and 1861 lowered the cost of all types of periodical.

Studies by Bill Brock, Susan Sheets-Pyenson, and Ruth Barton emphasise that *Nature* (f. 1869) was only the latest in a large crop of new commercial popular and semi-popular science journals appearing in the period from 1840 to 1870. Some of these built on the examples of cheap weekly mechanics’ magazines (e.g. the *English Mechanic* (f. 1865)), some emerged from trade weeklies (e.g. the *Chemical News* (f. 1859)), some developed from the more expensive genre of the monthly natural history magazine (e.g. the *Zoologist* (f. 1843)), and others experimented with the periodical genres traditionally associated with general topics (e.g. the *Popular Science Review* (f. 1862) and the *Reader* (f. 1863)).47 These journals catered to, and helped define, specialist scientific readings. They gave scientific practitioners many more alternatives to the existing general media where scientific debate had traditionally taken place and thus widened the gulf between general readers and scientific experts. Nonetheless, as Barton shows, popular science journals occupied a crucial nexus between trained scientists and the increasing number of readers with scientific interests because they functioned as sources of education and recreation and, increasingly during the 1860s, as platforms from which the new breed of scientific professionals could promote arguments for the cultural importance of science.48

The new scientific professionals did not, however, use only popular science journals in attempting to address their claims to a wider public. The problem of divergent interpretations of the meaning and uses of science had been spectacularly brought home to many experts during the controversy over *Vestiges of the Natural History of Creation* (1844).49 What this controversy showed, above all, was that the Victorian reading public now had access to a vast array of printed material in which conflicting views of science were expounded. Readers were not simply picking up claims made in the name of science in specialist journals, but in other established periodical genres, and in the welfter of new serial forms that emerged in the period from 1840 to 1870.50 If the new professionals were to achieve the cultural authority over science that they sought, they would need to make their voices heard in general periodicals, and many did. It was in this mid-century battle for cultural authority that scientific polemicists like Huxley came into prominence in the general periodical press.

One of the most striking developments in early Victorian periodicals was the increase in the quality and quantity of illustration. Exemplified by the *Illustrated London News* (f. 1842), *Reynolds’s Miscellany* (f. 1849), and the *Leisure Hour* (f. 1851), illustrated periodicals greatly expanded and unified the Victorian reading public’s visual experience and played a central role in creating a mass culture.51 Moreover, as the chapters in this book show, the increasingly widespread pictorial representations of scientific events, objects, and personalities in the general periodical press significantly shaped public perceptions of science.52 In the pages of illustrated newspapers, far wider audiences were now introduced to the scientific spectacles of the day, ranging from exhibitions of new technology to shows of exotic specimens. Savants themselves became familiar to a wider public, both collectively as represented at scientific meetings, and increasingly individually, as scientific celebrities. Scientific discoveries, too, began to be represented in pictorial terms, acquiring an appearance of factuality far more immediate than that conferred by textual description.

Illustrations were, of course, a key component in the comic journals that imitated and sought to enjoy the success of *Punch* (f. 1841). *Punch* and such rivals as *Fun* (f. 1861) built on earlier traditions in ‘high’ and ‘low’ comic journalism, from the wagsish visual caricatures of William Hone
and George Cruikshank and the grubby political satire of *Figaro in London* (f. 1831) to the genteel literary humour of *Frasier's Magazine* (f. 1830), *Hood's Comic Annual* (f. 1830), and *Bentley’s Miscellany* (f. 1837). What distinguished *Punch* and many other new comic journals from their ancestors – and what constituted major ingredients of their success among their predominantly bourgeois readers – was their development of comic form that combined respectability of tone, topicality, variety, and political conscience. As chapter 4 shows for *Punch*, scientific material played a much bigger part in this formula than hitherto recognized. Major scientific spectacles lent themselves to visual caricature in comic journals as much as sober depilation in the *Illustrated London News*; while the abstruse claims of astronomers, the immoral conduct of doctors, and the ingenious schemes of inventors provided material for comic journalists to continue their humorous, and frequently vitriolic, commentaries on the rights and wrongs of Victorian culture.

Illustrations also contributed to the success of other newcomers to the early and mid-Victorian market for periodicals: fiction-based weeklies and new serials for women and children. One of the outstanding features of mid-Victorian periodical publishing was the enormous circulation achieved by a string of penny fiction-based weeklies catering to a relatively uncultivated audience. By the 1850s, titles such as the *Family Herald* (f. 1842), the *London Journal* (f. 1845), and *Cassell’s Family Paper* (f. 1853) were read by several hundred thousand people each week. Building on the earlier tradition of cheap miscellanies, they offered large amounts of fiction, as well as useful information and serious articles, much of which was original and presented in a patronizing way. Of much higher literary and intellectual quality, though more expensive and lacking illustrations, were the two fiction-based weeklies ‘conducted’ by Charles Dickens: *Household Words* (f. 1850) and *All-the-Year-Round* (f. 1859). These featured fiction by writers such as Wilkie Collins, Elizabeth Gaskell, and Dickens himself, which frequently engaged with the same scientific, medical, and technological issues raised in the intellectually astute essays appearing elsewhere in the periodicals. The middle-class readership that Dickens targeted with his journals included the educated though not necessarily affluent women whom other early- and mid-Victorian publishers believed would clamour for cheap periodicals tailored to their needs. The most successful attempt to exploit this market was Samuel Beeton’s two-penny *Englishwoman’s Domestic Magazine* (f. 1832). In the preceding decades, most women’s magazines had been expensive monthlies for upper-class ladies that either focused largely on fashion and beauty or soberly promoted the morality and spirituality of Christian motherhood. The *Englishwoman’s Domestic* offered something very different and was frequently imitated. Its low price guaranteed it enormous sales among middle-class women for whom no comparable publication existed. Like the cheap fiction-based weeklies, it carried a large amount of medium-quality fiction, articles on history and biography, and answers to correspondents, but it trail-blazed with its systematic coverage of aspects of domestic management such as gardening, hygiene, and cookery. These articles best represent Beeton’s aim to improve readers’ intellectual, moral, and domestic abilities, and they furnished ample opportunities for introducing useful scientific and medical information.

Samuel Beeton also played a pivotal role in the mid-Victorian transformation of children’s magazines. Until the mid-1850s, middle- and upper-class children’s experiences of periodicals were usually either from family journals or juvenile serials published by religious presses. Juvenile periodicals launched from the 1830s increasingly differentiated between readers of different ages and gender, and offered much more secular material. Beeton’s *Boy’s Own Magazine* (f. 1858), a two-penny monthly aimed at older middle-class boys, fully exploited falling periodical costs, growing literacy among the more affluent children, and the rising mid-Victorian bourgeois taste for what Kirsten Droener calls ‘moral entertainment where an extrovert, imperial manliness mattered more than introspective piety or dry memorizing.’ It entertained with exciting adventure stories, puzzles, and a welter of (often coloured) illustrations, and instructed with hagiographies and detailed recipes for nature study, scientific experiments, and workshop projects, many of which were written by recognized experts such as J. G. Wood, who later edited the magazine. The runaway success of the *Boy’s Own Magazine* inspired other juvenile magazines. However, many boys wanted more entertainment and less instruction and this was provided by a flurry of immensely successful cheap boys’ weeklies published from the late 1860s, such as Edwin J. Brett’s *Boys of England* (f. 1866). Although many parents scorned them, Brett emphasized that his serials were designed to give less affluent boys wholesome alternatives to the ‘penny dreadfuls’ that had flourished in the 1840s. The *Boy’s Own Magazine* and *Boys of England* represented different ways of interpreting wholesome entertainment and instruction that shaped the late-Victorian era in juvenile periodicals.

Like Beeton, the publishers of the so-called ‘shilling monthlies’ – most notably Alexander Macmillan of *Macmillan’s Magazine* (f. 1859) and George Smith of the phenomenally successful *Cornhill Magazine* (f. 1860) – were entrepreneurs who sought to exploit a new sector of the mid-Victorian
reading public. Shilling monthlies catered for relatively educated but not traditionally affluent readers who were attracted to neither the cheap ‘family’ journals nor the expensive (2s) monthly literary magazines. They succeeded by offering more fiction, a generous helping of woodcuts and lithographs, and a plethora of serious articles on a wide range of subjects including history, art, and the sciences. Part of the appeal of this material was that it was penned by cultural figures respected by middle-class audiences, ranging from William Makepeace Thackeray, Anthony Trollope, and Sheridan Le Fanu for their high-quality fiction, to Thomas Henry Huxley, William Thomson, and Richard Proctor for their lucid scientific articles. As chapter 5 argues, scientific material in the shilling monthlies fulfilled the same function as scientific discussion in the new comic journals: it was a key element in these periodicals’ overall strategy of meeting the middle-class taste for topical, learned, and entertaining discourse. For professionalizing scientists like Huxley, however, these magazines presented an important forum for addressing a wider audience.

The founders of the new monthly reviews of the 1860s devised periodicals which emulated the intellectual debates taking place in societies, clubs, and conversazioni. They identified a gap in the periodical market for a more open intellectual forum, free from the party lines that tainted the quarterlies. The most radical was Chapman and Hall’s Fortnightly Review (f. 1864) which, paradoxically, was neither fortnightly (at least not after 1866) nor properly a review, primarily featuring free-standing articles that were not directly tied to the current lists of publishing houses. Intended as an English equivalent of the Revue des Deux Mondes (f. 1829), the Fortnightly was the first major periodical to disavow anonymity and instead enforce authorial responsibility by a strict policy of signature. The initial success of the Fortnightly was, according to G. H. Lewes (its first editor), ‘mainly owing to the principle adopted of allowing each writer perfect freedom; which could only have been allowed under the condition of personal responsibility’.

This policy of openness on questions of religion, politics, philosophy, literature, and the sciences certainly appealed to the scientific practitioners who contributed to its pages, including John Herschel, Huxley, and John Tyndall. The prominence of science was, from the very beginning, one of the defining characteristics of the Fortnightly, prompting criticisms that the periodical was politically more liberal than neutral, and theologically more rationalist than unbiased.

Signed journalism was also quickly adopted by a string of other intellectually highbrow serials, most notably the monthly Contemporary Review (f. 1866), which like the Fortnightly was priced at 2s 6d Founded as a response to the success of the secular Fortnightly by Alexander Strahan, the publisher of a string of religious magazines, the Contemporary focused more strongly on theological and philosophical issues, especially those that had been raised in the Metaphysical Society – an informal debating club that attracted statesmen, scientists, theologians, and philosophers, most of whom contributed to the Contemporary. Despite its Anglican leanings, the Contemporary differed strongly from most religious serials of the period in the wide range of theological, philosophical, and scientific positions that it published. Indeed, the Contemporary, at least while James Knowles remained as editor, featured some of the most vociferous arguments by Huxley, Tyndall, William Kingdon Clifford, and other scientific professionalizers in favour of the authority of trained scientific experts on social, intellectual, and cultural questions that had traditionally been the province of clergymen.

The insistence on signed articles in the Fortnightly and the Contemporary had important implications for the treatment of science in both journals, and perhaps induced a greater specialization amongst their contributors which in turn corresponded with the kind of professionalizing programme advanced by Huxley and others. As John Morley, Lewes’s successor as editor of the Fortnightly, reflected,

One indirect effect that is not unworthy of notice in the new system is its tendency to narrow the openings for the writer by profession. If an article is to be signed, the editor will naturally seek the name of an expert of special weight and competence on the matter in hand.

In the conditions of signed authorship which increasingly prevailed from the 1870s onwards, professional scientific writers were able to establish distinct authorial personas. By expressing consistent individual opinions across a range of different articles they established their expertise and credibility on particular topics, thereby ensuring that those without such intellectual credentials were denied the right to be heard. For Young, the monthly reviews represented almost archetypal exemplars of the ‘common intellectual context’, ahead of its eventual fragmentation in the 1880s and 1890s. On the contrary, however, they clearly represented a new and distinctive phase in the continuing development and re-negotiation of the relations between science and different periodical forms during the course of the century.

Science in late nineteenth-century periodicals

The last three decades of the nineteenth century witnessed an unprecedented growth in rates of literacy and levels of education, which, along with further technological innovations in printing and paper production
and ever more efficient railway distribution networks, continued to transform the periodical marketplace. These factors sustained the rapid increase in the number of titles, further reduced their prices, and again increased the size of the audience. The 1870 Education Act that helped create this newly literate mass audience (especially when compulsory attendance at Board Schools began to be enforced in the 1880s) also ensured the centralized guidance of school curricula which, as José Harris has argued, 'rapidly generated a new national popular culture - a culture that evoked new market responses in the form of mass-circulation newspapers'.

Lower production costs, larger potential audiences, and the growing homogeneity of popular culture meant that commercial periodical publishing expanded more rapidly in this period than ever before. Publishers willing to provide magazines and newspapers that were attuned to the demands of this growing mass audience - with illustrations, short fiction, and answers to correspondents being particular favourites - could now, in the words of the Liberal politician Henry Labouchère, 'make the journal a remunerative speculation'.

Indeed, one of the distinguishing characteristics of periodical publishing in this period was the emergence of corporate owners, including Alfred Harmsworth (later Lord Northcliffe), who were attracted by the increased profitability of the press.

The differential between the number of periodical and book titles published each year, which first began to diverge markedly in the 1850s, also grew exponentially in this period (see fig. 1.2), reflecting the continuing high price of books - especially the hugely expensive first editions bought principally by circulating libraries - at a time when periodicals were becoming ever cheaper. The 'periodical seems destined to supersede books altogether', noted Mark Pattison in 1877, the year in which the Royal Commission on Copyright declined to alter the arrangements between publishers and libraries that maintained inflated book prices. Pattison's hardly impartial observation appeared in the Fortnightly, which cost 2s 6d for each monthly issue of around 170 pages; a triple-decker novel at the time would generally cost at least 10s 6d for each volume. Only after 1894 were book prices revised downwards and, with the demise of the three-volume novel, brought into line with the changes in the cost of periodicals over the previous three decades. One of the consequences of the removal of taxes on newspapers and paper in the 1850s and 1860s had been the supplanting of quarterly titles by monthlies and weeklies, and the trend continued at an even greater pace in the later years of the century, with the emergence of highly influential dailies like the Pall Mall Gazette (f. 1865). The increasing speed of production, as well as the proliferation of journals, had important consequences for the consumption of periodicals in the final decades of the century (see chapter 7).

At the expensive end of the periodical market, monthly reviews like the Fortnightly, Contemporary, and the new Nineteenth Century (f. 1877) continued to take over the cultural role previously performed by the quarterlies that had established the pattern for intellectual debate at the beginning of the century. While, as Pattison observed wryly, 'venerable old wooden three-deckers' such as the Edinburgh and Quarterly 'still put out to sea', the 'active warfare of opinion [was] conducted by three new iron monitors, the Fortnightly, Contemporary, and the Nineteenth Century'. The Nineteenth Century, founded by James Knowles after a contretemps with the owners of the Contemporary, emerged as the principal flagship of the monthly reviews' values of liberal impartiality, signed articles, and reasoned debate. Additionally, the Nineteenth Century also pioneered roundtable formats of intellectual discussion (in the celebrated 'Modern Symposium' feature), and devolved ever-greater authority from the periodical and its editor to highly paid 'star' contributors like Huxley, Tyndall, and William Gladstone.

Meanwhile, in the mid-priced sector of the market, imported American magazines costing a shilling like Harper's New Monthly Magazine (f. 1850) were successfully challenging the former hegemony of home-grown shilling monthlies like the Cornhill and Temple Bar (f. 1859), largely because of the unmatched quality of their illustrations. The success of Harper's, which was selling over 25,000 copies in Britain by the mid-1880s, also signalled the growing internationalism of the periodical press during the last decades of the century.

The most significant changes and innovations, however, took place at the cheaper end of the periodical market. The popular marketplace in the 1870s and 1880s was dominated by penny weeklies such as Tit-Bits (f. 1881) and sixpenny monthlies like the illustrated Cassell's Family Magazine (f. 1874) and the religious Good Words (f. 1860). The market leaders in the 1870s were populist and aggressively imperialist monthly miscellanies like the Strand Magazine (f. 1891) and Pearson's Magazine (f. 1896) which, priced at 6d, sold over 250,000 copies each. These titles were also joined by a number of periodicals, such as the New Review (f. 1889) and the Review of Reviews (f. 1890), which espoused a new and distinctive style of journalism that was more vivid and self-consciously demotic. Organ of this so-called 'New Journalism', as is discussed at length in chapter 7, engaged in crusades against the vested interests of the political and intellectual establishment as well as pioneering new formats such as 'talking' headlines. These populist crusades and novel forms of presentation
Science in the Nineteenth-Century Periodical

were an attempt to make journalism less estranged from the lives of its ordinary readers, and to transform periodicals into fully inclusive public forums.

The rise of the new journalism also coincided with significant changes in the organization of the sciences as well as the ways in which they were presented. It has become a historical commonplace that during the 1870s and 1880s the practice of science became increasingly specialized and detached from the general culture. With the establishment of modern laboratories and salaried positions, as well as the further development of specialist scientific societies and journals, professional men of science became ever more isolated from the wider public. As we have seen, Young sees this as the fragmentation of his ‘common context’, and attributes it, at least partially, to the growth of general periodicals of a markedly lower intellectual standard in which the reporting of science was left to ‘pretentious hacks and... more or less competent amateurs’. Similarly, Peter Broks suggests that mass-circulation family journals of the last decades of the century restricted the possibilities for public participation in science, and instead represented science ‘as a commodity, a product not a process, to be consumed not participated in’. Even the presentation of science in the popular print media, he argues, ‘reinforced the idea of a great gulf between the scientist and the public’. The relationship between science and the popular print media, however, was considerably more complex and less one-sided in this period than Young and Broks have allowed.

This becomes especially evident when stylistic differences between the so-called ‘New’ and ‘Old’ journalism are taken into consideration. Rather than simply maintaining ‘lower intellectual standards’ than earlier periodicals, organs of the ‘New Journalism’ presented a wide range of scientific material to new audiences in radically different ways. These new journalistic methods of presenting science, including encouraging plebeian readers to submit details of their own experiments on a variety of subjects, often explicitly challenged the authority relations that men of science had been able to establish in the press earlier in the century. Additionally, innovative formats such as the celebrity interview (which had been imported from North America) could be used to generate an unprecedented sense of intimacy, cleverly mediated by increasingly powerful editors and proprietors, between the mass audience of the journals and producers of expert knowledge. The treatment of science in the popular print media could be considerably more dynamic and less elitist in this period than Young and Broks suggest. Indeed, the boundaries between what might be considered ‘elite’ and ‘popular’ understandings of science became increasingly blurred in the self-consciously democratic pages of the periodicals that came to prominence during the final decades of the nineteenth century.

The repeated shifts in the forms and audiences of nineteenth-century periodicals rule out any progressive history from a ‘common intellectual context’ to its fragmentation. The proliferation of socially and ideologically divided audiences and periodicals in the decades after the French Revolution, and the ‘invention’ of modern disciplinary science in the same period, were aspects of the transformation of the eighteenth-century bourgeois public sphere which radically altered the position of science in the general periodical literature. Yet the development of new kinds of writing about science served to reintegrate it in the new kinds of general periodical that were developed. Indeed, this seems to have occurred to an ever-greater extent as the cultural prominence and prestige of science increased over the course of the century. Such writings ranged from what Richard Yeo calls the ‘metascientific’ essays of gentlemanly scientists like Whewell and the humanistic assessments of men of letters like Carlyle in the early-century quarters, through the highbrow popularization of aspiring professionals like Huxley and scientifically inclined writers like Lewes in the mid-century literary magazines and reviews, to the campaigning journalism of Stead in the late-century populist weeklies and monthlies. The chapters in the first part of this book begin to sketch out in more detail some of the phases of these developments.

COMMUNICATING SCIENCE: RETHINKING THE ROLE OF THE PERIODICAL

The insight that periodicals represent some of the most significant material and cultural forms through which the sciences were communicated and debated in nineteenth-century Britain has far-ranging consequences for students of the period, and the accompanying historiographical issues require further consideration. Notwithstanding recent developments in periodical studies, historians of science still often use periodicals as relatively transparent records of the opinions either of the authors of individual articles or of particular publics, rather than considering periodicals as objects in themselves. On the other hand, periodical historians have tended not to pay particular attention to science, and when they have, they have usually focused on the self-consciously scientific articles rather than on the inter-penetration of scientific and other forms of discourse or on the fluctuating
and disputed boundaries of what is considered to be scientific. This book attempts to combine the best of these two approaches, showing that the characteristics that distinguish periodicals from other nineteenth-century media have a significant bearing on the history of science. In the remainder of this introduction we outline some of the most important characteristics of periodicals in this regard, considering the significance of how they were used and produced, their importance as sites of controversy and interchange, and their signal role in processes of literary replication.

Audiences

One of our central concerns in this book is with the issue of audience. As we have seen above, periodicals fulfilled a pivotal role in the nineteenth-century literary marketplace, allowing publishers, editors, and writers to attempt to shape the interpretative frameworks and self-awareness of readers in order to carve out new audiences, all the while adjusting their approach in response to the rapid and detailed feedback periodicals invited. As a result, they are, in Jon Klnacher's phrase, 'probably the clearest framework for distinguishing the emerging publics of the nineteenth century'. Such an insight brings a new perspective to the history of science in popular culture. A recurrent problem in the field has been the dominance of those approaches which prioritize the activities of science popularizers (often implicitly invoking the notion of 'diffusion') or which presuppose the relative autonomy of science in popular culture. Periodicals can be used to develop an alternative to these approaches: a dynamic history which brings into focus the interaction of readers and writers. Not only do periodicals embody debate, but they provide evidence of how individuals encountered and engaged such debate in relation to collective formations like class, gender, or ideology. Using periodicals like the Wesleyan-Methodist Magazine (chapter 3) and the Boy's Own Paper (chapter 6) to explore the reading audiences in relation to which individuals conceived of themselves, allows the historian to integrate the merely anecdotal records of encounters with science found in autobiographies, diaries, correspondence, and marginalia, into a wider account.

In his Making of English Reading Audiences, Jon Klnacher draws on the work of Mikhail Bakhtin to argue that the mutual creation of audiences is embodied in the dialogic form of periodical writing: it is in the representation of other social languages, he argues, that readers become aware of themselves as members of particular audiences. Such semiotic analysis must also be supplemented by historical evidence about the strategies employed in periodicals to consolidate groups of consumers as self-conscious

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audiences and the manner in which periodicals were distributed and used.

As chapter 3 shows, with respect to the Wesleyan-Methodist Magazine, some periodicals were managed by, and largely encountered through, heavily centralized authority structures - so much so that the book advertisements on the magazine's wrappers had to be scrutinized by a sub-committee. Of course, even here individual readers were by no means ineluctably bound by attempts at audience-creation. Yet, the recognition that, even in less extreme cases, periodicals bear linguistic and historical traces of such attempts allows the historian to begin to grapple with the fluid notions of audience with which historical readers themselves were confronted.

Producers

Given the importance of periodicals as sites for communicating and debating science, it is striking that the interests and activities of the publishers, editors, and journalists responsible for producing them have remained largely unexplored with reference to science. More than a quarter of a century has passed since Steven Shapin and Arnold Thackray argued that, instead of merely relying on the received historical canon, scholars should 'find out who published science, then assess the intellectual and cultural significance of their association with the enterprise of natural knowledge'. It is only recently, however, that historians have begun to address this issue more systematically. One of the gains engendered by a renewed focus on periodicals is that it brings into view a wide range of people involved in producing scientific literature whose sometimes very considerable historical significance has been overlooked.

The vast majority of nineteenth-century periodicals were commodities: their form and content were critically shaped by the demands of the book trade in which they were manufactured, marketed, and distributed. As several of the chapters in this book demonstrate, publishers who developed new genres of periodical were responsible for changing the representation of science. Publishing entrepreneurs like John Limbird of the Mirror of Literature frequently used innovative periodicals to establish themselves in previously unexploited niche markets. As chapter 2 shows, the result of Limbird's entrepreneurship was a new genre - the cheap weekly miscellany - which conveyed scientific writing in distinctive ways to a new mass market. Even established publishers, like George Smith of the Cornhill Magazine, were prepared to invest huge sums in periodicals, not only because of the regular and reliable income they could generate, but also because of their value both in marketing other publications and in cultivating a coterie of authors. As a result, as chapter 5 reveals, Lewes had to sell scientific articles
to Smith as part of a blend which would ‘be felt as a reason for buying the Magazine’, while Smith was uneasy about the potential commercial consequences of even a cautious endorsement of Darwinism in the magazine.70

While publishers exercised significant control over the representation of the sciences in periodicals, the power of the nineteenth-century editor could also be considerable. The transformation of the editor from a mere ‘bookseller’s drudge’ into a ‘distinguished functionary’ took place early in the century with Francis Jeffrey’s trail-blazing editorship of the Edinburgh Review (1803–29), and, as we have seen, the journal’s distinctive approach to the sciences rested on the predilections of Jeffrey and his editorial coterie.71 By the 1880s, Stead, the campaigning editor of the Pall Mall Gazette, proclaimed the coming of a new era of ‘Government by Journalism’ in which the editor’s mandate would be ‘renewed day by day’, while ‘his electors register[ed] their vote by voluntary payment of the daily pence’.72 In the burgeoning ‘New Journalism’ of the 1890s, editors like Stead (then at the helm of the Review of Reviews) emerged as demagogues of the era of mass democracy, appealing directly to readers — who were encouraged to send in details of their experiences with ghostly apparitions and to purchase the wares of homeopathic doctors — above the heads of even scientific contributors, such as Grant Allen, who wrote for the journal. Many journals upheld well-defined editorial positions, often (at least until the 1870s) with unsigned essays presenting the façade of a single authorial ‘we’. The management of such a corporate voice was no trivial feat. As chapter 4 makes clear, the fictional ‘Mr Punch’ who was notionally responsible for the contents of his journal was constantly renegotiated in weekly meetings in the Punch offices. Even where periodicals relied on signed contributions, editorial control was often draconian, particularly in cases like the Wesleyan-Methodist Magazine (chapter 3), where the journal was taken to speak for a well-defined ideological faction.

Under the system of anonymous publication, of course, it was often impossible for the majority of readers to ascertain what specific form of authority lay behind a scientific article. Written interventions by men of science in the leading reviews and magazines nevertheless helped establish their reputations among the cultural elite and were often financially indispensable in a pre-professional age. Later in the century, signed journalism enabled scientists like Huxley not only to state the claims of the nascent professional community, but also to establish their own reputations as scientific celebrities. Throughout this history, however, the lines of demarcation between men of science, men of letters, and scientific popularizers were far from clear, and were constantly being renegotiated. As discussed in chapter 8, writers like Lewes and James Sully struggled to establish their higher scientific ambitions while financing themselves by popular scientific journalism, and the two objectives often merged. Of course, the growth and diversification of periodical forms involved a similar expansion in journalism, and there is a large body of writers, many of them drawn from the medical professions, whose contributions to making nineteenth-century science remain unconsidered. Ranging from the religiously inspired writers of the Wesleyan-Methodist Magazine and the Boy’s Own Paper, through the hack writers of such pot-boilers as the Mirror of Literature, to the Bohemian contributors of Punch, such writers, and the forms of journalism they developed, clearly shaped the encounters with science of nineteenth-century periodical readers.

Controversy

Scholars have long recognized the historical value of studying controversies in the sciences. Less familiar, however, is the extent to which scientific controversies of the nineteenth century were conducted in, or extended to, semi-popular scientific journals and generalist periodicals. Indeed, as chapter 8 demonstrates in relation to the creation of ‘baby science’, such debates contributed significantly to the making of natural knowledge. This view runs counter to the prevalent distinction between what Harry Collins and Trevor Pinch call the ‘constitutive’ forum for scientific debate (the specialist periodicals, formal conferences, and other settings where actions are believed to be based on ‘universalisable non-contingent premises’) and the ‘contingent’ forum (namely the popular journals, after-dinner speeches, private gossip, and other settings where actions are not supposed to affect scientific knowledge). Yet even in the late-twentieth-century debate about parapsychology, Collins and Pinch could find no epistemological distinction between discussions in these two forums, and it is clear that in the nineteenth century such distinctions were even less easily made.73

There is now a growing literature demonstrating the insights into scientific controversies that can be gained by exploring the rich and relatively unexploited material in specialist and non-specialist periodicals.74 In particular, James Secord’s analyses of the tumultuous reception accorded Andrew Crosse’s electrical production of insects and of the sensation caused by the Vestiges of the Natural History of Creation (1844) demonstrate the considerable power of nineteenth-century mass-circulation newspapers and magazines to dictate the terms of scientific controversies.75 He shows that with the rapid rise of steam technologies and expansion of reading audiences,
tensions developed between the local cultures within which experimental claims were produced and the public arena where the meaning of such claims was transformed. What began as a claim in a private laboratory was dramatized and 'replicated,' with a range of literary and graphical techniques, into a fact or chimera, a discovery or non-discovery, in periodicals. Journalists, editors, publishers, and others involved in periodical production had the power to control the meaning of an experiment, and to force scientific practitioners to join the fray—whether by redirecting their laboratory projects or by writing to daily newspapers—and to promulgate their own views on what was fact and what was fancy.

Common contexts

The generic mélange of the periodical particularly lent itself to the interpenetration of language and ideas that scholars have, in recent decades, found to characterize literary and scientific writing in the nineteenth century. One of the abiding insights of Robert Young's 'common context' thesis is that the verbal and conceptual interconnectedness of the sciences, politics, theology, and literature were both sustained and revealed by their juxtaposition in periodical articles. However, since articles on the sciences are still habitually read in isolation from the larger periodical text which surrounds them, these connections are often missed. For instance, the insight that the language of materialism passed from attacks on scientific naturalists like Huxley and Tyndall to criticism of aesthetic poets such as Algernon Charles Swinburne and Dante Gabriel Rossetti has been obscured by a compartmentalized historiography. This linguistic slippage, though, becomes readily apparent when one examines the periodical press, where the same reviewers commonly wrote notices of both scientific and poetic publications, often identifying almost identical transgressions in both. Observing the conjunction of these subtly different usages reveals a wider play of connotations than would otherwise be apparent.

Reading across an entire periodical text has the effect of highlighting developing patterns of discourse which are not immediately apparent in an isolated text. The *Cornhill Magazine*, for instance, has generally been regarded as making little attempt to engage with Darwin's evolutionary theorizing. Yet, as is discussed in chapter 5, the language and concepts of Darwinism were far more prevalent in the magazine than might appear from reading any single article. In particular, the Darwinian language of struggle and competition soon featured in articles on the nutrition of the poor and on nutritional physiology, and even in the fiction of Anthony Trollope, while the affinity between humans and other primates was explored—often in a racially charged context—in Thackeray's fiction. Such appropriations were, of course, mutual. Lewes, for instance, developed a distinctively familiar language in which to relate the subjects of his scientific articles in the *Cornhill* to quotidian concerns. Thus his 'Studies in Animal Life' passed from the sexual dimorphism in Entomosoma to a discussion of the inferiority of the male sex in some great biological families, 'confessing' to the presumptively male reader 'that our sex cuts but a poor figure' and adding, 'this digression is becoming humiliating'. Elsewhere, it was 'the music of our deeply meditative' Tennyson which, for Lewes, elucidated digestive assimilation and the law of organic development. The stylistic demands of scientific journalism also had consequences for the manner in which scientific fields developed. As chapter 8 demonstrates, Lewes's familiarizing use of the term 'baby' in the title of his pioneering *Cornhill* article on 'The Mental Condition of Babies' (1863) raised questions both about his own ambiguous status as a scientist, and about his claim for scientific status for the study of infant development.

The value for the history of science of taking seriously the original periodical context in which writings first appeared is amply illustrated when the re-examination of familiar works in this way reveals hitherto unsuspected conceptual and linguistic linkages with the sciences. The serial appearance of George Eliot's *Romola* in the *Cornhill* in 1862–3 is a case in point. The collaborative writing practices of Eliot and Lewes are well known, and Lewes's periodical essays have often been juxtaposed with Eliot's fiction. By reading *Romola* in its original context, however, it becomes clear that the highly intelligent heroine of the novel was presented to contemporaries in association with a discussion of recent scientific evidence concerning the relative size of male and female brains in Lewes and John Herschel's 'Notes on Science' column for February 1865. The dialogue between Eliot's novel, with its study of female intellectual aspiration, and Lewes and Herschel's article, with its refusal to accept brain size as unambiguous evidence of female intellectual inferiority, becomes clear once the distinctive qualities of the original publication format are considered.

In many cases, of course, it is not clear to what extent the interplay between the elements of a periodical were intended to be deliberate. From a reader's perspective, however, this was not necessarily particularly relevant. The appearance of *Punch's* continual attacks on medical quackery (discussed in chapter 4) across the page from the advertisements for patent medicines which appeared weekly on the magazine's cover (see fig. 4.4), was eloquent, whether premeditated or not. In many cases, however, the interplay was
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quite obviously intentional. As editor of Household Words, for instance, Charles Dickens juxtaposed the death and regeneration motif of novels such as Bleak House with articles on the chemistry of decay and recomposition and the conservation of energy. Less-well-known editors also had a vested interest in relating different elements of the periodical. As chapter 2 shows, the death of 'Chuny', the famous menagerie elephant, prompted a spate of articles in the cheap weekly miscellany, the Mirror of Literature, which sought to capitalize in diverse ways on the topicality of the subject. Similarly, as discussed in chapter 10, Stead intermingled scientific romance and more sober futuristic writing on electricity as part of his socialist utopianism in the pages of the Review of Reviews.

 Literary replication

The peculiar combination of multiple texts within the covers of the periodical is given an additional twist by the frequent appearance in periodicals of extracts, abstracts, and other representations of texts first published elsewhere. These processes of literary replication constituted significant interventions in the literary marketplace. As chapter 9 urges, for instance, leading scientific biographies of the nineteenth century were primarily known through the extracts and reviews published in the periodical press. Such reviews often read very differently from the biographies on which they were based, as when the Victoria Magazine used Henry Bence Jones's Life and Letters of Faraday to urge the cause of women's scientific education. As James Secord has recently argued, the processes of extracting, abstracting, and reviewing undergone by such key works of nineteenth-century science as Vestiges of the Natural History of Creation contributed significantly to shaping their meaning for readers. Such processes could be extremely complex. Readers of the two-penny Mirror of Literature, for example, were in 1830 treated to extracts, not from Charles Lyell's expensive Principles of Geology itself, but from George Poulett Scrope's supportive review of the first volume. Moreover, since Scrope's review had been published in the six-shilling Quarterly Review, few readers of the Mirror are likely to have been able (as advised by the Mirror) 'to turn to the Review, read it, and judge' for themselves. To such readers, the Mirror stood in place of both Lyell's and Scrope's original texts. In these circumstances, the potential for the transformation of meaning was considerable—an insight not lost on contemporaries. When, for instance, Stead approached Huxley to support his new abstracting journal, the Review of Reviews, Huxley was cautious,
counselling that 'passages without context often give a very wrong impression of the writer's meaning.' Moreover, Huxley's fears were well placed, and, as chapter 7 demonstrates, he soon found that Stead's practice of abstracting could transform the meaning of his own writings in a number of significant ways, ranging from deliberate partiality to unintended blunders.

A comparative approach to studying the use of extracts, abstracts, and reviews in a range of periodicals reveals how different kinds of writing about science were developed for diverse audiences. Thus, while Scrope's Quarterly review of Lyell's Principles was an authoritative and sober assessment, the extracts from the review in the Mirror of Literature emphasized merely the wonder of natural phenomena, seizing on, as the editor had it, only 'a few points interesting to the general reader.' Elsewhere in the Mirror, material that was intended to be narrative colour in articles published in the fashionable monthlies became, in extracted form, the substantive content of shorter articles. More generally, the appearance of particular genres of scientific writing across the full range of periodical types, allows the historian to consider how the use of such genres varied on the grounds of class, age, gender, or religion. Chapter 9 explores some of these issues in relation to the genre of scientific biography, showing how obituaries, reviews, biographical sketches, and passing references were put to work to serve an assortment of moral, ideological, and educational purposes in different periodical contexts. Moreover, the development of new genres of scientific writing sometimes took place as a form of dialogue between different kinds of books and periodicals. Thus chapter 10 shows how the emergence of electrical futurist writing in a British context depended heavily on W. T. Stead's borrowings from American books and journalism, but also on the responses of existing periodicals like the Nineteenth Century and Fortnightly Review to Stead's innovations in the Review of Reviews.

The rich intertextual field afforded by nineteenth-century periodicals offers historians and literary scholars a varied and plentiful harvest. Far more than mere records of opinion, periodicals provide some of the most important sources of evidence about the ways in which the sciences came to be such a potent aspect of modern culture. They constitute one of the best means of exploring the shifting audiences for science, and of examining the agency of assorted writers, illustrators, and publishers in manipulating those audiences. They also reveal how scientific controversy was conducted and controlled across specialist and non-specialist forums, and how the sciences and other forms of discourse were continually interlinked. The
incentives for combining the study of nineteenth-century periodicals and the history of science in the period are thus manifold. However, the field is still in its infancy. Large phases of periodical history in relation to science remain uncharted, and many historiographical themes remain to be explored. The chapters in this book begin the process of sketching out the terrain, but it is to be hoped that they might inspire a future generation of scholarship in this area.