

MARINA FRASCA-SPADA AND NICK JARDINE

## Introduction: books and the sciences

Now, happier lot! enlighten'd realms possess  
 The learned labours of the immortal Press;  
 Nursed on whose lap the births of science thrive,  
 And rising Arts the wrecks of Time survive.  
 (Erasmus Darwin)<sup>1</sup>

From classical times great books have stood as landmarks and book lists served as charts of the growth of the arts and sciences. In the earlier twentieth century they played major roles in consolidating the history of science as a discipline. Paul Tannery, George Sarton, Lynn Thorndike and other positivist historians, many of them passionate book-collectors, presented synthetic bibliography ('selective, critical and constructive', as opposed to merely descriptive and analytical, according to Sarton)<sup>2</sup> as the foundation for science history. After the Second World War Alexandre Koyré and his emulators concentrated more on the ideas at work in great books than on accumulating bibliographical detail. University teaching of the history of science should, they insisted, be centred on the critical reading of canonical texts, especially those emanating from the 'Scientific Revolution', itself a twentieth-century historiographical construction. Herbert Butterfield's account of the importance of 1543 nicely conveys the bookish flavour of this didactic history of science:

The year 1543, which saw the publication of Copernicus's great work and of the important translation of Archimedes, is a date of considerable significance in the scientific revolution, because it saw also the publication of the *magnum opus* of Vesalius, namely the *De Fabrica*, the work which stands as the foundation of modern anatomy.<sup>3</sup>

In recent years the disciplines of history of science and history of the book have been greatly expanded and transformed. Where a couple of decades ago these fields were still relatively specialised and isolated, they are now more generously conceived, and more closely integrated with general, social and cultural history. Where once historians of science were at pains to distinguish the activities and products of science itself from its social contexts and uses, nowadays they emphasise rather that scientific activities are (by and

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large) social activities, and they foreground the interplay of the sciences with other disciplines. Likewise, where history of the book once focused primarily on publication and bibliography, paying relatively little attention to the contents or uses of books, today it is widely accepted that we should study texts and their interpretations hand in hand with books and their uses.

There are further notable parallels between history of science and history of the book. Both fields have moved away from models of diffusion or dissemination of information from active producers to passive consumers. In the history of the book the history of reading has become a lively sub-field. Here books no longer figure as mere vehicles or packaging of texts; rather their material constitution – *mise-en-livre* – and the layout and typography – *mise-en-page* – are recognised as crucial in recruiting readers and conditioning the ways in which they read. Readers emerge as active recipients, variously constituting meanings as they appropriate works. Historians of science, similarly, emphasise readers' active roles in communications among experts, between teachers and pupils, and between elites and popular constituencies. Both fields have shifted their focus from canonical authors and their elite reception to the full range of writings and readerships. Moreover, in both fields the exemplary status of authors and works has come to be recognised not as a given, but as the historical product of often protracted canonisation through the efforts of followers, reviewers and commentators, not to mention the would-be classic authors themselves. Finally, both historians of science and historians of the book have become increasingly alert to the dangers of anachronism – of unreflectively imposing our categories on to past activities, of focusing on precursors to currently valued practices and doctrines. A measure of such imposition is inevitable for purposes of analysis, explanation and communication with present-day readers; but few nowadays can write with an altogether clear conscience about Renaissance 'scientific research' or licensing as a 'precursor' of copyright.

The present volume deals with the interactions between these flourishing fields. To set the stage let us glance at some of the ways in which the history of the sciences and the history of the book can complement and reinforce one another.

Writing in 1606, Johannes Kepler attributed the proliferation of printed books to the effects of planetary conjunctions on that human faculty which makes men social by nature, so that 'the minds of many men may come together in an undertaking'; and he memorably celebrated the effects of the flood of books:

Through them there has today been created a new theology and a new jurisprudence; the Paracelsians have created medicine anew and the

Copernicans have created astronomy anew. I really believe that at last the world is alive, indeed seething, and the stimuli of these remarkable conjunctions did not act in vain.<sup>4</sup>

Two centuries later, in the verses quoted above, Erasmus Darwin hailed the press as nursemaid of the arts and sciences. Similarly, in her seminal, if widely criticised, *The Printing Press as an Agent of Change* (1979) Elizabeth Eisenstein argued that Butterfield's paradigmatic achievements of the Scientific Revolution, the Copernican system and Vesalian anatomy, were made possible by the multiplication, standardisation and fixity of printed books.<sup>5</sup> And books figure as 'immutable mobiles' in Bruno Latour's account of the ways in which 'centres of calculation' – museums, academies, observatories, laboratories – recruit, delegate and control peripheral agents.<sup>6</sup>

The history of such grand pronouncements about the impact of print on the sciences would make an interesting study in its own right; but today few are happy with such claims. In their chapters in this volume, McKitterick notes that the replication of medieval texts was by no means as unreliable and erratic as Eisenstein implies, and Kassell emphasises how manuscripts continued to play major roles in the sciences far into the early modern period; by contrast, the stabilisation of printed texts was a long and painful business, far from completed even by the end of the sixteenth century. In any case, the impacts of the press on learning have not always been unambiguously beneficial – as Erasmus Darwin observed in a footnote to the verses heading this introduction, it has fostered 'new impositions' along with 'the arts of detecting them'. And print has been no less apt to aid and abet what later generations have deemed to be fads and crazes deleterious to the sciences – Lavaterian physiognomy and quinarian taxonomy, for example – than to encourage the sound sobrieties of Newtonian mechanics or analytical geometry. Nor, as Brotton here urges in the case of sixteenth-century Ottomans, should we uncritically take their failure to adopt the press as a sign of backwardness or decadence.

But there are more fundamental problems. The quest for generalisations about books and science is surely doomed by the fact that there was no such discipline as science, in our sense, in the early modern period. Natural history, astrology, alchemy, natural philosophy, physiology and mixed mathematics, to name just a few well represented in this volume, did not, even approximately, form a natural kind. Furthermore, the whole image of manuscript, print and electronic communication as media which variously facilitate or hinder the growth of knowledge is misleading. More profitable, as the chapters of this volume amply reveal, are approaches which attend minutely to the roles of authorship, production, distribution

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and reception of works within particular sciences in particular periods. What is remarkable is the sheer specificity of many of these roles: take, for example, the operations of reading ambivalent and esoteric texts (on occasion in relation to visionary dreams) in an alchemical adept's initiation, as tellingly described by Kassell and Johns; or the ways in which eighteenth-century encyclopaedias used cross-referencing to convey the systematic linkages between sciences, as spelt out by Yeo. Equally noteworthy are the transformations in the roles of books over time. Thus there have been major shifts in the location of authority and credibility in the sciences: from stationers and booksellers to authors and publishers (Johns' afterword), from commentaries to encyclopaedias (Yeo), from books to articles in journals (Broman), and so on. Another striking case is the metamorphosis of the library catalogue from the Baroque to the Romantic era wittily exhibited by Clark.

For all this diversity the chapters of this book do bring to light some general functions of books across wide ranges of sciences, places and periods. Let us briefly consider some of them. Genre links book history to central concerns of the history of the sciences. Particular sciences are in a given period often associated with, indeed partly constituted by, particular genres of writing – as demonstrated, for example, in Grafton's account of geniture collections and in Mosley's discussion of letter-books. Such genres, often embodied in characteristic material types of books (from formal commentaries in massive folios, to students' textbooks in pocketable duodecimos) constitute the 'systems of expectations' or 'implicit covenants' that link authors with readers. For genre provides at once norms of composition and guidelines for reading; and it is above all through genre that writers and readers take their places in traditions of writing and reading.<sup>7</sup> A grasp of the relevant genres is thus essential for the historian out to understand the works of past sciences, and to appreciate the ways in which those works were addressed to and appropriated by readers.

As brought out by many contributors (McKitterick, De Renzi, Yeo, Fyfe, Roldán Vera), studying genres all too often dismissed as derivative or secondary, such as commentaries, anthologies, editions, textbooks, popularisations and translations, is crucial to understanding the ways in which knowledge and the sciences have been handed on from generation to generation and from place to place. Frasca-Spada and L. A. Jardine and Stewart indicate how the humble work of editors may be of paramount importance in normalising doctrines and creating paradigms, and in establishing authors as canonical. And, as Topham shows, the attempt to found a whole new disciplinary school may be centred on writing and publishing a single textbook. Moreover, as N. Jardine argues, the maintenance of discipline in many of the sciences is heavily dependent

on the handbooks, manuals and protocols through which their practices are standardised, calibrated and replicated.

Another active area of book history is the study of the organisation and layout of books, and in particular of ‘paratexts’ – tables of contents, postillae, footnotes, indices, illustrations, etc. – and of the varied ways in which they guide readers through texts and condition their responses to them.<sup>8</sup> Paratexts have been centrally involved in many of the practices of the sciences. Thus, as Blair and Frasca-Spada show, indices, glosses and footnotes have been crucial in the teaching of natural philosophy, rendering material accessible to students and intimating to them connections between the sciences. And, as Kusakawa, De Renzi and Spary demonstrate, study of the illustration of natural historical books yields substantial insights into the varied conventions linking natural objects with their visual and textual representations, and these, in turn, with the readers to whose tastes they appeal.

It is not only through its useful findings, but also by its historiographical example that book history is inspiring to historians of the sciences. The works of Henri-Jean Martin, Don McKenzie, Robert Darnton, Roger Chartier, Martha Woodmansee, Carla Hesse and Mark Rose, to mention but a handful of distinguished practitioners, offer models that historians of the sciences may profitably emulate. Thence we may draw on writings exemplary in their integration of history of texts with history of books, and of history of ideas with history of material culture (McKenzie, Chartier), in their appreciation of the inextricability of legal and political realities from their representations and ideologies (Hesse, Woodmansee, Rose), in their balancing of respect for actors’ categories with use of robust analytic and explanatory categories (McKenzie), and in their narrative ingenuity in conveying past lived experience (Martin, Darnton).

What does the history of science offer in return? To start with, there are many topics central to the history of the book for which the history of the sciences may provide important methodological insights and materials. Two of these, the credibility of books and literary genre, we have already touched on. Practitioners of the sciences have in all periods been much committed to establishing the credentials of their own works and, on occasion, discrediting those of others; and they have long engaged in debates about the proper grounds for acceptance or rejection of testimony. Thus the processes by which credibility was assessed and secured have a high degree of historical visibility. De Renzi, in exploring the relations between types of testimony in natural history – eye-witness accounts *vs.* hearsay, described *vs.* depicted, oral *vs.* written *vs.* printed testimony – contributes to the vigorous current debate about the ways in which the credibility of reports of natural phenomena has been

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established and adjudicated. The flourishing state of the history of genres and persuasive strategies in the sciences is attested by the contributions of Grafton, Yeo, Broman, Topham and Secord. Here again the advantage to the book historian is visibility. Sometimes exponents of the sciences have been content to adopt and adapt their genres from other fields; but on many occasions they have run neck and neck with the most avant-garde of literary authors in creating new genres: works composed *more geometrico*, new types of encyclopaedias, textbooks, journals, etc. Where with established genres and their adaptations the conventions and modifications are rarely explicitly articulated (and then often in highly simplified and misleading didactic forms) the conventions of new and controversial genres of the sciences are often explicitly articulated, contested and defended.

In a widely cited article of 1982, Darnton introduced the notion of the ‘communications circuit’, which:

runs from the author to the publisher (if the bookseller does not assume that role), the printer, the shipper, the bookseller, and the reader. The reader completes the circuit because he influences the author both before and after the act of composition. Authors are readers themselves. By reading and associating with other readers and writers, they form notions of genre and style and a general sense of the literary enterprise, which affects their texts, whether they are composing Shakespearean sonnets or directions for assembling radio kits. A writer may respond in his writing to criticisms of his previous work or anticipate reactions that his text will elicit. He addresses implicit readers and hears from explicit reviewers. So the circuit runs full cycle.<sup>9</sup>

The publications of the sciences provide an ideal field for exploring the most problematic parts of the communications circuit, those relating to the reading and appropriation of books and, most difficult of all, the feedbacks from readers to authors. As Secord has noted elsewhere, for certain types of scientific books the responses of readers are peculiarly traceable:

for the handful of scientific books that became sensations have left more identifiable traces than comparable works of fiction, history, and poetry; references to fossil footprints and nebular fire-mists have a specificity that makes their source relatively obvious. Because of this, a widely-read scientific work is a good ‘cultural tracer’: it can be followed in a greater variety of circumstances than almost any other kind of book.<sup>10</sup>

Moreover, as Grafton, Blair, Kassell, Frasca-Spada, Terrall, Fyfe and Roldán Vera show, there is a series of practices relating to the uses and receptions of books – citation, footnoting, ‘mnemotechnics’, conversation about books – for which the sciences provide a wealth of wonderfully apposite material. As for the obscure processes by which readers’ responses and authors’ expectations of

such responses interact, they are often relatively explicit in the case of scientific works: for in the sciences there have arisen elaborately formalised, and hence researchable, conventions for scrutinising, refereeing and reviewing.

The history of the sciences can also make a major contribution to the history of the book by exploring the ways in which the ‘bookish practices’ (to use Blair’s phrase) that make up the communications circuit are linked to more general cycles of production and consumption. In the sciences there is indeed an extraordinary variety and richness in the relations of books to other objects. Often, as Mosley indicates, the production, use and privileging of astronomical instruments, models and manuals proceeded hand in hand. Books may act as substitutes for objects, and vice versa: for example, the illustrated natural history book being a virtual collection, the collection being organised in imitation of a book. Or the object and the book may be one and the same, as with Linnaeus’ ‘*Plantae Laponicae*’, a herbarium bound as a book and donated with Benjamin Delesserts’ library to the Institut de France.<sup>11</sup> As theorists of interpretation have long insisted, readers are trapped in the hermeneutic circle: needing to grasp the genre and purpose of a work as a whole in order to get to grips with its parts, and vice versa; conditioned as critics in their reading habits by the very traditions of interpretation they are out to criticise. The interactions of books with objects are sometimes of little help in this predicament, piling mystery on mystery, as with the hieroglyphic alchemical books and invisible substances explored by Kassel. But typically they are god-sends. Thus instruments are hermeneutic keys to their manuals, the manuals in turn keys to the interpretation of the instruments and their uses; and as in the cases of Linnaeus’ published *Flora Laponica* and its accompanying ‘*Plantae Laponicae*’ and Adanson’s collection of shells and his book on shells (described by Spary) collections may be keys to the reading of books and books to the understanding of collections.

Some areas of the history of the sciences are integral parts of the history of the book. Thus, as Johns shows, the physical and psychological effects of reading and its place in a healthy regimen formed a substantial chapter in the history of physiology. The history of property rights over instruments and discoveries in the sciences is another such field, for, as indicated by Mosley and Johns, the rights of makers over their instruments and of natural philosophers over their discoveries have served as touchstones in the long battle to secure literary property rights for authors. Finally, there is the major branch of the history of technology concerned with the production of books that forms the very foundation of book history. The present work does not venture into the history of technology; however, the contributions of McKitterick, Secord and others are

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variously indicative of the appropriations of technologies of book production in the transmission of the sciences.

The present volume is intended as introductory, as a work of first resort for all those interested in the history of the sciences in relation to the history of the book. To make their work accessible, contributors have kept footnotes to a minimum and provided ‘further reading’ lists on their topics. In planning the volume, the editors have aimed to do full justice to the richness and specificity of the interactions between the history of the sciences and history of the book, whilst providing a reasonably comprehensive coverage of this interdisciplinary terrain. Accordingly each section of the volume combines chapters of relatively broad scope with chapters tackling specific works and episodes in depth.

Periodisation is a tricky business. The narrative conventions and readers’ expectations of synthetic works like the present one demand it. But, at least in history of the sciences and history of the book, it is potentially misleading. It may be inaccurately suggestive of radical discontinuities: between labile manuscript and stable print, between a culture of patronage and privileges and one of commerce and competition, between the authority of books and that of specialist journals in the sciences. Further, it tends to obscure the diversity in the timescales of significant developments – consider the contrast highlighted by Johns in relation to reading between the long duration of traditional commonplaces about healthy daily regimen and the rapid turnover of physiological theories purporting to underpin and explain them.

The first section, ‘Triumphs of the book’, runs roughly from the Carolingian revival of learning to the end of the Baroque. Among the earlier triumphs which figure here are the preservation of classical learning and the installation of university teaching; later ones include the formation of new genres, new philosophies and new technologies, along with the protracted and uneven achievement for certain kinds of printed books of unprecedented levels of stability and authority. At the same time there are certain distinctive continuities, notably in the didactic realm: thus throughout the period book cataloguing, annotating, commenting, and the forming of commonplace books played major roles in the practice and maintenance of the sciences.

The second section, ‘Learned and conversable reading’, covers a ‘long eighteenth century’, roughly 1688 to 1815. It looks at the changes and continuities in the uses of books at the traditional learned sites, that is, cabinets, libraries and universities. It is widely claimed, following Jürgen Habermas, that this period saw the emergence of a ‘public sphere’ associated with the formation of a bourgeois society and the commercialisation of the book market.<sup>12</sup> Aspects of Habermas’ thesis, notably an idealistic characterisation



of a public sphere of rational and disinterested discussion, and failure to do justice to earlier and later domains of public debate, have been criticised;<sup>13</sup> however, as our contributors demonstrate, there were formed in this period important new sites of debate of the sciences, from academies and journals to salons, coffee-houses and public displays.

The third section, 'Publication in the age of science', covers the first half of the nineteenth century, when science itself was formed as an alliance of disciplines. Innovations in production, distribution and consumption of books, themselves viewed at the time as prime examples of scientific progress, made possible the mass production of books. The contributors focus on the varied roles of books in the establishment of the new science in its educational, national and international settings.

The 1840s and '50s provide a natural end-point for the volume. In these decades the scale of production of books showed a remarkable increase;<sup>14</sup> by then science, vigorously promoted by mass-produced textbooks and treatises, was consolidated and institutionalised as an educational and cultural formation; and specialist journals were well on the way to taking over from treatises as the primary loci of scientific authority and vehicles of professional scientific innovation.

The Owl of Minerva flies at dusk. In the 1980s and 1990s both science and books became problematic. Where once science was widely perceived and promoted as an autonomous and disinterested master discipline united by a single methodology, historians, sociologists and philosophers now tend to argue for the irreducible multiplicity of the methods of the sciences, and for the inextricability of pure science from its technological and socio-political engagements. Books too are losing their privileges and integrity, and in this the sciences are at the cutting edge: in all their long-standing central roles in the sciences – in teaching, in research, in the delegation and control of agents, and in the establishment of public images – books are on the way out. With the waning of these functions, books, like science, are losing their obviousness. Many, the editors included, are becoming nostalgic for the handiness and heftiness of books; and many are coming to miss the reassuring authority of science. But for all of us as historians there is a brighter side. The problematisation of science and its media surely makes us alert to issues concerning the history of the book in relation to the sciences, or at least more alert than were historians in bygone days when science and its books were familiar fixtures. And we may hope that historical studies, including those we present here, will make us more critical and sensitive in reflecting on and coping with the anxieties and predicaments generated by the fragmentation of science and the electronic revolution.

## Notes

- 1 E. Darwin, *The Temple of Nature* (London, 1803), Canto IV, lines 269–72. Thanks to Elly Bell for drawing our attention to this passage.
- 2 G. Sarton, ‘Synthetic bibliography’, *Isis*, 3 (1921): 159–70.
- 3 H. Butterfield, *The Origins of Modern Science, 1300–1800* (London, 1949), p. 39.
- 4 J. Kepler, *De stella nova* (Prague, 1606), p. 188.
- 5 E. Eisenstein, *The Printing Press as an Agent of Change* (Cambridge, 1979). For a critique of Eisenstein’s claims see A. Grafton, ‘The importance of being printed’, *Journal of Interdisciplinary History*, 11 (1980): 265–86.
- 6 B. Latour, *Science in Action* (Milton Keynes, 1987), ch. 6.
- 7 On genres as shared systems of expectations, see E. Hirsch, *Validity in Interpretation* (New Haven, 1967), ch. 3; on genres as covenants, see D. Damrosch, *The Narrative Covenant: Transformation of Genre in the Formation of Biblical Literature* (San Francisco, 1987).
- 8 See especially G. Genette, *Paratexts: Thresholds of Interpretation* (1987), trans. J. E. Lewin (Cambridge, 1997).
- 9 R. Darnton, ‘What is the history of books?’ *Daedalus* (Summer 1982): 65–83; reprinted in *The Kiss of Lamourette. Reflections in Cultural History* (New York, 1990), pp. 107–35, at p. 111.
- 10 J. Secord, *Victorian Sensation* (Chicago, 2000), Introduction.
- 11 See W. T. Stearn, ‘Introduction’, in *Carl Linnaeus’ Species Plantarum. A Facsimile of the First Edition*, vol. I, pp. 1–176, at p. 115.
- 12 J. Habermas, *The Structural Transformation of the Public Sphere: An Inquiry into a Category of Bourgeois Society* [1962], trans. of 2nd edn. T. Burger (Cambridge, MA, 1989).
- 13 For telling comments see N. Fraser, ‘Rethinking the public sphere: a contribution to the critique of actually existing democracy’, in C. Calhoun (ed.), *Habermas and the Public Sphere* (Cambridge, MA, 1992), pp. 109–42; and J. Raymond, ‘The newspaper, public opinion, and the public sphere in the seventeenth century’, *Prose Studies*, 21 (1998): 109–40.
- 14 See S. Eliot, ‘Some trends in British book production, 1800–1919’, in J. O. Jordan and R. L. Patten, *Literature in the Marketplace: Nineteenth-Century British Publishing and Reading Practices* (Cambridge, 1995), pp. 19–43; R. Wittmann, *Geschichte des deutschen Buchhandels. Ein Überblick* (Munich, 1991); C. Bellanger, J. Godechot, P. Guiral and F. Trevrou (eds.), *Histoire générale de la presse française*, vol. II (Paris, 1969).