



## An Early Modernist's Perspective

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## *FOCUS: SCIENTIFIC READERS*

# An Early Modernist's Perspective

*By Ann Blair\**

### ABSTRACT

Historians of science can gain new insights into the material practices and intellectual trajectories of natural philosophers by attending to evidence of what they read and how. From the time of the early modern period we have sources not often extant for earlier periods, including manuscript reading notes, kept in separate notebooks or in the margins of books, and advice books on how to read. From this variety of sources we can piece together evidence (though generally not a complete picture) about the reading habits peculiar to individuals as well as those widely shared in a given cultural context, including ways of relying on the reading of others; by attending to traces of reading we can also learn more about the reception of particular scientific works. The history of reading broadens the range of questions the historian of science can pose to analyze a scientific work in its historical context.

**E**ARLY MODERN SCHOLARS were distinctly aware of reading as a physical activity. Many a learned preface in the Renaissance at once boasts and complains of the hardship of “so many late nights spent studying.” Methods for winning the battle against fatigue could become extreme: it is reported that, as a student, the eighteenth-century classical scholar Friedrich August Wolf “would sit up the whole night in a room without a stove, his feet in a pan of cold water and one of his eyes bound up to rest the other.” Scientific activity is distinct from classical scholarship in encompassing a broader array of demanding activities, such as computation, experimentation, and observation from nature, but reading is still central to scientific activity today and was even more so in periods before the specialization of scientific fields and methods. As historians of science increasingly attend to the material practices of science, reading should figure among them. Reading cum note-taking—the kind that historians are best able to study—involved special tools: books and

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libraries, paper and notebooks, writing implements and tables, but also amanuenses, such as the one who read for Robert Boyle when he suffered from distemper in the eye. Studious reading also took a variety of forms, from the slow and painstaking to the rushed and fragmented, constrained by pressures of time and limited access to books. René Descartes had only thirty hours to read Galileo's *Dialogue* in a copy that Isaac Beeckman lent him. Girolamo Cardano, concerned to make haste throughout his polymathic range of activities, explained how, in "devouring a mighty volume," he would mark for omission "parts very trite or of little use" and other passages that were obscure and could await later investigation; his notes were thus aids to browsing and skimming.<sup>1</sup>

Studies of scientific reading are still at their early stages, but we can also look to recent work in the history of learned reading more generally for indications of some of the new questions this approach raises. In this brief survey I will highlight three major research directions: the study of individual reading habits, of widely shared practices, and of the reception of particular works. Reading can be studied at the level of the individual thinker who typically acquires new knowledge and critical understanding through reading, as attested by extant notes or diaries; a finished work will also often indicate texts an author has read and how he or she approached them, through explicit citations as well as tacit allusions. Existing studies couched in terms of the intellectual development of and "influences" on a thinker can usefully be reconsidered in light of the history of reading. Attention to reading as a process assumes that reading is not only a personal experience but also one that is shaped by cultural norms—transmitted more or less explicitly through education and imitation—and that can be differentiated according to cultural context. On the one hand, the practices of individuals can be contextualized through a history of reading in the relevant intellectual and cultural milieu(x). On the other hand, we can form a picture of widely shared practices by piecing together partial and scattered evidence, which cannot always be associated with a well-known figure. Ideally, we could reconstruct practices associated with specific cultural contexts—whether defined by time, place, or profession. Finally, reading can be studied as the principal mode for the reception of a scientific work. Historians can hope to trace not only reactions of specialists, but also reception by non-specialists, through records of book ownership (though these do not necessarily indicate that the books in question were read) and of actual reading—for example, in manuscript annotations and in manuscript or printed comments and references.<sup>2</sup>

<sup>1</sup> Mark Pattison, *Essays by the Late Mark Pattison*, ed. Henry Nettleship, 2 vols. (New York: Burt Franklin, 1889), Vol. 1, p. 343 (on Wolf; I thank Jonathan Sheehan for this lead); Robert Boyle, *Some Consideration Touching the Style of the H. Scriptures* (London: For Henry Herringman, 1661), sig. A4r; René Descartes to Marin Mersenne, 14 Aug. 1634, in *Oeuvres*, ed. Charles Adam and Paul Tannery (Paris: Vrin, 1996), Vol. 1, pp. 303–304; and Girolamo Cardano, *De propria vita liber* (Lyon: Guillaume Rouille, 1557), p. 187, trans. by Jean Stoner as *The Book of My Life* (New York: New York Review Books, 2002), p. 151. On Cardano's approach see Nancy Siraisi, *The Clock and the Mirror: Girolamo Cardano and Renaissance Medicine* (Princeton, N.J.: Princeton Univ. Press, 1997), pp. 52–65.

<sup>2</sup> Adrian Johns has been a pioneer in advancing the history of early modern scientific reading; for his most recent contribution, including a helpful overview of the field, see Adrian Johns, "Reading and Experiment in the Early Royal Society," in *Reading, Society, and Politics in Early Modern England*, ed. Kevin Sharpe and Steven N. Zwicker (Cambridge: Cambridge Univ. Press, 2003), pp. 244–271; in addition see Johns, *The Nature of the Book: Print and Knowledge in the Making* (Chicago: Univ. Chicago Press, 1998), Ch. 4 and the references from the index. For an entry into the history of reading more generally see Guglielmo Cavallo and Roger Chartier, eds., *A History of Reading in the West*, trans. Lydia G. Cochrane (Amherst: Univ. Massachusetts Press, 1999); and Kevin Sharpe, *Reading Revolutions: The Politics of Reading in Early Modern England* (New Haven, Conn.: Yale Univ. Press, 2000). For the important reminder that "perhaps the majority of the books ever printed have

The history of reading is notorious for lacking systematic grounds for generalization: we can never come close to having all the reading notes of an author or a complete set of responses to a text by its readers. Many limitations in the history of reading are inherent in the kinds of evidence that survive. Reading, like reflection, is an interior experience that need not generate any written traces; and even when it does, such traces cannot convey the full extent of the mental experience. Those readers who did not also write or were not written about remain utterly elusive, although they have always constituted a majority; popular and female readers are likely to be particularly occulted for this reason, at least in the early modern period, owing to their generally lower levels of education. Nonetheless, some limitations in the history of reading can be palliated by attending to them. Better cataloguing of manuscript annotations in printed books, for example, would facilitate the discovery and collection of new evidence. Much of the success of the history of reading will depend on finding inventive ways of coordinating different kinds of evidence to devise a convincing, if nonetheless partly speculative, reconstruction of the reading experience of both individuals and groups of individuals in particular contexts.

#### INDIVIDUAL FIGURES AS READERS

Biographers of important scientific figures have long been interested in the books that their subjects owned and in their reading notes, as well as in the notes and drafts that constituted original work in progress. These studies are analogous in many ways to the work of literary historians focused on the genesis of a literary work or *critique génétique*; they pose their own evidentiary problems. The historians of nineteenth-century literature who developed this approach benefited from collections of personal papers, often vast, that authors self-consciously formed in order to bequeath them to institutions or to family members (who might command a handsome price for them). For earlier periods the records are considerably more scarce. The earliest extant “author’s books” (autograph or dictated by the author) date from the twelfth century, but these are fairly finished works rather than working notes or drafts.<sup>3</sup> Only since the early modern period have collections of working notes and papers of various famous scholars been preserved with care through the centuries. In some cases the papers that were preserved were notes for projects not completed, which were passed down in the hope that they would someday be published.<sup>4</sup> But we also have records of reading kept in notebooks or on loose leaves, often grouped in bundles. Even the richest of these collections are never simple reflections of an author’s working methods, however—they were typically ordered and pruned after the activities that initially generated them by the author or others, with an eye to shaping the image of the author for posterity; in addition, they were susceptible to much chance intervention and loss over the centuries. When using such collections of papers or “personal archives” it is essential to

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rarely been read” see Hugh Amory, “The Trout and the Milk: An Ethnobiographical Talk,” *Harvard University Library Bulletin*, 1996, 7:50–65, on p. 51.

<sup>3</sup> For an entry into critique génétique see Michel Espagne, *De l’archive au texte: Recherches d’histoire génétique* (Paris: Presses Univ. France, 1998); and Pierre-Marc de Biasi *et al.*, *Pourquoi la critique génétique? Méthodes, théories* (Paris: CNRS, 1998). On medieval “author’s books” see Armando Petrucci, *Writers and Readers in Medieval Italy: Studies in the History of Written Culture*, ed. Charles M. Radding (New Haven, Conn.: Yale Univ. Press, 1995), Ch. 8.

<sup>4</sup> The notes and drawings that Conrad Gessner had collected for a *historia plantarum* took a particularly long and circuitous route to publication in the eighteenth century; see Hans H. Wellisch, *Conrad Gessner: A Bibliography* (Zug, Switzerland: IDC, 1984), p. 22 ff.

consider the formation and the transmission of the collection as well as its contents, as a fascinating recent volume has emphasized.<sup>5</sup> We have rich studies of the papers of Robert Boyle and Isaac Newton, for example.

The best-preserved reading notes are often those made in the margins and flyleaves of printed books, which were saved inadvertently along with the books themselves, although they may have suffered in later years from being cropped in rebinding or whitewashed to suit the preference of the rare-book market for volumes in pristine condition. The most detailed study of Newton's reading practices rests on the 862 volumes that belonged to him that are extant in the Trinity College Library. Of these, about a hundred contain annotations in Newton's hand, including corrections (especially in mathematical books), cross-references to other works on the topic (especially in alchemical books), and remarks of a general nature, not always related to the subject of the book. Newton is noted for his distinctive practice of highlighting passages by dog-earing or turning a corner of the page in to point to something in the text, typically to flag obscure proper names, quotations, or references to himself. A chronological examination of Newton's reading notes reveals a shift from his early pattern of close reading of a few philosophical and mathematical works (central among them those of Descartes) to his later interest in a broad range of problems, including the alchemical and the theological, which he expected to resolve largely through reading and excerpting.<sup>6</sup>

Evidence about an individual's reading becomes most interesting when it can be assessed within the broader context of contemporary practices. Studies of seventeenth-century English reading can already contribute grounds for an initial assessment of what is distinctive about Newton: his annotations follow contemporary patterns in providing corrections and cross-references but are less typical in omitting marginal summaries or keywords. Newton's dog-earing is unique, but his inclusion of remarks without apparent relation to the text being read is not unusual. Annotations in early modern books often included doodles or miscellaneous extraneous material (recipes, poems, family genealogies), whether because the process of reading itself elicited such wanderings of the mind or because the blank spaces in printed books proved a convenient place to write things down either for temporary use or for later retrieval, even when one was not reading at the time. Other kinds of annotations commonly found in early modern books (but not in Newton's) were designed to track the topics treated and to highlight passages of special interest. The most diligent annotators would copy into the margin a topic word or expression to indicate what was under discussion in each passage. A selection of these topic words could be gathered on a flyleaf with page numbers to serve as a personal index to the volume. Other methods of marking topics of interest involved marginal flagging and underlining or marking passages with symbols that meant something to the annotator, though the key to their meaning can rarely be reconstructed by the historian. Finally, one finds comments of a personal nature: readers adduce lived experience to parallel that described in the book or interject

<sup>5</sup> See Michael Hunter, ed., *Archives of the Scientific Revolution: The Formation and Exchange of Ideas in Seventeenth-Century Europe* (Woodbridge, Suffolk: Boydell, 1998).

<sup>6</sup> Regarding notes in margins and on flyleaves see William Sherman, " 'Rather Soiled by Use': Attitudes towards Readers' Marks," *Book Collector*, 2003, 52:471–490. On Newton's annotations see John Harrison, *The Library of Isaac Newton* (Cambridge: Cambridge Univ. Press, 1978), p. 15 ff.; and Scott Mandelbrote, *Footprints of the Lion: Isaac Newton at Work*, Exhibition at Cambridge University Library, 9 October 2001–23 March 2002 (Cambridge: Cambridge Univ. Library, 2001). Newton's method of "highlighting" can be identified in over a quarter of his surviving books at Trinity College; see Harrison, *Library of Isaac Newton*, pp. 25–27. The shift in his reading pattern over time is noted in Mandelbrote, *Footprints of the Lion*, p. 10.

objections, criticisms, or praise, engaging in a kind of personal dialogue with the book as both text and object.<sup>7</sup>

#### COLLECTIVE READING PRACTICES

Beyond studies of individuals, the history of scientific reading can make a more broadly significant contribution by attending to collective reading practices. The marginal annotations surviving in printed books are most often anonymous, or associated with a name that is otherwise unknown, but they can be put to good use in studies of collective practices, which might then be differentiated by field and context. Reading notes are certainly very personal—indeed, Michel Foucault reportedly expressed a desire to study the quotations excerpted in reading notes because they seemed to him to be works “of the self, not imposed on the individual”; they promised to give quasi-psychoanalytic insight into the thinking of the individual reader free to choose what was worthy of attention.<sup>8</sup> But in early modern Europe, at least, reading notes also followed consistent patterns, often in accordance with prescriptive advice in books on how to read “with profit.” Neither the form nor the content of reading notes is free from the constraints of cultural norms; on the contrary, they can give us insight into habits of mind that are not often made explicit.

Pupils in humanist schools were taught to read with special attention to rhetorical turns of phrase and useful information about ancient history, mythology, and culture that they could re-use as material in their own compositions. These elements of *realia* would include natural philosophical knowledge typical of ancient authors, such as the four elements, the three geographical zones, and basic Aristotelian explanations of natural phenomena. Schoolboys were taught to keep notebooks in which to write down the best bits they encountered in reading—at first upon dictation from the teacher, then on their own under the supervision of the teacher, and finally, it was hoped, independently throughout their reading lives. Although humanists boasted of the novelty of their teaching—indeed, their focus on the quality of Latin style and their inclusion of a broadened array of classical texts were new—this method of commonplacing by selecting the best bits from canonical texts certainly was not. Encyclopedic compilations like Vincent of Beauvais’s four-volume *Speculum maius* (1255), which included a volume on nature and natural philosophy, the *Speculum naturale*, resulted from just such a method of reading by snipping. These compilations were designed to spare their users the labor of reading and excerpting choice passages from a literature on nature that was already considered too abundant to master for oneself.<sup>9</sup>

<sup>7</sup> For an illustration of a manuscript index see Ann Blair, *The Theater of Nature: Jean Bodin and Renaissance Science* (Princeton, N.J.: Princeton Univ. Press, 1997), pp. 196–197. On the difficulties of interpreting marginal symbols see Anthony Grafton, “How Guillaume Budé Read His Homer,” in *Commerce with the Classics: Ancient Books and Renaissance Readers* (Ann Arbor: Univ. Michigan Press, 1997), pp. 135–183, esp. pp. 152 ff. For a rare example of a key to such symbols see the page from a Folger Library volume reproduced and described in William Sherman, “‘Rather Soiled by Use’: Renaissance Readers and Modern Collectors,” in *The Reader Revealed*, ed. Sabrina Alcorn Baron (Washington, D.C.: Folger Shakespeare Library, 2001), pp. 84–91, on p. 84. For a typology of annotations in this period see Sherman, *John Dee: The Politics of Reading and Writing in the English Renaissance* (Amherst: Univ. Massachusetts Press, 1995). On annotations and their interpretation more generally see Roger Stoddard, *Marks in Books, Illustrated and Explained* (Cambridge, Mass.: Houghton Library, 1985); and Helen Jackson, *Marginalia: Readers Writing in Books* (New Haven, Conn.: Yale Univ. Press, 2001).

<sup>8</sup> Michel Foucault, “On the Genealogy of Ethics,” in *Michel Foucault: Beyond Structuralism and Hermeneutics*, ed. Hubert L. Dreyfus and Paul Rabinow, 2nd ed. (Chicago: Univ. Chicago Press, 1983), pp. 229–252, esp. pp. 245–250.

<sup>9</sup> “Since the multitude of books, the shortness of time, and the slipperiness of memory do not allow all things

Traditional natural philosophy was not particularly distinct from other disciplines in its working methods: like theology, law, theoretical medicine, and other branches of philosophy, it created knowledge by accumulating, debating, and commenting on statements by authorities collected from reading books. Historians of premodern natural philosophy have in many cases already been studying reading by focusing on methods of commentary and citation of ancient texts.<sup>10</sup> Attention to the process of reading itself can deepen our understanding of the cycle of textual production: How did students and scholars first respond to, then store for re-use, material encountered in reading? What different forms of memory did they engage? These might include natural memory (both long and short term) and memory aided by artifice, including not only the systems of place memory made famous by Frances Yates but also the eminently practical and longer-lived forms of retention represented by note-taking. With the emergence and gradual dominance of new empirical and mathematical methods in the sixteenth and seventeenth centuries, there is much potentially exciting work to be done tracing the distinctive features and roles of reading in the new science and their relation to traditional methods of reading, which persisted in humanistic fields and for some kinds of scientific works (e.g., works of compilation).<sup>11</sup> Even if reading was no longer the principal method of scientific discovery, it remained an important way of learning and attempting to master the results of others.

Owen Gingerich's survey of surviving copies of Copernicus's *De revolutionibus* reveals the circulation of two sets of manuscript annotations among specialist readers desirous of mastering the book's difficult content. As they were copied again and again, these annotations may have served as substitutes for the oral commentary of a knowledgeable instructor and made possible a reading experience shared across distances of space and time.<sup>12</sup> While we do not know the circumstances under which these copies were made from the original annotations by Erasmus Reinhold and Jofrancus Offusius, this example of reliance on the reading notes of another fits into a pattern of delegated reading and note-taking of which historians of reading are increasingly aware.

It is well known that early modern scholars in all fields often relied on amanuenses, sometimes on more than one, to whom they would entrust different tasks. These were the equivalents for text-based practices of Steven Shapin's "invisible technicians," who also remain generally unacknowledged in published works and elusive even in private documents. Despite a general refrain of complaints about the inferior results to be achieved in reading by delegation, some pedagogues actively recommended the practice.<sup>13</sup> The value

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which are written to be equally retained in the mind, I decided to reduce in one volume in a compendium and in summary order some flowers selected according to my talents from all the authors I was able to read": Vincent of Beauvais, *Bibliotheca mundi* (Douai: Baltazar Beller, 1624), Vol. 1: *Speculum naturale*, Prologue, p. 1 (my translation). See also Ann Blair, "Humanist Methods in Natural Philosophy: The Commonplace Book," *Journal of the History of Ideas*, 1992, 53:541–551.

<sup>10</sup> See, e.g., Nancy G. Siraisi, *Avicenna in Renaissance Italy: The Canon and Medical Teaching in Italy after 1500* (Princeton, N.J.: Princeton Univ. Press, 1987).

<sup>11</sup> For some suggestions for a history of note-taking see Ann Blair, "Note-Taking as an Art of Transmission," *Critical Inquiry*, 2004, 31:85–107. On techniques of artificial memory by the visualization of places see Frances Yates, *The Art of Memory* (Chicago: Univ. Chicago Press, 1966). For other forms of visual memory, focused on the look of the page, see Mary Carruthers, *The Book of Memory: A Study of Memory in Medieval Culture* (Cambridge: Cambridge Univ. Press, 1990). On the role of the commonplace book as a model for works of compilation see Richard Yeo, *Encyclopaedic Visions: Scientific Dictionaries and Enlightenment Culture* (Cambridge: Cambridge Univ. Press, 2001).

<sup>12</sup> Owen Gingerich, *An Annotated Census of Copernicus' De revolutionibus (Nürnberg, 1543 and Basel, 1566)* (Leiden: Brill, 2002), pp. xix–xxi.

<sup>13</sup> Steven Shapin, "The Invisible Technician," *American Scientist*, 1989, 77:554–563. Michael Hunter has

attributed to the notes taken by someone else is also evident from bequests of personal notes made explicit in wills and fought over in cases of disputed legacy. The notes of highly regarded scholars were especially valued, not only by the sons and nephews who often carried on a tradition of scholarship begun in the previous generation, but also by outsiders who occasionally attempted to purchase such notes.<sup>14</sup> In all these cases contemporaries assumed that notes taken by another would be of use, that they could be consulted in a predictable way and applied to one's own purposes. These expectations point to methods of reading and note-taking that were shared at least within certain milieux.

Reading and note-taking could also be practiced collectively—for example, by groups of students or members of a literary society. Vincent Placcius, professor of rhetoric at Hamburg, boasted of the utility of a chest he had devised for storing slips of paper that enabled groups of readers to work together at a common task by pooling their notes. Already in the 1560s the project of writing a new history of the Christian Church from the Lutheran perspective engaged a team of some fifteen students and scholars, each assigned to specific tasks, from reading and taking notes to arranging the notes and composing a narrative from them; this collaborative undertaking resulted in the publication of thirteen volumes known as the Magdeburg Centuries. Attention to early modern methods of collaborative work, notably by reading and note-taking, can help us contextualize the goals and methods of the Royal Society as it set itself the task of recording experiments and observations in its archives and reporting on them to its members in the *Transactions*.<sup>15</sup>

Much work is needed to distinguish the various methods of reading and note-taking in different historical, geographical, and institutional contexts. Readers probably also deployed different reading methods for different kinds of works—and probably in ways that were field specific. Just as legal note-taking generated peculiarly large accumulations of citations, different scientific fields—from medicine to astronomy—may well have developed distinctive practices of reading, note-taking, and writing, yielding (for example) varying degrees and kinds of precision.<sup>16</sup> Contemporaries were certainly aware of a range of

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distinguished up to eleven amanuenses from the different hands found in the Boyle papers; see Hunter, ed., *Archives of the Scientific Revolution* (cit. n. 5), p. 12. For more discussion of reading by proxy see Lisa Jardine and Anthony Grafton, "Studied for Action: How Gabriel Harvey Read His Livy," *Past and Present*, 1990, 129:30–78; and the discussion in Ann Blair, "Reading Strategies for Coping with Information Overload, ca. 1550–1700," *J. Hist. Ideas*, 2003, 64:11–28.

<sup>14</sup> On disputes over the legacy of the sixteenth-century Italian naturalist Luca Ghini see Paula Findlen, "The Death of a Naturalist: Knowledge and Community in Late Renaissance Italy," paper delivered at the Renaissance Society of America, Toronto, 2003; related research on the bequests of Renaissance naturalists is forthcoming in Findlen, *A Fragmentary Past: The Making of Museums and the Making of the Renaissance*. Families with multiple generations of scholars include the Vossii, Scaligers, Casaubons, Estiennes, and Zwingers. For a report that someone attempted to purchase the notes of the famous legal scholar Hermann Conring see Vincent Placcius, *De arte excerpendi, vom Gelährten Buchhalten liber singularis quo genera et praecepta excerpendi* (Stockholm/Hamburg: Gottfried Liebezeit, 1689), p. 185. Already in antiquity Pliny the Younger reported an attempt to buy his uncle's notes for 400,000 sesterces (*Epistles* 3.5); for discussion see Jens Erik Skydsgaard, *Varro the Scholar: Studies in the First Book of Varro's De re rustica* (Copenhagen: Munksgaard, 1968), p. 102.

<sup>15</sup> Placcius boasts about his useful chest in *De arte excerpendi*, pp. 146, 161–162. On the Magdeburg Centuries see Anthony Grafton, "Where Was Salomon's House? Ecclesiastical History and the Intellectual Origins of Bacon's *New Atlantis*," in *Die europäische Gelehrtenrepublik im Zeitalter des Konfessionalismus*, ed. Herbert Jaumann (Wiesbaden: Harrassowitz, 2001), pp. 21–38. On the reading and note-taking practices of the Royal Society see Johns, "Reading and Experiment in the Early Royal Society" (cit. n. 2); and Johns, *Nature of the Book* (cit. n. 2).

<sup>16</sup> For a study of Johannes Kepler's different approaches to reading history, imaginative literature, and astronomy see Anthony Grafton, "Johannes Kepler: The New Astronomer Reads Ancient Texts," in *Commerce with the Classics* (cit. n. 7), pp. 185–224, esp. pp. 203–224. For an entry into early modern juridical citations see Michel Reulos, *Comment transcrire et interpréter les références juridiques . . . contenues dans les ouvrages du*

reading methods from which to choose. Francis Bacon used a digestive metaphor to describe these distinctions: “Some books are to be tasted, others to be swallowed and some few to be chewed and digested; that is, some books are to be read only in parts; others to be read, but not curiously; and some few to be read wholly, and with diligence and attention.”<sup>17</sup> Descartes is described by his contemporary biographer Adrien Baillet as hostile to the practice of selecting “detached thoughts” from the works of great men. He favored reading a text many times over in order to master the “spirit” of it, in much the same way as Jesuit pedagogues recommended reading only a few books, but thoroughly and “always to the end.” But even Descartes also reportedly “leafed through” books.<sup>18</sup> The first act of reading was thus to select the kind of reading appropriate to each book and set of circumstances.

Authors occasionally gave readers explicit advice on how to approach their work. In the preface to his massive alphabetical *Historia animalium* (1551) Conrad Gessner explained that the “utility of lexica” like his “comes not from reading it from beginning to end, which would be more tedious than useful, but from consulting it from time to time.” Descartes, on the contrary, asked one reader of his *Geometry* to take the trouble to read it with pen in hand, following the calculations, whereas he recommended reading through his *Principia* like a novel and saving any difficulties for a subsequent reading.<sup>19</sup> Attention to methods of reading, both as advocated by authors and as actually practiced by readers, can sharpen our understanding of the role of genre in scientific writing. All those involved in producing a book, from authors to publishers, participated in shaping the nature of a text and its published form to suit its targeted audience and purpose. Early modern natural philosophy was produced in genres that persisted from the Middle Ages (e.g., commentaries, specialist treatises, books of secrets) but also in a number of new genres, such as the textbook, associated with the educational boom of the sixteenth century, “dialogues” and “essays” targeted at a nonspecialist, nonstudent audience, and “reference works” aimed

XVI<sup>e</sup> siècle (Geneva: Droz, 1985). On medical note-taking see Richard J. Durling, “Girolamo Mercuriale’s *De modo studendi*,” in *Renaissance Medical Learning: Evolution of a Tradition*, ed. Michael McVaugh and Nancy G. Siraisi (*Osiris*, N.S., 6) (Philadelphia: History of Science Society, 1991), pp. 181–195; on the genre of the *consilia* see Jole Agrimi and Chiara Crisciani, *Consilia médicaux*, trans. Caroline Viola (Turnhout: Brepols, 1994).

<sup>17</sup> Francis Bacon, “Of Studies,” in *Essays* (1612), rpt. in *Francis Bacon*, ed. Brian Vickers (Oxford: Oxford Univ. Press, 1996), pp. 439–440, on p. 439. Vickers notes that “curiously” should be understood here from its root, *cura*: “with minute attention”; see p. 773. The passage is also used without acknowledgment in James Cleland, *The Institution of a Young Nobleman* (London, 1607), p. 147; it is cited approvingly as Bacon’s in D. G. Morhof, *Polyhistor*, ed. Johannes Moller (Lübeck: Petrus Boeckmann, 1732), Vol. 1, Bk. 1, chap. 2, par. 9 (p. 14), Bk. 2, chap. 8, par. 20 (p. 409).

<sup>18</sup> Descartes’s preference for rereading to master a text is discussed in Adrien Baillet, *Vie de M. Descartes*, 2 vols. (Paris: Daniel Horthemels, 1691; rpt., New York: Arland, 1987), Vol. 2, Bk. 8, chap. 3, p. 469; for some discussion see Dinah Ribard, “Le savoir philosophique et les livres: Sorel et Bayle,” in *Le XVII<sup>e</sup> encyclopédique*, ed. Claudine Nédélec (Cahiers Diderot, 12) (Rennes: Presses Univ. Rennes, 2001) p. 147. Compare the advice of the Jesuit Franciscus Sacchini, *De ratione librorum cum profectu legendi libellus* (Würzburg, 1614), pp. 32, 41–42, which was reprinted down to the mid-eighteenth century. For more discussion of Descartes’s indebtedness to his Jesuit education see Anthony Grafton, *Traditions of Conversion: Descartes and His Devil* (Berkeley, Calif.: Doreen B. Townsend Center for the Humanities, 2000). On Descartes’s “leafing through” books see Baillet, *Vie de M. Descartes*, Vol. 2, p. 468; see also Geneviève Rodis-Lewis, *Descartes: His Life and Thought*, trans. Jane Marie Todd (Ithaca, N.Y.: Cornell Univ. Press, 1998), pp. 110, 244 n 38.

<sup>19</sup> Conrad Gessner, *Historiae animalium lib. I de Quadrupedibus viviparis* (Zurich: Froschauer, 1551), sig. beta 1v. Gessner seems conscious here of the need to explain what he means by “consulting” a book (as opposed to a person or an oracle), which suggests that the expression was unusual at the time. For Descartes’s recommendations see “Descartes à \*\*\*” [Oct. 1637], in *Oeuvres*, ed. Adam and Tannery (cit. n. 1), Vol. 1, pp. 457–458 (on the *Geometry*), Vol. 9, Pt. 2, pp. 11–12 (on the *Principia*).

at both scholarly and generalist users. The emergence of the periodical in the late seventeenth century warrants special attention, since it is associated by both historians and historical actors with new ways of reading, but the specifics of these ways of reading await precise study.<sup>20</sup>

#### STUDYING THE RECEPTION OF A WORK

Intellectual historians have long since moved away from an older vision of their field as the study of how great minds responded to great books across the ages. The focus has shifted to assessing the impact of a work or an idea in a given historical context. This approach often underscores the historical significance of a work long forgotten that was a best seller in its day or highlights the gap between the initial poor reception of a work and its later entry into the “canon” of a discipline. The importance of studying the reception of a work to assess its historical impact is generally well appreciated. As various cases have illustrated, reception is not a simple process of diffusion of ideas but involves their appropriation by readers who adjust them in light of their own assumptions and ideals (which may also be transformed in the process).<sup>21</sup> The process of reception or appropriation can begin transforming a text even before its publication, though these first readers of a text are often as invisible as amanuenses and vicarious readers.

Editors and correctors in the printing house, translators, censors, illustrators, engravers, and illuminators, who often remain unmentioned or anonymous, could have a significant impact on the reception of a text. In the Middle Ages readers who copied a text would make modifications, both intentional—to improve the clarity of the sense as they understood it—and unintentional. Medieval book owners could also hire professional readers to facilitate access to a difficult text by adding annotations and glosses, which would aid the owner in reading it but also govern the reception of the text beyond its initial owner. Most spectacularly, Andreas Osiander’s preface to Copernicus’s *De revolutionibus* shaped the initial understanding of the work as an instrumentalist alternative to Ptolemy. Osiander’s reading, which preceded even the publication of the text, dominated the reception of the work through the end of the sixteenth century.<sup>22</sup> Closer attention to the people involved in the production of a book, from front matter and illustrations to indexes and errata lists, can bring to light the role of historical actors other than the author in shaping how a work was read, by whom, and for what purposes.

Peculiar to some scientific works were unusual tasks assigned to the book owner or reader, including cutting out and installing volvelles with string, lifting flaps, or cutting out and pasting new illustrations over erroneous ones. Coloring in engravings, with or

<sup>20</sup> On Johnson’s references to reading periodicals as “mere reading,” as opposed to other kinds of reading, see Robert De Maria, Jr., *Samuel Johnson and the Life of Reading* (Baltimore: Johns Hopkins Univ. Press, 1997), Ch. 1.

<sup>21</sup> On appropriation see Roger Chartier, *The Order of Books* (Cambridge: Polity, 1994), Ch. 2; and A. I. Sabra, “The Appropriation and Subsequent Naturalization of Greek Science in Medieval Islam,” *History of Science*, 1987, 25:224–243. For an example see Elisabeth Labrousse, “Reading Pierre Bayle in Paris,” in *Anticipations of the Enlightenment in England, France, and Germany*, ed. Alan Kors (Philadelphia: Univ. Pennsylvania Press, 1987), pp. 7–16.

<sup>22</sup> On the role of medieval readers see R. J. Tarrant, “The Reader as Author: Collaborative Interpolation in Latin Poetry,” in *Editing Greek and Latin Texts*, ed. John N. Grant (New York: AMS Press, 1989), pp. 121–163; and Kathryn Kerby-Fulton and Maidie Hilmo, *The Medieval Professional Reader at Work: Evidence from Manuscripts of Chaucer, Langland, Kempe, and Gower* (Victoria, Canada: English Literature Studies, 2001). On the impact of Osiander see Robert Westman, “The Melanchthon Circle, Rheticus, and the Wittenberg Interpretation of the Copernican Theory,” *Isis*, 1975, 66:165–193.

without attention to models that might have been available from the author, was a job typically delegated to a paid professional, though occasionally it may have been performed by the owner of the book. These books involving completion by the owner or reader are typically displayed today as delightful curiosities. But a closer look at these volumes—from the small-format textbook for each student to own to the massive folio edition designed for group instruction—would offer insight into the often pedagogical contexts in which they were used. These make-it-yourself books also constitute evidence for the prevalence of utilitarian attitudes toward the book—attitudes that are visible, too, in clearly destructive uses of books in which the printed text itself was cut up to be pasted in a notebook or to compose another work.<sup>23</sup>

Finally studying the reception of a book can help the historian reach a better understanding of the meaning of a text in its historical context, as I can attest from my own research. While Jean Bodin's *Universae naturae theatrum* (1596) first struck me, from my modern vantage point, as profoundly indebted to Aristotelian assumptions about causal understanding, the four elements, and the three principles, contemporary readers of this work were struck instead by the extent to which Bodin disagreed with Aristotle. One reader from the period who left abundant marginal annotations noted every occurrence in which he found "Aristotle criticized," for a total of 160 such notes. In reading Bodin through the eyes of this reader, I was also drawn to inconsistencies and peculiarities of Bodin's arguments that I might not have considered closely, given how much of Bodin's text seemed inconsistent and strange to my modern sensibilities. There is no substitute for wide reading among comparable contemporary works to position a text in its historical context, but the traces of reading and ownership that survive can guide the historian through foreign intellectual terrain with a unique kind of expertise.<sup>24</sup>

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Studies focused narrowly on scientific reading in the early modern period may prove unmanageable or unappealing in many cases. They pose unique problems in identifying relevant materials and, in addition to the usual paleographical difficulties, in reading cramped and cropped marginal notes. Most important, a majority of reading notes are not original but repetitive of material in the text, so that their significance can only be appreciated alongside a careful study of the text in question and its context. A history of scientific reading need not be an independent undertaking; rather, its concerns can be integrated into the set of questions that historians of science routinely address. If we make a habit of attending to clues about reading as we come across them in texts, books, and marks in books, we can, by accumulating scattered observations, collectively enliven our under-

<sup>23</sup> See Owen Gingerich, "Astronomical Paper Instruments with Moving Parts," in *Making Instruments Count: Essays on Historical Scientific Instruments Presented to Gerard L'Estrange Turner*, ed. R. G. W. Anderson et al. (Aldershot, Hampshire: Variorum, 1993), pp. 63–74. On other kinds of cutouts see Sten Lindberg, "Mobiles in Books: Volvelles, Inserts, Pyramids, Divinations, and Children's Games," trans. William S. Mitchell, *Private Library*, 1979, 2:49–82; and Suzanne Karr, "Constructions Both Sacred and Profane: Serpents, Angels, and Pointing Fingers in Renaissance Books with Moving Parts," *Yale University Library Gazette*, 2004, 79:101–127. For a likely example of a "homemade" rubrication, which has since bled, see the copy of *Hortus sanitatis* (Mainz, 1491) at the Houghton Library, Harvard University, Cambridge, Massachusetts. On practices of cutting and pasting, which I hope to study further, see Blair, "Reading Strategies for Coping with Information Overload" (cit. n. 13).

<sup>24</sup> The decisions contemporary owners made in binding Bodin's *Theatrum* to other works were also crucial in leading me to works that contemporaries considered comparable to Bodin's; indeed, these works often contained printed references to Bodin's *Theatrum*. See Blair, *Theater of Nature* (cit. n. 7), Ch. 6.

standing of what doing science meant in different contexts. We are now well aware that, despite the constancy of the codex form and of the basic terminology of reading over long periods, there are many forms of reading, which vary by time and place but also within a historical context according to the kind of book and the decisions of the reader involved. At this point it is hard to generalize from the scattered cases about which we know something. John Locke was loath to mar his books by annotating them, while, a century earlier, Conrad Gessner recommended cutting them up in order to index them. Some learned men in the seventeenth century reportedly relied primarily on their excellent memories to retain information, while others were like Nicolas Fabri de Peiresc, who never failed to record in his own hand anything interesting that happened. Some, like Descartes and the Jesuits, recommended reading only a few books, but thoroughly, while Samuel Johnson would learn about a new subject by looking at “catalogues in libraries and at the backs of books.”<sup>25</sup> Attention to scientific reading promises to bring to light not only telling individual examples, but also the grounds for generalizations about an aspect of scientific practice that can add to our understanding of both how ideas were formed and how they were received in particular contexts.

<sup>25</sup> Concerning Samuel Johnson, see *Boswell's Life of Johnson*, ed. G. B. Hill, 6 vols. (Oxford: Clarendon, 1934), Vol. 2, p. 365. On Locke's reading practices see De Maria, *Samuel Johnson and the Life of Reading* (cit. n. 20), p. 38; and Richard Yeo, “John Locke's ‘New Method’ of Commonplacing: Managing Memory and Information,” *Eighteenth-Century Thought*, 2004, 2:33–69. For Gessner's recommendation see Conrad Gessner, *Pandectae* (Zurich: Froschauer, 1548), fol. 20r, trans. in Hans Wellisch, “How to Index a Book—Sixteenth-Century Style: Conrad Gessner on Indexes and Catalogs,” *International Classification*, 1981, 8:10–15, on p. 12; this is discussed in Ann Blair, “Annotating and Indexing Natural Philosophy,” in *Books and the Sciences in History*, ed. Marina Frasca-Spada and Nick Jardine (Cambridge: Cambridge Univ. Press, 2000), pp. 69–89. The attempted purchase of the notes of Hermann Conring failed because he reportedly relied more on his memory than on note-taking (see note 14, above). On Peiresc see Pierre Gassendi, *Viri . . . senatoris Peiresc vita* (Paris: Sebastian Cramoisy, 1641), p. 361; I am grateful to Peter Miller for this lead.