

# Chapter 1

## Printers, Publishers, and Sellers: Actors in the Process of Consolidation of Epistemic Communities in the Early Modern Academic World



Matteo Valleriani and Andrea Ottone

**Abstract** This chapter proposes a global view of the set of dynamics of interplay that were generated in the early modern publishing sector around a single astronomical work, the *Tractatus de sphaera* by Johannes de Sacrobosco. The *Sphaera*, a thirteenth-century tract of geocentric cosmology, rather than remaining a static text, became over the centuries a multiauthored dynamic textual tradition. This essay argues that publishers, printers, and booksellers had a fair share of agency not only in perpetuating but also in shaping the evolution of this long-lasting textual tradition. The present essay traces the ways this agency was configured.

**Keywords** *Sphaera* · Johannes de Sacrobosco · Cosmology · History of science · Book history · Network theory · Digital Humanities

### 1 Introduction

Early modern astronomy is a constellation of great discoveries by scientists such as Nicolaus Copernicus (1473–1543), Galileo Galilei (1564–1642), and Johannes Kepler (1571–1630). Such great discoveries, proposing and striving to promote a new heliocentric worldview, went down in history associated with great events: the publication of the respective works by which the new cosmology was disclosed to an educated audience. While the emphatic perspectives of the great scientists have been used and re-used to reconstruct the early modern history of astronomy and cosmology, little has been done to understand the nature of the scientific knowledge possessed by their aforementioned educated audience.

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In the context of the research project *The Sphere: Knowledge System Evolution and the Shared Scientific Identity of Europe*, a corpus of 359 early modern editions has been collected with the focus on one particular text: Johannes de Sacrobosco's (d. 1256) *Tractatus de sphaera*. Collected editions span from 1472, the year that saw the first two printed editions of Sacrobosco's text, to 1650, which is approximately when the *Tractatus* loses scholarly relevance.<sup>1</sup> The *Sphaera* was used at virtually all European universities, gymnasia, and other institutions of higher education during the early modern period. Originally compiled in Paris during the thirteenth century, this text comfortably transitioned from manuscript to early print culture, gaining an outstanding visibility as the standard text for introductory classes of astronomy at the Faculties of Liberal Arts, conceptually encapsulated within the framework of the *quadrivium*.

Sacrobosco's text was however not a standalone source that European scholars and students used to learn cosmological rudiments. On the contrary, Sacrobosco's tract was often published along with commentaries and textual apparatuses, thus making the *Sphaera* a common space for scholarly engagement. In fact, the term *Sphaera* designated not only Sacrobosco's own treatise but, more generally, was used as a label for specific collections of texts used in astronomical teaching (Valleriani 2017). Just as there was an *articella* for medicine, there was a *corpus astronomicum* called *Sphaera*. Such a *corpus astronomicum*, a proper introduction to geocentric cosmology, was first shaped during the late Middle Ages (Pedersen 1975), but it continued its evolution until the first half of seventeenth century, long after the outbreak of the Copernican revolution. While Sacrobosco's text remained at the pivot of this corpus for over three centuries, the corpus of texts surrounding it became increasingly elaborated. Regional trends developed over time and many updated commentaries were appended, especially during the sixteenth century.

Previous studies have emphasized how a general tendency toward the homogenization of astronomical knowledge emerged, especially from the 1530s and the 1540s. In particular, the impulses of the Reformation transformed the curriculum of the Faculty of Liberal Arts of Wittenberg into a model that was imitated all over Europe until the end of the century and beyond (Valleriani et al. 2019; Zamani et al. 2020).

In order to understand the mechanics of this evolutionary process, the whole corpus of *Sphaera* treatises has been gathered and dissected into "text-parts." In the context of this methodology, single text-parts are defined as textual passages not smaller than a paragraph, and that cover a defined subject matter with relative completeness. One text-part in the corpus of Sacrobosco's *De sphaera*, for instance, is the *Theoricæ novæ planetarum* by Georg von Peurbach (1423–1461). This text was first included in the *Sphaera* treatises as early as 1482, and by 1537, it had been reprinted seventeen times in as many known editions of the *Sphaera*. If we include literary addenda such as epigrams, sonnets, and other types of composition that are usually considered "literary paratexts"—often printed in scientific books beginning in the sixteenth century—a text-part could be much more modest in length.

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<sup>1</sup> The database is accessible through the project website: <https://sphaera.mpiwg-berlin.mpg.de>. Accessed 08 June 2021.

A representative example might be the short *carmen* written by Donato Villalta (1510–1560) and dedicated to the scholar Pierio Valeriano (1477–1560), printed for the first time in 1537 and reprinted a further thirty-two times.

The corpus in its entirety contains 540 defined text-parts. These have been not only identified by publication dates, printers, and publishers, but are also accompanied by in-depth investigations of their authors. Most of the editions credit only a certain number of authors (usually two or three) on the title pages. By dissecting the works into text-parts, however, a number of uncredited texts were revealed, meaning that the text-parts' authors' names are not declared on the title pages, thus making them unretrievable at a metadata level.

Text-parts tend to recur among editions in the *Sphaera* corpus. By singling out text-parts that were published at least twice, with the second instance released at least one year after the first, the number drops to 241 text-parts, meaning that 299 text-parts were published either only once or more than once but only in the same year. The remaining 241 text-parts recur 1,394 times. Recurrences range from just one instance to a maximum of eighty-seven.

On the basis of the analysis described above, the geo-temporal manifestation of recurrences allows for the identification of editions as either imitated or imitating models on the basis of the combinations of text-parts they contain. In particular, it emerged that editions produced in Wittenberg gained a hegemonic position in the European production of introductory textbooks for cosmology and astronomy. Much of the process of general homogenization of knowledge, therefore, took place through this general tendency to mutual imitation in premodern scholarship.

On an abstract level, text-parts—intended as semiotic signs of knowledge—can be conceived as atoms that migrated and re-aggregated in different constellations of content over time and space. A specific edition corresponds therefore to a definite combination of text-parts. When repeated via imitation, these can be singled out as redactional formulas used by publishers to lure specific audiences. This dynamic of circulation and re-aggregation of text-parts is at the basis not only of the process of homogenization of scientific knowledge in the West but also of its progressive mathematization and its practical turn (Valleriani 2017).

On a more pragmatic level, instructors performing their teaching duties were compelled to choose textbooks that best suited their pedagogical purposes and scientific inclinations, whereas publishers handled multiple redactional formulas, for instance, by determining a constellation of text-parts enriched and adorned with variants of illustrations, diagrams, and tables to best suit consumers and gain slices of a crowded market. From a historical perspective, therefore, the question emerges as to what lies behind the choice made by an instructor over a specific cluster of text-parts, or the choice made by a publisher to offer the market a specific redactional formula. How were these choices made? Which were the typologies of the actors involved? Where did the inputs come from? In other words, understanding the abstract process of the circulation of knowledge—here described as a mechanism of appearance, reappearance, and mixing up of text-parts—still requires the human factor. Behind the assembling and reassembling of texts, there were whole communities of people interacting with one another over a short or a very long distance.

To understand this dynamic at work, one initial analytical stage involved authors alone (Valleriani 2020a). A first round of investigation regarded all scholars explicitly cited on title pages in their capacity as authors, commentators, and editors. When an edition was authored by at least two scholars who were also alive at the time of publication, a potential relationship, via printer or publisher, among the two was assumed. The results clearly indicated that such communities of authors, though extant, were not sufficient to explain the wide circulation of their texts. The recurring text-parts were therefore matched with a corresponding author. Hence, a longer list of 222 commentators emerged, comprising both credited authors and uncredited authors, identified by way of the atomized text-part analysis described above.

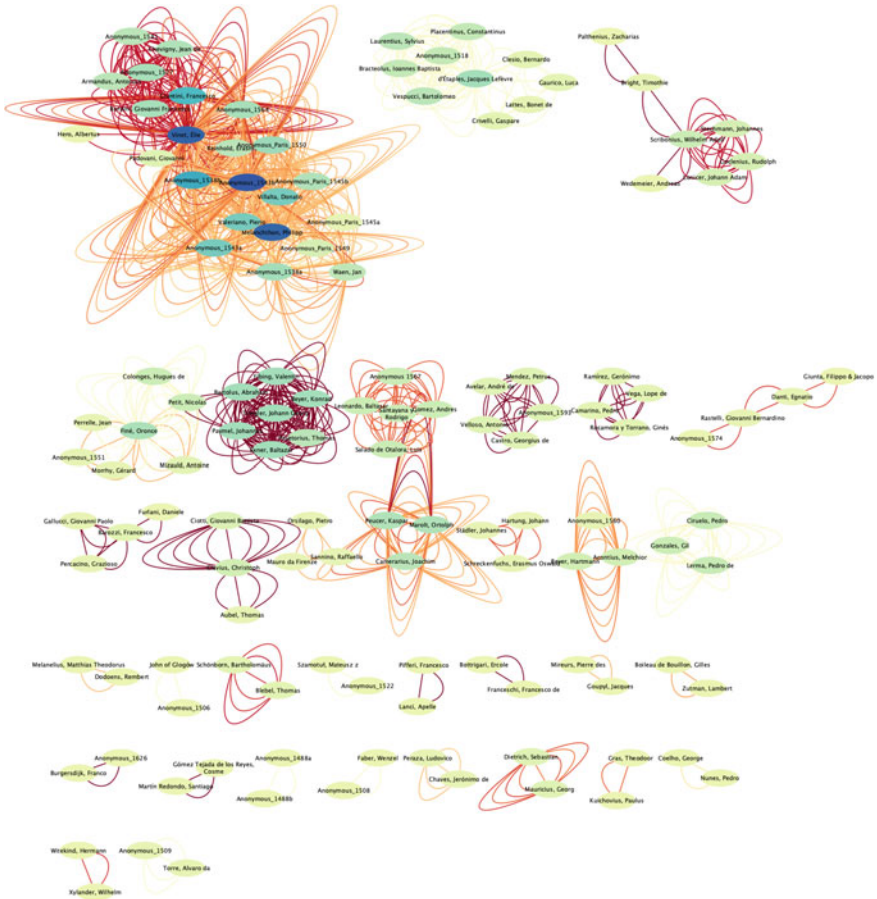
By applying the same formal conditions, a network of potential communities of authors emerges in a more encompassing picture (Fig. 1).

The number of contemporary authors who were potentially in contact with one another is 130 but the components of the network are distributed over a span of 172 years, starting in 1472. The general network therefore is highly disconnected. While there clearly is a big component that groups four distinct sub-regions, the rest of the network is constituted of a high number of smaller components of various sizes. The big component comprises for the most part the authors included in the several editions of the *Sphaera* produced in Wittenberg, the printing center that gave birth to the hegemonic redactional model of the *Tractatus* in Europe.<sup>2</sup> However, the graph in its entirety is not structured to enable the circulation of a great number of text-parts at a European level, as determined by previous studies.

The studies hitherto accomplished, however, completely neglected other relevant components of this thread, namely publishers and printers who worked hard to bring these clusters of texts into a material form. While studies concerned with early modern book producers and distributors are abundant, rarely has the focus been on studying book traders as a collective body operating around a single intellectual piece. Even more rarely has this task been attempted in the frame of a *longue-durée* research. By going back two centuries before the emergence of modern science, the goal is to retrieve the collective *modus operandi* of the European printing community while engaging in the production of one of the most widely used scientific textbooks of the time.

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<sup>2</sup> In this respect, it is worth mentioning that some anonymous text-parts which were included in the Wittenberg textbooks and which, therefore, became greatly influential all over Europe were compiled and edited by Georg Joachim Rheticus (Valleriani et al. 2022).



**Fig. 1** Network of authors of text-parts constituting the treatises collected in the *Sphaera* corpus, which contain, among others, Johannes de Sacrobosco’s *Tractatus de sphaera*. Authors are pairwise connected to each other, when their texts appeared in the same editions and where both alive at time of publication. Network data and network visualization by Beate Federau

## 2 Printers as a Collective Body of Actors

In the context of knowledge communication networks, publishers, printers, and booksellers played a significant part. Scholarship has long dismissed the idea that the book industry was merely a gear in the factory of written culture. Publishers, printers, and bookdealers at large have been increasingly recognized as holding a fair share of agency in shaping and influencing the textual and visual outlook of literature while processing it for printed circulation (Darnton 1982). Their role became particularly determinant in the process of assigning intellectual products an intrinsic commercial value. By working at the intersection between authors and users, bookdealers were

capable of absorbing and interpreting the needs of both poles and translating those needs into books with good sales records. At times, publishers and printers would take excessive agency while replicating literary works (Chap. 9). This utterly enraged contemporary authors, irritated by the liberty with which the former reinterpreted their works, interpolating and corrupting their texts and thus endangering their reputation—aside from causing them financial harm. Authors growingly sought copyright protection through book privileges (Ginsburg 2013; Squassina 2017). The authors' efforts in seeking those protections provide a vivid testimony of publishers' tendency toward intellectual appropriation in print publishing, revealing their primary role in textual production.

If the active dialogue between authors and readers is conceived as limited to the lifespan of the author, the dialogue between readers and an authored text could, and often would, survive the author. Depending on the impact of a literary work, the dialogue may endure for centuries. And virtually, no reader would hold a merely passive role. The process of reading is interpretative and transformative. A reader with a quill would already take up the role of a commentator, though not necessarily an impactful one. A restricted number of readers, however, would do much more than scribble marginal notes on their own copies (Grafton 2021). They would make their interpretative readings public, thus taking an authorial role and, eventually, making their way to the title page. So did a number of scholars who read and provided interpretations of a given text. This type of continuative relationship between readers and texts revived the life of a literary work, keeping the ball rolling.

In the context of a centuries-long literary tradition, the actors of the book industry gained even greater agency in perpetuating the fortune of a text that outlived its primary author or multitude of authors. In this continuing process of textual perpetuation and transformation, publishers could play a primary role in commercializing a text disengaged from authorial paternity. They could assemble and reassemble text-parts and merge them with visual aids in the effort of proposing a formula suited to the market. This is the exact context in which Sacrobosco's *Sphaera*, a medieval text with a plethora of living and mostly non-living commentators, endured for almost two centuries of print culture. Voided of the active role of its original author, the *Sphaera* became a standard on which editors, commentators, publishers, printers, and correctors performed before a participative audience. In this configuration, publishers and printers (when not the same person) were those who usually had the last word on how to fuse textual and metatextual elements—the intellectual, material, and visual features that made a given edition appealing to users and competitive in the marketplace of textbooks for higher education. Printers and publishers of the *Sphaera*, moreover, were mostly active and experienced in academic book production and distribution (Chap. 7); not rarely they were “accredited university booksellers” (Chap. 2). Publishers and printers knew better how to turn a book into a bestseller, and the *Sphaera*, a work that long survived its primary author, was no exception.

Terms such as publisher, printer, bookseller, and to some extent even *consumer* will be extensively used in the pages that follow; but they are open to several levels of critique and accusations of reductionism. First of all, the very configuration of the early modern publishing industry hardly allows historians to sharply distinguish one

professional figure from another. These roles may at times be distinct on the title page of a single edition, but it still holds true that in the everyday life these men and women would not distinguish their professions as sharply as we sometimes do, and in the heat of the book trade, they would deploy the expertise of each.

Furthermore, the very use of terms like publisher, printer, and seller as single individuals does not do justice to the complexity of a publishing house, a print shop, a bookshop, or a network of sellers. A single publishing house could use consultants and accountants, informants whose role in the planning and delivery of a single edition gets no mention on a title page (Rück and Boghardt 1994; Giesecke 1998).<sup>3</sup> The print shop was a collective body of artisans, more or less literate, who had the ultimate responsibility of translating the intellectual efforts of scholars and entrepreneurs in a tangible commodity.<sup>4</sup> A single bookshop functioned through the collaboration of masters and apprentices. With regard to consumers, although the same terminological awareness used for printers, publishers, and sellers is not necessary, it is nevertheless worth mentioning that the act of distinguishing consumers, producers, and dealers of printed books may be useful at an explicative level, but it again carries an element of reductionism. Publishers, printers, and sellers, when not the same person, could be themselves eager consumers and might therefore place themselves in the position of their own customers.

To chase the complex, unfolding mechanism that for almost two centuries brought the *Sphaera* corpus to a large circulation in Europe, the decision here has been to gather exemplificative stories into three sections covering respectively the levels of production, distribution, and consumption. The aim has been to recreate both the sequence of motion of an edition from the press to the shelves, and to follow the *Sphaera* corpus through the three main knots of the book industry network: publisher, dealer, and collector. The sequence follows a commonsense-based view of the market, but the circular motion of this process should not be overlooked, because of the mutual influence of each level on the others.

### 3 Production

Producing the *Sphaera*, like many mathematical and astronomical works, presented several graphic challenges. Works of geometry, astronomy, and the natural sciences employed visual aids to communicate content. A greater number and a better quality of diagrams, images, and tables made the difference between one edition and another. In the artisanal world of early modern printing, quantity and quality were two parameters that affected costs. Publishing houses and printing shops would make no secret

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<sup>3</sup> We are grateful to Falk Eisermann for bringing this methodological aspect to the attention of the working group.

<sup>4</sup> For an example of the lively activity and craftsmanship of a Renaissance print shop, see (Gerrotsen 1991).



of enhanced visual aids in promoting their editions; they announced the augmented features of their editions with a rhetoric of mastery and ingenuity.

An example of this comes from the context of Paris printing community, with particular reference to Simon de Colines (1480–1546) and Henri Estienne (1460–1520) (Chap. 2). Part of this rhetoric was plain advertisement strategy and self-promotion. However, it was an aspect of the printing craft that integrated users and producers, and it opens up our understanding of a factor that needs stress: printing astronomical works was no amateur business. Whoever ventured in production of this kind needed specific skills at hand and the ability to handle augmented costs with adequate commercial strategies. In the case of the *Sphaera*, this was an even more critical point: for a work of large-scale consumption, the transnational competition could be fierce, thus making adequate revenues critical.<sup>5</sup> If on one hand a fiercer competition encouraged innovation, and innovation primarily involved more visual aids and explicatory apparatuses such as tables, indexes, and diagrams, on the other hand these quality-enhancing elements were taken at a greater risk of market failure. Furthermore, quality-enhancing innovations and their consequent augmented costs required the consideration that there was only so much a publisher could ask the target audience to spend on a product (Milazzo 2020). With reference to the *Sphaera*, the wallets of primer consumers could be quite thin, as students of the quadrivium were not necessarily the wealthiest consumers on the book market (Chap. 8).

In the planning phase, the craft of publishers was to conceive a formula that the market would welcome, gather enough funding to finance it, maintain the channels of transmission (eventually build new ones for the purpose of a single project), and guess the right print run for the market to absorb. Much of this work required financial and logistical know-how along with a practical sense of the market merged with empirical means of assessment (Chap. 8). But, aside from this operative skill set, publishers were those who would best interpret the appetite of consumers; ultimately, they would bet money (most often not their own) and their reputations (which would later influence their access to credit lines) on an editorial formula that merged content and outlook and satisfied the expectations of the audience. At times, they would try to shock the market with innovations. In this way, they hoped to penetrate a rather conservative environment in which the preservation of a past model was a virtue and innovation could be perceived as a form of corruption. When successful, publishers would create a new niche demand, profitably go around their competitors still bound to an old formula and succeed out of their commercial intuition.

Once a specific formula proved successful, the market readjusted around it. The new formula could imply a novel outlook, refashioned content, or a newly translated text. A new redactional formula would eventually gain momentum and become a

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<sup>5</sup> The term *transnational* is here used to capture the ongoing process of modern state building. The term is being favored to *international* to signify the fact that the process of state formation was not yet complete. In the context of commercial networks, *transnational* poses an emphasis on the role of political and normative structures as an element of the governance of a supranational integrated reality, such as the book market. In the context of epistemic networks and groups of cultural correlation, the term *transregional* is being used instead to place emphasis on elements of cultural, linguistic, or geomorphological assimilation.



model for others to follow. The *Sphaera* saw the juxtaposition of different redactional formulas that experienced a period of hegemony over the market, only to be later replaced by new redactional formulas (Pantin 2020) (Chap. 3). For a literary tradition like that of Sacrobosco's *Sphaera*, variations in redactional formulas may have implied more than just a shift in the format; most often they involved the aggregation or re-aggregation of text-parts, the addition of new or clearer visual aids, the introduction of short manuals for building and applying mathematical instruments, and the increasing enrichment of the text—originally a qualitative introduction to cosmology—with computational tables to support mathematical workflows. The abovementioned studies on the formation of text-part clusters have shown that when such combinations proved appealing to the market, they were rapaciously imitated throughout Europe, either with or without the consent of those who initiated the new redactional formulas.

When it comes to the interaction between the *Sphaera* and wider print culture, Wittenberg plays a key role on both a quantitative and qualitative level (Chaps. 4, 5 and 10). The vibrant town in Saxony presents most of the common characteristics of the printing centers that produced editions of the *Sphaera*: a lively university community with a laborious print industry, mutually supporting each other in the interplay of supply and demand.

Wittenberg, a modest town in its own terms, came under the spotlight of Europe in the times of the Reformation. Its university became pivotal for central Europe and its scholars earned international resonance. With enrollment growing and local theologians rising in fame, the local print industry experienced a dramatic burst. From the 1530s on, the town participated in the production and dissemination of the *Sphaera* corpus with a redactional model that soon became dominant on the European market.

The explanation for such great success needs stress. Wittenberg being one of the centers of the cultural-religious debate of the time, its book production also received considerable attention, at least from areas sympathetic to the Reformation. The ongoing religious controversy, however, contributed in general to rise attention towards Reformed scholars, even in Catholic lands, at least until Catholic censorship developed into a firm structure (in a process that began in the 1560s) and brought these names from fame to infamy in certain regions of Europe (Sander 2018). This is clearly the case of Philip Melanchthon's (1497–1560) initiative to promote the 1531 and 1538 editions of the *Sphaera* (Chap. 5). These editions, which soon became a standard in German lands, gained ground in Catholic lands as well, with Venice quickly using it as a templet for local editions. When a single edition sold well, transnational attention rose over its redactional formula. This would eventually justify cross-confessional cultural transfers in Catholic lands equally interested in participating in the transregional commercialization of new editorial formula of the *Sphaera*.

Wittenberg more than other printing centers simplifies and magnifies the interlocking of the intellectual atmosphere of a college town and that of a busy printing industry. With growing attention toward the small town as a cultural epicenter, the local university also experienced rapid growth in the student population. The

local print industry followed. However, unlike older universities (like Paris), which could count on a long tradition of ruling the book trade even in manuscript culture (Chap. 2), Wittenberg's university took quite a while before establishing an official university press and a structured regulation of the local industry. This left much of the dealing to the private initiatives of scholars, investors, and craftsmen. The *laissez-faire* system adopted in Wittenberg generated a heated dialectic between the professionals involved in the making of books: authors, editors, publishers, printers, and binders (Chap. 5). Observing the unfolding of this tension is to observe part of the inner mechanisms of the infrastructure that produced and distributed the *Sphaera*. The unfolding of these interactions highlights the pressing priorities of the various parties involved in the production chain of books, the *Sphaera* among them: the desire for quality and accuracy on the part of authors and investors; the necessity of earning profits that publishers needed to keep themselves afloat in a difficult market; the struggle of editors, printers, and binders, who tried to make a living while operating at the bottom of the food chain.

Hence, tracing the history of the most fortunate rendition of the *Sphaera* does not necessarily mean following a history of success. Such is the case for Joseph Klug (1490–1552), the printer behind one of the most influential editions of Sacrobosco, whose business sank, along with his reputation, leading to financial misery despite the visible legacy he left in the propagation of the *Sphaera* corpus. Behind Klug's financial ruin lays, evidence shows, the strangulating tug of war between quality and the necessities of competitive pricing.

At the intersection of all these demands were printers who were left with the dilemma of accepting ill-paid contract jobs or handing those opportunities to competitors, only to be cut out of future initiatives (Chap. 5). The ecosystem of the print industry seen from the microcosm of Wittenberg proves even more profitable to historians due to the wealth of information on the urban fabric of the university town (Chap. 4). A planimetric view of this community of scholars, entrepreneurs, and artisans reveals the compartmentalization or the alliance between the professions involved in the book industry. The respective extent of the estates owned by any of the characters involved in the production of the Wittenberg *Sphaera*, and their placement in administrative positions of the town become symbolic elements in reconstructing power relations and structures of the fairly pyramidal system that was the early modern book industry.

## 4 Distribution

Distribution dynamics may be as transformative for a text as the printing process. It is through wide circulation that editorial formulas gain momentum, earn popularity, and eventually become dominant (Chap. 10). Market frictions are determinative in putting different formulas to the test, and it is through the spinning of several coexisting editions in the book market that different redactional formulas and graphic outlooks merge to create new editorial models.

The intellectual market of astronomical and mathematical texts seemed to follow precise trends and patterns that infused academic centers with a particular dynamism in the discipline and established their leadership in longevity. Such is clearly the case for Paris in mid-sixteenth century. In the field of mathematical and astronomical texts, Paris often set a standard for other publishing centers in terms of both layout and content (Chaps. 9 and 13). Paris, however, was not alone. As to how redactional and visual models migrated from print center to print center, the most intuitive answer would be that this happened with the circulation of the commodities themselves. Books circulated virally in the transnational market, and publishers—ever aware of one another—possessed enough sensibility to figure a good editorial idea from a less fortunate one. They then decided which models to follow, imitate, or reinterpret.

However, ideas could also follow the migratory trajectories of people. With regard to the *Sphaera*, the German printer Erhard Ratdolt (fl. 1477–ca. 1528), active in Venice in the late fifteenth century, provides an example of how a single editorial model could propagate as a consequence of the relocation of a single printer who carried his know-how and professional idiosyncrasies from city to city (in this particular case from Augsburg to Venice) (Chap. 3).

The human factor in the migration of ideas is surely an element to bear in mind, but in investigating the proto-industrial world of early modern printed books, the market-driven dynamics of the circulation, filtration, and optimization of ideas is an element difficult to resist. Following the idea that better-selling books earn superior commercial value, thus raising the attention of other publishers and triggering the imitative mechanism, an adequate knowledge of the transformative potential of the market is called for.

Nothing epitomizes the challenges of the transnational book market better than book fairs, and nothing represents the phenomenon of Renaissance book fairs better than the Frankfurt fair.<sup>6</sup> To investigate the representation of Sacrobosco's editions at the Frankfurt fair is to measure the transnational aspirations of the several editions that entered the market between the sixteenth and seventeenth centuries. With at least twenty instances of the *Tractatus* being officially declared at the fair, early modern editions of the *Sphaera* seem to have been conceived as literary products aimed at a transnational rather than at a localized market. Furthermore, official declarations at the fair (as shown from surviving catalogues) do not capture the complete picture of what was actually traded at the venue (Chap. 6). Thus, if the absence of an official mention of the *Sphaera* at regular exhibitions would have been a significant indication of a primarily local circulation of the *Tractatus*, its episodic yet substantial presence in official documents of the Frankfurt fair is evidence of its transnational circulation, which was likely even larger than evidenced. In fact, the non-regular mention of the *Sphaera* at the Frankfurt fair, in light of its mass production throughout Europe, opens up other relevant issues. To be officially declared at the fair, products had to meet criteria of novelty (Maclean 2021, 12). Hence, the recurrence of official declarations of the *Sphaera* at Frankfurt is an indicator of alleged or true instances

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<sup>6</sup> For an overview of Renaissance book fairs see (Nuovo 2013, 281–314). For more information on the Frankfurt Fair, see (Maclean 2021) and (Chap. 6).

of redactional innovations. Ultimately, considering the *Tractatus* in the scope of transnational commercial venues (such as fairs) clarifies the market drive behind instances of innovation that justified the migration of paratexts, text-parts, and other visual and textual apparatuses. Furthermore, chasing its several appearances at the Frankfurt fair helps detail the geographic trajectories that the editions of the *Sphaera* followed on the transnational market. The presence of Catholic printing centers like Rome in the listing of *Sphaera* editions at Frankfurt (a largely Protestant commercial trading center from the first phase of the Protestant Reformation) confirms the cross-confessional vocation of the product. Instead, the absence of *Sphaera* editions stemming from relevant print centers such as Paris and Wittenberg—both especially influential in setting the editorial standard of the overall corpus—complicates the view of the ways in which these editions found their way through the transnational market.

Another way for publishers to reach out to a transnational audience was by building an independent distribution infrastructure framed by existing channels of the European book trade and trade at large. An example that stands out is that provided by the Giunta publishing firm. Florentine in origin, cosmopolite by vocation, the Giunta built a commercial empire with trading posts in some of the most relevant printing centers of Catholic Europe (Chap. 8). Given the large scope of their commercial network, the magnitude of their output, and the sophistication of their publishing choices, the question is raised as to where the *Sphaera* fit in their global portfolio. The answer that emerges is that to a large-scale publisher with a muscular position in the continental market, the *Tractatus* looked like a less-than-impressive deal. As intellectual merchandise, the *Tractatus* was aimed at an audience that the Giunta regarded with only moderate interest. Students of the quadrivium, as a social group and commercial target, were large in number but had fairly modest means. Publishers such as Giunta were accustomed to moving large, multivolume works of high-class scholarship for consumers in the high professions. These were generally people of good financial standing who had a legitimate need for quality imprints. Hence, they represented a far more appealing group of customers. They were medical practitioners, lawyers, clergymen, or institutions, both secular and ecclesiastical, such as courts, monasteries, convents, and whole administrative or ecclesiastical districts. In comparison, students halfway through their education were much less significant consumers.

A further demotivating factor was the fierce competition to serve quadrivium students. The over three hundred editions of the *Sphaera* and the war of pirate reprints show that the commercial race was brutal (Chap. 6). Furthermore, the technical skills deployed to make an old text like the *Sphaera* look like a new and attractive one (new visual aids and a refreshing alchemy of old and new text-parts that could also battle the second-hand market) made the engagement time consuming, costly, and risky. Placing the *Sphaera*, or any other early modern textbook of this kind, in the midst of the free market proves relevant to understanding it not only as an intellectual piece, but also as a commercial artifact.

In the context of the integrated book market of Renaissance Europe, there were commercial ecosystems that stood out for a few peculiarities. This is the case of the Iberian Peninsula, a commercial area that, as far as the circulation of the *Sphaera*

in Latin was concerned (Latin being the standard language of higher education), was overly dependent on foreign imports, leaving most local production to vernacular versions (Chap. 7). The imbalance between vernacular and Latin editions in the publishing portfolio of local publishers mirrored the general structure of the Iberian print industry, which mostly catered to the local market rather than engaging in risky exports. But the predominance of vernacular editions of the *Sphaera* finds its explanation in the particular use that Iberian consumers made of the *Tractatus* and the different social and professional typologies that Iberian publishers targeted. While the archetypical user of Sacrobosco for most of the continental market remained Latin-reading students of the quadrivium, Iberian publishers aimed rather at more mundane groups, such as explorers and traders involved in maritime travel (Crowther 2020; Lanuza-Navarro 2020; Leitão 2008, 2013). In light of this, the Iberian tradition of learning from Sacrobosco's legacy appears to be more linked to the empire-building effort than to the formation of national elites, functionaries, and scholars to be employed in the efforts of modern state building. If on the one hand the Iberian Peninsula was an eager recipient of the trans- and sub-alpine production of the *Sphaera* corpus, on the other hand, due to the far-reaching radius of their commercial routes, Spain and Portugal were also responsible for expanding Sacrobosco's tradition from continental Europe to the New World.

## 5 Consumption

The consumption level has a twofold relationship with production and distribution dynamics, in that it functions equally as trigger and recipient of both. For the *Sphaera* corpus, the natural landing environment was the world of education.

The *Tractatus* was indeed handled in the book fair catalogues, such as that of Frankfurt, under the category *scholastica* (Chap. 6). Its wide circulation found a reason in the interconnection of two mutually dependent processes: on one side the increasing demand for a mathematical education, and on the other the evolution of the knowledge displayed in the *Sphaera* corpus from a qualitative introduction to geocentric cosmology to an introduction to mathematical astronomy. Christopher Clavius (1538–1612), for instance, the architect of the Jesuits' *Ratio studiorum*, considered mathematics the means to understand precepts of natural philosophy (Chap. 11) (Feldhay 1999, 2021; Price 2014). The layout of these textbooks, moreover, and in particular the design of their frontispieces and title pages clearly display the increased relevance of mathematical astronomy (Chap. 2); they therefore hint at a profound change in the role and function of *Sphaera* knowledge.

Coming back to the field of education, Jesuits, occupy a distinct space. Therefore, they provide a valuable viewpoint whence to observe the trajectory of astronomical studies and the *Sphaera* corpus in particular in the curricula of higher education. Moreover, the Jesuit movement sits almost halfway in the chronology of the history

of the *Sphaera* in print culture (1570–1650). This is an invaluable feature if one considers that with their placement in the chronology of the early modern period, Jesuits were structuring their pedagogy by filtering much of the Renaissance tradition and stretching their vision toward the cultural and social challenges of the Baroque era, to which they contributed considerably by setting a competitive educative standard. Further, the setting of the Jesuit school curriculum—*Ratio studiorum*—was a process that animated a lively internal debate in the Society. Much of this debate was put on record for historians to assess the inner logic that guided them in establishing their educative paradigm. The inner debate over mathematical education in the Jesuit curriculum reveals tensions, disagreements, and reconciliations helpful in unpacking the black box of the Renaissance and Baroque pedagogy with regard to applied mathematics (Chap. 11).

The picture that emerges from the debate internal to the Society of Jesus is quite demotivating for mathematics enthusiasts. An increasing interest in mathematical learning is indisputable, especially if compared to previous centuries. Nonetheless, the period of transition between the Renaissance and the Baroque eras saw a resistance in pedagogical circles of the full-scale mathematization of the sciences, as was called for by some innovators like Clavius—also a prominent commentator of Sacrobosco—whose passionate defense of mathematical knowledge contributes to the understanding of his own cultural agenda as a user, teacher, and commentator of the *Tractatus*. The debate triggered in the Society of Jesus, however, reveals that to Jesuit hierarchies, mathematics was perceived as inapt to respond to the challenges of post-Tridentine society and inadequate to fit the cultural model that Jesuits aimed to pursue through their schools. If not isolated, Clavius's ideas concerning the role of mathematics in the Jesuit curriculum were clearly regarded as secondary, a factor that over time created a distinction between the general scientific tendencies and the curricular developments inside the order. Nonetheless, this distinction is extremely helpful in ranking mathematics and astronomy in the realm of late Renaissance and early Baroque education, thus allowing a tentative social and cultural profiling of the consumers interested in works of applied mathematics like the *Sphaera*.

The example of a consumption dynamic provided by Paris (Chap. 13) highlights an aspect of the early modern book market that is too often neglected: the tight relationship that existed between supply and demand. If large-scale distribution was an option for publishers and printers embedded in a proto-industrial market, the still largely artisanal production of the pre-mechanized printing press also required the careful handling of print runs in response to primarily local demands.

For instance, this type of producer–consumer interaction is clearly exemplified by the short, yet meaningful adventure of a group of Iberian scholars, the *calcuratores*, who, for a limited span of years (1508–1515) established themselves in Paris, likely in the attempt to implant a foreign tradition of mathematical studies. This experiment seems to have in fact faded away soon after that community of mathematicians departed the city. Their short Parisian adventure however opened a small but fresh niche in the already vibrant market of mathematical works in Paris. This episode in the history of Parisian mathematical books should provide an example of how

nanced the pre-mechanized book market was in comprising both large- and short-scale modes of book production and consumption, more explicable in terms of an induced attempt at cultural promotion rather than independent streams of market demand.

Another outstanding example of how production could be tightly linked to demand comes from Leipzig (Chap. 12). Being a university town, Leipzig hosted a considerable number of consumers of the quadrivium curriculum—readers thus also interested in the *Sphaera*. Leipzig however was also the site of a relevant book fair. The town was therefore fully integrated in the commercial channels of the transnational book trade that pivoted around the Frankfurt fair. Admittedly, one was scheduled soon after the other to allow attendants to visit both (Maclean 2021, 24). Surprisingly, however, when it came to producing a large-consumption product such as the *Sphaera*, the Leipzig print industry used a thoroughly independent redactional model fully rooted on a local manuscript tradition, thus showing no interest in participating in the imitation war at play between other relevant printing centers. Evidence would then suggest that both consumers and producers were following their own self-determined agenda based on continuity. Likewise, the redactional formula of Leipzig did not inspire other European printers; the circulation of *Sphaera* imprints produced in Leipzig was primarily local. Most likely, copies served the nearby university of Wittenberg (at least until the latter initiated its own local tradition in the 1530s to set itself apart as a dominant transregional standard). This illustrates how the texts of the *Sphaera* corpus could either reach a global radius or remain largely relegated to serving the learning purposes of a restricted community. This fact alone may nuance any overly enthusiastic claims of automated scientific information sharing linked to new printing technology. In fact, large-scale production was an available option—but so was a reduced-scale production and distribution mode. A single scholarly tradition could be doctored to stay quiet and local.

## 6 Modes of Production of Early Modern Scientific Textbooks

As mentioned, the early modern European system of production and dissemination of written knowledge in print was a very complex one, and yet this was only one part of a much more complex system of production, innovation, and transmission of scientific knowledge. It has been highlighted how each part of this system was bound by a relationship of reciprocity. The purpose of this section is to settle these complexities and to break down the integrated system into smaller and more comprehensible parts. The focus will be solely on the multiple dynamics that pertained to the production of textbooks, which, as in the case of the *Sphaera*, were mainly intended to serve the purpose of the higher education.

Meaningful historical conclusions concerning the early modern academic book market can only be reached after acknowledging that dealing with textbooks from this era means dealing with sources that often remained in the same state as their



printers conceived them for the market.<sup>7</sup> It is not completely clear why textbooks were handled differently than other texts. This feature certainly relates with their normative-pedagogical function, as these were instruments for teaching in the context of highly regulated educational institutions. But an overarching study concerning the normative features of early modern textbooks in reference to the evolution of their content, format, and market is still largely missing.

With regard to a tentative model of the workflow that brought a textbook to press, a standard way to begin the unfolding of any literary project (including textbooks) would be its authorial textual conception. In the case of the early modern editions belonging to the *Sphaera* corpus, authorship does not refer to the original text—which constituted the nucleus of the corpus. This was compiled in the thirteenth century, long before the printing press came to be. Rather, for a book like the *Sphaera*, the so-called authorial conception was mainly linked to the selection, philologic refinement, and eventual novel integration of the numerous commentaries and text-parts that deepened specific subjects touched on by the main text. Another form of semi-authorial intervention involved in the production of the *Sphaera* concerns translators, who gave birth to new vernacular renditions of both the main text and the commentaries that accompanied it. Such works were printed together with the *Tractatus* of Sacrobosco. Their authors were almost always scholars involved in quadrivial teaching (Valleriani 2020a). Scholars directly linked to the world of teaching also had direct insight into the chosen commercial target. This allowed them to link their intellectual initiative to specific teaching needs for the academic years to follow, thus assuring a publishing project with a minimum number of sales.

Publishers, for their part, were the professional figures tasked with translating the intellectual and pedagogic impulses of authors into feasible products. They were also the ones who would make a project financially viable by putting their reputation, their commercial networking capacity, and their financial credibility on the line (Burkart 2019, 42–50).

Wary of the niche market and of the redactional formulas in circulation with variable market acclaim, publishers worked with authors in the conceptualization of a piece. Publishers, however, were also up to the much more mundane task of drafting a functional plan of action. Consideration over the adoption of a specific redactional formula had to be weighed with consideration of the materiality of the commodity that was being planned (paper, format, types, iconographic apparatus, and so forth).<sup>8</sup> All of the above would require a set of costs that had to be balanced with an adequate retail price suitable to the pockets of targeted users. Even more detailed considerations over costs were on the way: storage, shipment, insurance, and copyright fees, to name a few. All considerations on costs and possible revenues had to be measured against the capacity of the market to absorb the product. Publishers whose know-how included

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<sup>7</sup> According to Sarah Werner, early modern textbooks were sold stitched or paper wrapped (Werner 2019, 23). This feature might be related to the fact that such works are often preserved in their original state and not bound to other works, as this is often the case for other literary genres.

<sup>8</sup> For an example, concerning the decision-making process and its inter-links with considerations over the intended audience in the context of a large-scale printer-publisher such as Christophe Plantin (1520–1589), see (Renaud 2020).

skills of market predictability (Chap. 8) were responsible for proposing a feasible figure for print runs. Here is where the know-how of publishers merged with the exact knowledge of the scholars they collaborated with in regard to how ample or tight the most proximate market of reference would be. In the case of textbooks like the *Sphaera*, it is fair to hypothesize that the figure coincided with the number of students enrolled in quadrivium classes for the current year and prospectively for the years to come. This was perhaps the easiest variable to forecast, and the foreknowledge was plausibly capable of covering a good part of the initial costs. Anything beyond that number could translate into direct or indirect revenue, one may hypothesize.<sup>9</sup>

Conversely, a small print run, although it minimized risks, also made the project less profitable. However, a shallow-radius distribution network and small storage capacity were all considerable limits to large print runs and thus to larger profits. The task of publishers then was that of building a sufficient distribution network to make their initiatives sustainable and, even better, profitable. A big name in the printing community had a bigger reputation based on a larger network of local and transnational alliances. This allowed them a more ambitious plan, a greater capacity for cutting costs per copy by producing larger print runs, and easier access to lines of credit (based on the expectations that creditors had for the financial viability of the planned publishing initiative). The economy of scale was fully at work in the process of turning an intellectual effort into a salable commodity.

Economic considerations concerning the size of print runs, moreover, did not solely regard the book market as observed from the perspective of an individual printer and publisher as described above. The textbook market had its own characteristics, and these were valid all over Europe, though with more or less efficacy depending on specific territorial regulations. Following the argument developed by Paul Gehl for schoolbooks in sixteenth-century Italy (Gehl 2013), all textbooks were first and foremost designed, produced, and distributed for a local market. In other words, they were the result of a trade-off between the teachers and lecturers on one side and the printers and the publishers on the other.<sup>10</sup> In this trade-off, teachers and lecturers represented the educational institutions present on the local markets. This kind of trade-off could take place for a variety of reasons. The most relevant in the case of the *Sphaera* corpus was the fact that, as mentioned above, the same teachers and lecturers were also the authors of the commentaries or of other texts that, in the redaction of an edition, were added or appended to the original (Valleriani 2020a).

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<sup>9</sup> The issue of revenue in the field of book trade is a nuanced one. Bookdealers did not solely base their trade on the exchange between commodities and cash. Bartering was also common practice. This could involve books in exchange for books (Maclean 2021, 50–51, 247–278), which could be traded for cash or used as currency to tighten commercial or political advantages or to maintain patronage-based liaisons. Booksellers, however, would also exchange books for ordinary commodities (Dondi and Harris 2013).

<sup>10</sup> For a focus on the commentator and lecturer Jacques Lefèvre d'Étaples, see (Chap. 2); for the relation between Wittenberg printers and Philipp Melancthon, (Chap. 5); for the trade-off between Paris printers and the group of the *calculatores*, (Chap. 13). For another example, concerned with the Parisian publisher and bookseller Guillaume Cavellat, see (Pantin 1998).

Some of these textbooks were then able to enter a transnational market. Gehl analyzes only the case when the production of a specific textbook (or of a specific text-part thereof) was taken over by a printer or publisher who had established a transnational market for their business. On the basis of his empirical analysis, access to the transnational market seems to have opened when a sufficient number of reprints or reissues had already taken place at a local level. In other terms, it is possible to hypothesize that a specific threshold of (re-)production had to be met in order for a textbook to access a wider distribution network. This hypothesis can be expanded by cases derived from Paris printers and publishers, who were working on the local market while active, at the same time, on a transnational one. The opportunity therefore existed for scholars to enter both markets at once by means of a single publication agreement. A known example is the relationship between the famous reformer of the mathematical curriculum of the university of Paris, Élie Vinet (1509–1587), and Guillaume Cavellat (1500–1576) (Chaps. 2 and 9) (Pantin and Renouard 1986).

Large-scale publishers guaranteed access to a wide transnational market by means of established channels of distribution, transnational alliances, sound marketing strategies, and regular attendance at fairs such as Frankfurt's (Chap. 6). But alongside good sales performances, there was another relevant way in which redactional models might have circulated and inspired imitative reprints; this involved the awareness that actors of the publishing industry had of alternative redactional models. As mentioned, Wittenberg's editions of the *Sphaera* soon became a dominant model in Europe (Valleriani et al. 2019; Zamani et al. 2020). These were however primarily conceived to cater to the local academic market: their absence from the Frankfurt fair's catalogue may be evidence that advertising them to a transnational audience was not a priority. Their emergence as dominant redactional models may then find an explanation in the interest they garnered among European authors and publishers regardless of their transnational visibility (Chap. 10). Sometimes, such awareness was made explicit by publishers, as in the case of the 1562, 1569, 1574, and 1586 editions by Girolamo Scoto and his heirs, who presented them as reprints of the previous Paris edition of Cavellat (*ex postrema impressione Lutetiae*).

All these distribution considerations had to jibe with publishers' knowledge of their own distribution capacity; publishers were well aware of the franchising structure they had built over the years, the alliances they held with colleagues around Europe, and their influence on the market. In sum, publishers knew the capacity and extent of their distribution network and planned print runs according to this factor, alongside estimations of market saturation.

A powerful weapon publishers and authors could consider deploying were book privileges. These were costly legal instruments granted to either authors or publishers (or, at times, to the former by the way of the latter). Privileges not only shielded grantees against pirated copies but also granted them a monopolistic position within their book market (most of the privileges had a limited geographic span). Privileges were among the itemized expenses that publishers took into account when planning a publishing project. Book privileges were granted only to editions that introduced

true innovations to the content (mainly texts, images, or apparatuses). It is fair to say that the objective of gaining even a local monopoly worked as an incentive for innovation. Thus, textual or metatextual innovations in frequently republished works like the *Sphaera* were also market-driven elements.<sup>11</sup>

Most material production costs were negotiated in a dialogue that, at least in the case of Wittenberg, saw printers in a position of great disadvantage (Chap. 5). With publishers interested in getting away with the most convenient price for a single print run and willing to use local competition among printers as valid leverage, printers could be forced to make the most of a contracted job by downgrading the quality of their work to the minimum standard agreed upon with the publishers.

The complexity of the pre-production process was partially mirrored by the microcosm of the print shop, where diverse skills brought by diverse characters could meet and benefit from mutual cooperation. Mathematical texts such as the *Sphaera* required special expertise (Chap. 2), and the production of innovative diagrams and images required an astronomer to work with an engraver and for the two to agree upon the accuracy of the visual outcome. This necessity occasioned episodes of intellectual collaboration between professionals who would otherwise have little reason to work together. The act of correcting proof sheets could have been the mechanical practice of an ordinary corrector whose task was collating imprints with a rubber-stamped manuscript. However, clues suggest that quality editions made use of expert scholars to confirm that complex mathematical material would hold together (Pantin 2013). In certain cases, authors and printers could even be the same person, creating a fine short circuit between theoretical knowledge and mechanical know-how (Chap. 2) (Axworthy 2020).

Summing up, grasping the academic book market requires an understanding of the inherent mechanisms of both the local and global markets and their reciprocal interaction. On the local market, the dominant factor was represented by the close relationship between book producers and instructors, as well as the educational institutions in which they were active. On the global market, the dominant factors were twofold: from a material and economic perspective, the dominant factor was the distribution network of book producers, and from a more abstract perspective, the dominant factor was the mutual awareness among book producers in addition to the authors' networks. The European success of the Wittenberg *Sphaera* was due mostly to the latter. However, Wittenberg models were first imitated by great transnational printers and publishers in Venice and Paris, who in turn were echoed by other distribution networks.

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<sup>11</sup> Another feature of book privileges worth mentioning is that they occasionally provide indirect clues on print runs. For example, it is known that in Venice, it was customary from the 1540s onward to grant book privileges only for editions exceeding four hundred copies (Nuovo 2013, 110).

## 7 Continuities and Further Research

This volume has been conceived as a continuation of the work published in 2020 concerning the authors of the commentaries of the *Sphaera* (Valleriani 2020b). The goal was to complete investigations of the actors, networks, and modes of transmission of knowledge involved in the perpetuation of the epistemic tradition linked to the *Tractatus de sphaera*.<sup>12</sup>

This volume is exclusively concerned with the circulation of the *Sphaera* in print, although it is fairly obvious that the printing press was not the exclusive circuit of dissemination and consumption of the *Tractatus*. Print culture and manuscript culture largely coexisted in the period represented by the *Sphaera* corpus, and manuscript redactions of Sacrobosco likely played a significant role in shaping the modes of transmission of astronomical and mathematical knowledge, as well as the dynamics of consolidation of epistemic communities (Dicke and Grabmüller 2003; Richardson 2009; Richardson and de Vivo 2011).

Secondly, the study mainly covers continental Europe, with the exception of brief coverage of the Iberian trans-Atlantic territories. If the tradition of Sacrobosco's scholarship has been pursued in the areas in which it flourished, the volume does not touch upon English-speaking regions and northern Europe. This is justified by the fact that such areas did not have a relevant role in producing printed editions of the *Sphaera*, with the exception of a few nautical manuals translated from Spanish into English in Britain, mainly based on excerpts or brief paraphrases of the text.

Finally, in compiling adequate case studies, one relevant center of book production, Antwerp, was not included. In the context of the print history of the *Sphaera*, Antwerp was in fact a late comer, and not an outstanding contributor in terms either quantitative or qualitative, with none of the local editions becoming a dominant model.

In spite of these limits, however, the volume covers forty-three percent of the sources of the corpus.<sup>13</sup> By means of these studies, it will now be possible to interpret data concerned with the social, economic, and institutional relationships among authors, printers, and publishers, and thus to determine whether the emergence of an epistemic family of treatises, characterized by their similarity to the Wittenberg model, is structurally related to the emergence of a social group. This is the direction of future research.

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<sup>12</sup> To pursue the investigation presented in the first volume of the series, forty-three percent of the corpus was taken into consideration (<https://sphaera.mpiwg-berlin.mpg.de/doi-visualisation-authors-volume>).

<sup>13</sup> For a visualization of the sources of the *Sphaera* corpus that are mentioned in each chapter of the present book, see the "Visualizations" page on the *Sphaera* project website: <https://sphaera.mpiwg-berlin.mpg.de/sphaera-printers-volume/>. Accessed 16 June 2021.

## Abbreviations

### *Digital Repositories*

Sphaera CorpusTracer Max Planck Institute for the History of Science. <https://db.sphaera.mpiwg-berlin.mpg.de/resource/Start>. Accessed 07 June 2021.

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