

# Chapter 1

## Prolegomena to the Study of Early Modern Commentators on Johannes de Sacrobosco's *Tractatus de sphaera*



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**Abstract** By way of introduction to the present volume, a corpus of 359 treatises is described that was used in early modern educational institutions for introductory classes on cosmology and that is referenced by the following contributions. Following a taxonomy of early modern commentaries, central characteristics are analyzed in detail such as the rate of production of the treatises, the places where they were produced, and their various languages and formats. The focus then turns to the balance between the temporal dynamics of production of the treatises and the lifespans of their commentators. This reveals how the early modern textbooks first amplified medieval scientific knowledge and only slowly began to support and spread the echoes of scientific debate among contemporary scholars. The institutional and intellectual profiles of the commentary authors are then described on the basis of the results presented in the contributions to this volume. The commentators are described by referring on one hand to their relations to the universities, religious orders, and commercial institutions, and on the other to their engagement with disciplines both inside and outside the conceptual framework of the quadrivium. Finally, a quantitative summary of the results achieved by this volume is presented along with outlines for future research endeavors that will focus, consequently, on the role of the printers and publishers of the same commentaries.

Commentaries on the *Sphaera* of Johannes de Sacrobosco (died ca. 1256) constitute a peculiar genre in the *mare magnum* of medieval and early modern scientific commentaries. They are peculiar for a number of reasons. First and foremost, they do not comment on an ancient text but rather on a late medieval textbook, compiled for coursework at the University of Paris (Thorndike 1949, 76–142). Sacrobosco's

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work, a short qualitative introduction to geocentric cosmology, was not ambitious in its treatment of mathematical astronomy. It is actually best defined as a manual for using a scientific instrument, namely, the armillary sphere. It is a piece of deictic writing and it was probably used for deictic teaching—its main purpose was to make students familiar with this specific instrument. A second peculiarity of these commentaries is the fact that their history of publication, the precise run of editions between the thirteenth and the mid-seventeenth century,<sup>1</sup> exhibits such exceptional continuity that the usual historical periodization that divides the Middle Ages from the early modern period does not seem significant in the least.

The original text does not introduce any relevant innovation from the point of view of cosmological knowledge. It is clearly based on the geocentric conception of the universe found in Ptolemy's *Almagest*, but it is also influenced by later works, especially from the Islamic scientific tradition, as Lynn Thorndike has clearly shown (Thorndike 1949, 1–75). Nevertheless, the textbook cannot be considered a simple paraphrase or abridgment, first of all because it contains a short but significant passage at the end to contextualize it in the general frame of Christian theology, and secondly because it has an original textual structure—it was designed to function in a particular context: the newly conceived university, built around the scheme of the quadrivium.

Retracing the history of the treatise over four centuries is a fascinating project that can only be accomplished by splitting it up into specific aspects and time windows. The exceptional continuity of this commentary tradition is due to the central role of cosmology in the general scientific and cultural framework that emerged in the late medieval time. The cosmological worldview was the nucleus around which the European knowledge system—with its constellation of scientific subjects—was organized. This central role remained unchanged until the mid-seventeenth century, when it mutated not only because of the emergence of alternative worldviews but also because of the progressive specialization of subjects previously attached to cosmology, which in turn achieved the status of new, independent disciplines. The matter of which scientific subjects were seen as kindred to cosmology had in fact been evolving throughout the centuries in question. In the thirteenth and fourteenth centuries, for instance, the study of cosmology at the universities was certainly instrumental to the study of *computus ecclesiasticus*. The association between these two subjects—cosmology and calendric—is readily apparent to even a cursory analysis of the many *Sphaera* manuscripts deposited in archives of medieval sources. They very often appear in collections of university textbooks that contain treatises on both subjects. Yet this association can scarcely be found in later periods. Meanwhile, the text of Sacrobosco in the early modern period was often written or printed together with texts whose subjects were previously either non-existent, such as cosmography, or not associated with cosmology.

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<sup>1</sup>After 1650, some further editions of the commentaries on Sacrobosco's *Sphaera* were published. However, the role of this text, for instance in the context of university teaching, declined to such an extent that those late editions can no longer be considered representative of the scientific debate in Europe in that period.

If the tradition of commentaries on the *Sphaera* of Sacrobosco is seen in light of the role of cosmology within the entire scientific knowledge system, what appears are four centuries characterized by a profound continuity. If, however, the same tradition is analyzed with the aim of determining which scientific subjects pivoted on cosmology in the same knowledge system, this continuity also seems to accommodate a more dynamic development, one which might allow us to reconstruct how scientific knowledge, as it was imparted at European universities, fundamentally changed over time.<sup>2</sup>

This characteristic opens up the possibility for a temporal segmentation of this long commentary tradition, a segmentation which is further supported—and perhaps made necessary—by three important contextual factors and changes that took place in the first phase of the early modern period.

Firstly, commentaries on the *Sphaera* got on board the exciting new medium of the printed book in 1472. Two 1472 editions, one printed in Ferrara and the other in Venice (de Sacrobosco [1472a]; 1472b), opened a long, spectacular series of 359 different editions of treatises on the *Sphaera* up to 1650.<sup>3</sup> As book historians (recently, Angela Nuovo in particular) have well demonstrated, the market for printed books became a transnational European market very quickly. Large printer's workshops set up a selling network able to cover large geographic areas, which smaller workshops could also tap into. The European book market was already well established before the turn of the fifteenth century, and great central nodes such as book fairs supported the continuous development of this market during the whole early modern period. An elaborate texture of printers, publishers, and booksellers emerged all over Europe and continuously expanded. These central nodes—the book fairs, and centers such as Paris, Venice, and Basel—attracted a myriad of printer's workshops, either because they were appropriately situated on the lines of distribution or because of the presence of authorities and institutions relevant and necessary to their economic activity (Nuovo 2013).

The second factor relates to the history of the universities. From the same period of the expansion of book printing activity toward the end of the fifteenth century, the so-called third phase of university foundation took place. Especially the sixteenth century is marked by an impressive increase in the number of universities in Europe. Because of the high mobility of lecturers and students, the universities as such can be seen as another network of interconnected nodes sharing similar aims, structures, and, most importantly, knowledge (Rüegg 1994–2011, Vol. 2; Grendler 2002).

The increasing homogenization of scientific knowledge over the continent, also detectable in the corpus of the early modern commentaries on the *Sphaera*, might be

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<sup>2</sup>The reconstruction of a shared scientific identity in Europe between the late medieval and early modern periods, based on an analysis of the evolution of its underlying knowledge system, is the overarching goal of the project in whose context the present study was conducted. For more information, see <https://sphaera.mpiwg-berlin.mpg.de>. Accessed June 2019.

<sup>3</sup>The number of known books constituting the corpus of the printed commentaries on the *Sphaera* of Sacrobosco can obviously increase if new texts are found. The database displaying the current status of research is available through the website of the *Sphaera* research project (see footnote 2).

explained by the combination of these first two factors. However, homogenization does not mean stagnation or lack of innovation. In fact, homogenization was a process that could only take place through the continuous input of innovations by the actors of networks—innovations such as additional *scholia*, new images for the same textual content, or a description of a new solar clock. Innovations were the motor that justified exchange and connectivity in the network, and the higher the level of exchange, the more homogenous the knowledge became—the shared scientific knowledge of Europe that manifested itself in the teaching of young students in their first years at the faculties of liberal arts.

The third factor is represented by great epochal processes and events in general. Although their consequences are often difficult to grasp by looking directly at the *Sphaera* commentaries, the journeys of exploration and events such as the Reformation in 1517 clearly determined “waves of knowledge” that are detectable in the content of these treatises—for instance, they had bearing on the appearance of new subjects and the disappearance of others.

Because of these factors, it appears justifiable to segment the analysis of the commentary tradition into at least two great temporal phases, the first dating from the authorship of the treatise by Sacrobosco’s own hand until the first appearance of the treatise as an incunable in 1472; the second from this same year until 1650, when the commentary tradition of this specific text and its scientific relevance came to an end. What follows will refer to the second phase of this editorial history.

This segmentation into two epochs, however, does not yet fully consider the medium through which the knowledge was disseminated. The diffusion of print technology did not suddenly nullify the habit of using handwritten material for study purposes. It is well known that, at least during the first phase of the history of printed books, manuscripts remained predominant as a medium. Therefore, when an editorial history of this temporal length is investigated, one has to deal with two different time scales, each associated with a specific medium. This would imply that the investigation of the corpus of early modern commentaries on the *Sphaera* of Sacrobosco should not be limited to the printed books only, but needs to take into consideration the manuscript tradition as well.<sup>4</sup> Unfortunately, however, no census of the manuscripts of this era containing the text of Sacrobosco with or without commentary has ever been compiled. This means, first, that research can only be carried out based on the exclusive analysis of printed sources, which in contrast to handwritten manuscripts have been systematically and completely identified and collected; and second, that research results, especially concerning the phase during which the printed book established itself as the academic standard, have to be considered temporary until further source analyses can complete the picture.

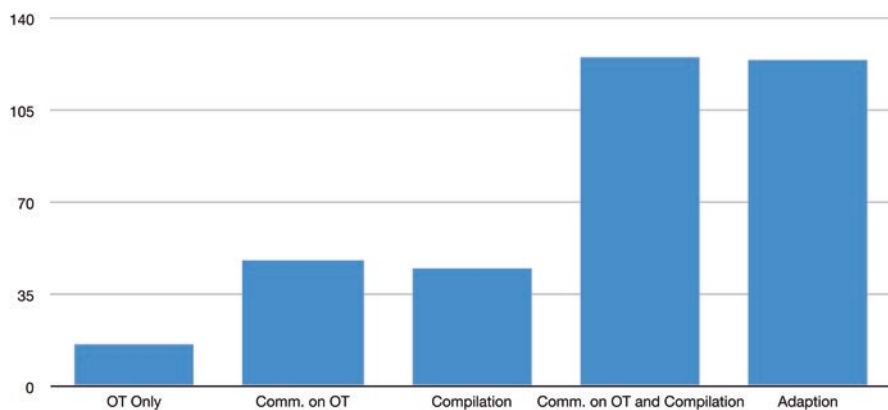
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<sup>4</sup>Research that systematically combines the analysis of printed sources with the handwritten ones for a long period during the fifteenth and sixteenth centuries would require additional temporal scaling because of regionally different speeds of decline for the manuscript and emergence for the printed book as the principal medium for scientific and teaching purposes.

## 1 The Corpus of the Printed Commentaries

The 359 printed treatises, which cover a time span of 178 years, offer the possibility to investigate multiple aspects of this editorial history. On one hand, there are basic changes to the knowledge system (even as it remained grounded in cosmology), and on the other there is the way these changes came to be “represented” through the evolution of printed books. These two points of focus can be investigated on the basis of their mutual relationship. In this respect, it is useful to sub-divide the corpus into a taxonomy that reflects the book or edition typology. In particular, five categories can be identified by following a bottom-up approach, that is, by analyzing the corpus in its entirety and focusing only on textual elements (Fig. 1.1).

The first type of book that can be easily identified contains the short original tract of Sacrobosco, and nothing more. This is the smallest group of books in the corpus and it mostly appears in the first phase of the history of production. A close look at the texts nevertheless shows that they cannot be considered truly identical. In these books as well as in all the others that contain a reproduction of the original text, deviations of all sorts can be detected. Indeed, a census of all these variations is still a *desideratum*. Often, such changes concern linguistic or syntactic aspects. Sometimes they are made explicit—for instance, on title pages or colophons (*sphaera revisa*, *sphaera emendata*, etc.)—particularly under the influence of the humanistic requirement for a more elegant Latin, but many times they were just applied by the correctors employed in the printer’s or publisher’s workshops, who mostly remained anonymous. Thorndike indeed noticed that different variants of the text were circulating already during the first phase of its history in the thirteenth and



**Fig. 1.1** A typology for the editions constituting the corpus of early modern printed commentaries on the *Sphaera* of Johannes de Sacrobosco: editions that contain the original medieval tract (OT) only; those that contain the original treatise with commentary; those that contain the original treatise and other treatises (compilations); those that contain the original treatise, commentary, and other texts; and adaptations

fourteenth centuries (Thorndike 1949, 1–76). Other differences are more content related. They can concern the citation of sources and even aspects of cosmology. Finally, new variants were created through the process of translation into local tongues, as will be shown later. Generally speaking, it can be said that the reproduction of the original text certainly was faithful, but not made with the historical and philological sensitivity that would be expected nowadays. In the spirit of the time, the continuous variations compiled until the very end of this series of editions did not encounter any scientific objection, as the main goal was scientific and not philological.

The second type of book displays the original treatise plus a commentary on it. This is not, however, the most relevant of the sub-groups of treatises, as one might expect. It also appears quite early in the history of this corpus, but in total only accounts for 48 editions. The identity of the corpus is characterized by a combination between the second and the third type of edition, namely, compilations.

Compilations are volumes that contain the original tract (without comments) alongside other texts. The most studied example of this is the compilation of Sacrobosco's text with Georg von Peurbach's (1423–1461) *Theorica planetarum* (Chap. 6). In this case, the compilation of the two texts clearly aimed to enlarge the spectrum of subjects the volume dealt with: from the description of the *machina mundi* to a method for determining the positions of the planets. Often, however, commentaries on the *Sphaera* were added that might or might not refer to specific passages of the original text—though they were never directly integrated into its textual flux. A classic example of this kind of commentary addition is represented by the compilation of Sacrobosco's text with the *Questions* of Pierre d'Ailly (1340–1520). The latter text itself is not a commentary on the *Sphaera*, but placing the two texts together nevertheless creates a commentary, a way to deepen certain aspects of the original text.

Identifying compilations, which account for 45 editions in the corpus, is made particularly difficult and “risky” for source analysis because of a series of issues related to the characteristics of the early modern book market. In particular, the practice of producing bound books developed very slowly and did not become a market standard until after the period in question.<sup>5</sup> Quaternions were printed, stored in the bookshops as piles of sheets, and bound in the shops themselves, together with other books, selected by the customer at the moment of purchase. However, this does not imply that printers and publishers were producing only single texts and avoiding the design and manufacture of more elaborate books like compilations. For a researcher with some knowledge of the quadrivium tradition—the teaching

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<sup>5</sup> During the second half of the sixteenth century, some publishers and printers introduced the *corezze*, a sort of light binding whose main function was to facilitate the transportation to, and storage at bookshops. They did not represent normative guidelines concerning the content of a final volume, which was bound at the shop by the seller according to the selection of books made by the customer (Nuovo 2013, 136).

framework to which these books mostly belong—recognizing the printer’s intention is often quite simple indeed.<sup>6</sup>

As mentioned, a combination of the second and third book types gives us the most essential representation of the corpus of editions. These are volumes that contain at least one commented edition of the *Sphaera* of Sacrobosco and further content-related texts as well. The great Venetian anthologies of 1508 and 1531, published by Giuntino Giunta (1477–1521) and Lucantonio Giunta (1457–1538), respectively, are among the most impressive examples of this mixed typology. They contain commentaries and texts of authors such as Bartolomeo Vespucci, Francesco Capuano (died ca. 1490), Jacques Lefèvre d’Étaples (ca. 1455–1536), Johannes Regiomontanus (1436–1476), Pierre d’Ailly, and Robert Grosseteste (ca. 1175–1253) (de Sacrobosco et al. 1508, 1531), and they were produced with the clear intent to give an up-to-date survey of the relevant subjects. This group amounts to 125 editions and is therefore the most significant for understanding both the role of cosmology and the way knowledge was systematized over time.

The last type of treatise can be called ‘adaption.’ Identifying the books in this category requires the most background knowledge. These books, together a considerable group of 124 editions, do not actually contain Sacrobosco’s text. They are seen as related to it, above all because they share a similar design, that is, they discuss the same subjects and in the same order. They also often make use of the same illustrative apparatus, at least partially. Finally, adaptations also include the so-called *Quaestiones*, books written in the form of questions and answers and intended for the students as an auxiliary means to prepare for an examination. While the identification of adaptations is very simple in certain cases, such as in the case of the works of Alessandro Piccolomini (1508–1578),<sup>7</sup> in many others the application of this category requires a close reading and a final decision on each individual source at hand. This type of edition serves as a limit category to distinguish the corpus from other works produced in the frame of early modern cosmology. It is necessary for the corpus to maintain a well-defined identity, and at the same time to keep the number of sources under examination at a manageable level.

Apart from the first type (a simple reproduction of Sacrobosco’s treatise), all the *Sphaera* editions can be considered forms of commentaries. Beginning from the kind of comment that is created by breaking the original text into sections for the insertion of additional text, or “atomizing” the text, as Anthony Grafton calls it

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<sup>6</sup>Besides a content-related analysis of the texts, there are several further ways to distinguish between compilations of texts as conceived by the printers and those created by individual customers in the bookshops. The principal ones are: (a) if it exists, an analysis of the table of contents, (b) the position of the colophon, (c) an examination of binding, paper, types, and ink, and (d) a comparison with other copies of the same volume. Nevertheless, a certain degree of uncertainty remains sometimes in reference to some editions, in particular to those which were produced in the early phase of the diffusion of printing technology, during which the design and conception of ‘book’ as a final product was still under development.

<sup>7</sup>Alessandro Piccolomini authored fourteen editions that belong to the corpus of the printed commentaries on the *Sphaera* of Sacrobosco. For more information about these editions, see <http://hdl.handle.net/21.11103/sphaera.100964>

(Grafton 2010), these typologies can be used to understand the historical developments that slowly brought the practice of commentary in science to an end, giving way to the emergence of a new genre, which in turn became a forerunner to the scientific monograph. Moreover, the compilation of texts, despite being a practice that always existed on an individual level (any medieval manuscript is testament to this), almost became a new genre of its own when it entered the world of the printed book—namely, when it exited the realm of individual research and interests to become an object of public scientific discourse, a process motivated in large part by the printer's will to conquer or maintain sectors of the academic book market.

If other elements aside from the textual aspects of the treatises are considered, such as the visual apparatus, the panorama becomes even more sophisticated. Ongoing research is showing that the books constituting this corpus contain roughly 16,000 content-related scientific illustrations, most of them astronomic and cosmological diagrams. Together with other sorts of images—frontispiece, illustrations from title pages, printer marks, decorations, and initials—they amount to about 20,000. Scientific visual material does not simply display knowledge that is otherwise written. It conveys it in a different way and can even display different scientific content. The development of the visual material used in this corpus (Chap. 9) attests to the increasing relevance of this medium for the transmission and transformation of knowledge. In other words, the insertion of images into the texts can be seen as an additional way of commenting on it.

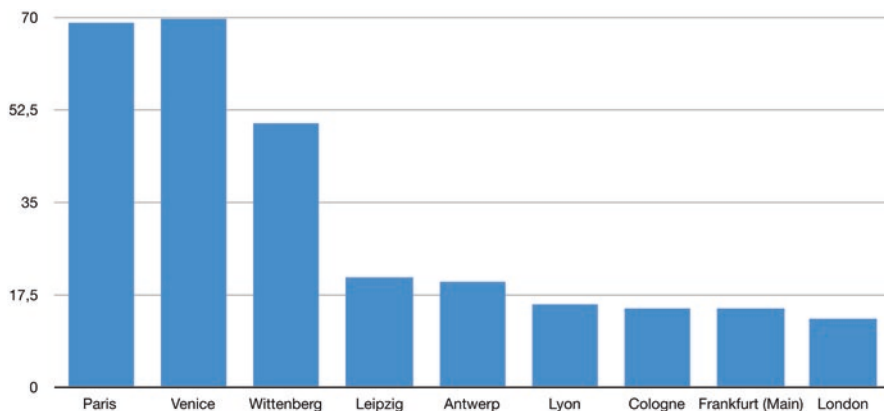
Textual typology and visual apparatus are aspects of the book whose materiality calls for the analysis of further aspects, including those related to the printing process and those concerned with selling the book as a product. Although not all this data is available, some further considerations pertaining to the internal dynamics of the corpus and especially to the role of the commentators within the framework of this corpus can be easily added at this stage, namely those concerned with the places of production, the formats of the books, and the languages in which they were published.

In Europe, the production of these commentaries took place in forty-one different cities whose geographical distribution basically covers the entire continent, from Krakow to Lisbon and from London to Rome. Nevertheless, the production was not equally distributed and if only those centers of production are considered where at least ten different editions were printed, only nine cities remain (Fig. 1.2). As one might expect, the two most relevant centers are Venice and Paris, both hubs of the transnational European market for printed books. The third position of Wittenberg is all the more relevant if one considers that it entered this market as late as 1531, forty-one years after the first printed edition. As the intellectual center of the Reformation, its political and pedagogical influence over Europe is reflected by this position.<sup>8</sup> The fourth position of Leipzig, on the contrary, is based on the production of books that took place before 1520, at which point its role as the main producer of university textbooks was completely taken over in the course of only a

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<sup>8</sup>For a study that shows how Wittenberg's treatises shaped the content of the textbooks on cosmology in Europe, see (Valleriani et al. 2019).





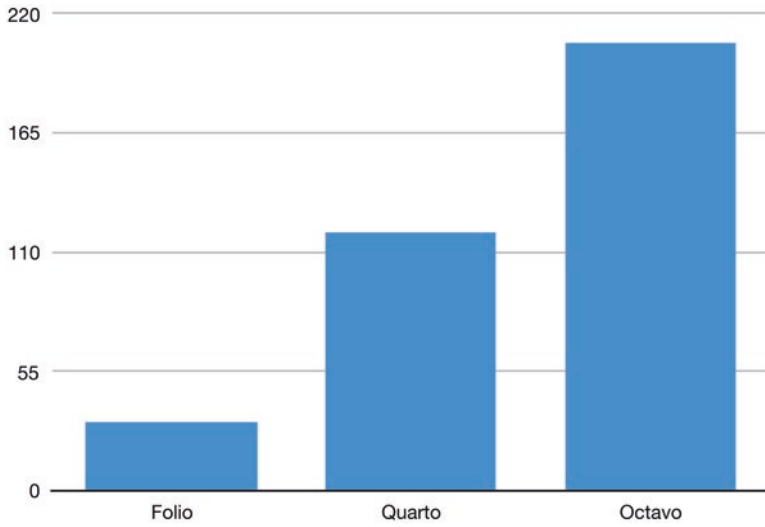
**Fig. 1.2** The top nine places where early modern printed commentaries on the *Sphaera* of Johannes de Sacrobosco were produced

few years by Wittenberg after the onset of the Reformation. Antwerp deserves a special mention, too; its position at number five is due to production that, though beginning in 1543, was prolific only between 1560 and 1585, when the intensity of production of this commentary was at its peak across the continent. If the book-producing cities are considered nodes of a network, what results is a wide circulation of knowledge that is mostly determined by a few centers. In other terms, the centers of production of the treatises collected in the corpus analyzed here are the same major centers of production of printed books in general, except perhaps for the low relevance of Basel.<sup>9</sup>

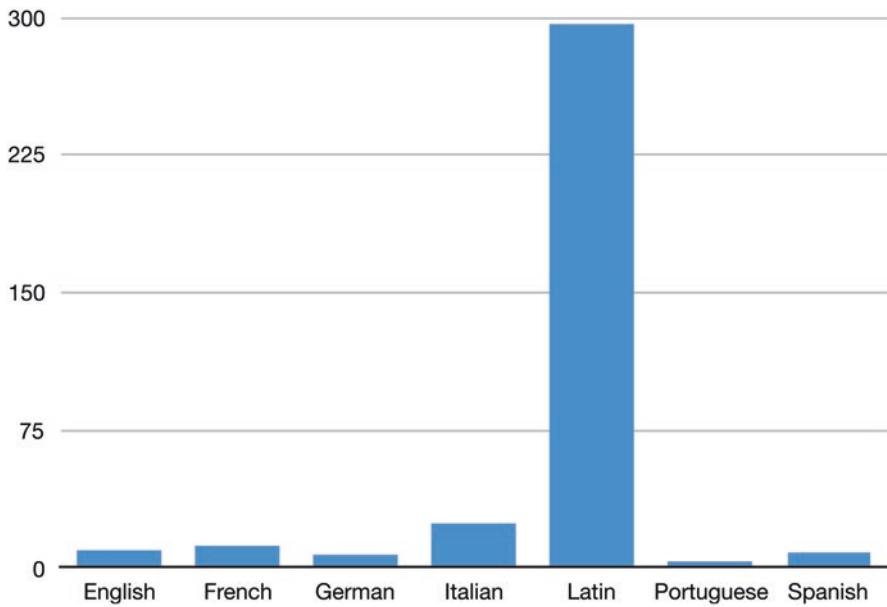
That these books were mostly destined for the student market can be easily shown by considering their prevalent formats (Fig. 1.3). Among the three major format categories—in order of decreasing size and price: folio, quarto, and octavo—<sup>10</sup> the in-octavo books are the models that shape the material identity of the corpus most. Moreover, the folio format was mostly produced during the first 50 years of the history of *Sphaera* editions, that is, in the period for which the data at our disposal are less representative (because reading material still regularly came in manuscript form).

<sup>9</sup>For an interesting study concerned with the diffusion of the commentary on Sacrobosco's *De sphaera* in the region culturally influenced by Prague, see (Hadravovi and Hadravovi 2019).

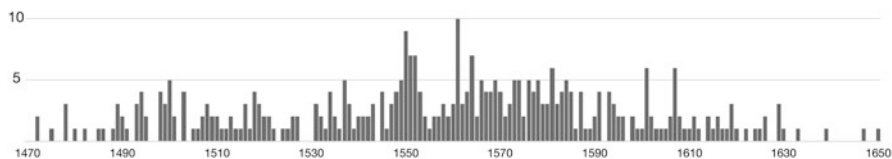
<sup>10</sup>The editions of the corpus were printed twice in sextodecimo format otherwise always either folio, quarto, or octavo. We disregard the folding of the sheets. The precise dimensions of the books, moreover, are more differentiated, and certain editions would more accurately be defined as small folios or small quartos. Furthermore, the three categories do not denote any universally accepted book dimension, as libraries tend to follow slightly different organizing principles. Nevertheless, the use of the categories (disregarding those small differences) still accounts for how printers and publishers made investments, and therefore represents an indication of the final price of the books.



**Fig. 1.3** Book formats of the early modern printed commentaries on the *Sphaera* of Johannes de Sacrobosco



**Fig. 1.4** Languages in which the early modern commentaries on the *Sphaera* of Johannes de Sacrobosco were published



**Fig. 1.5** Temporal distribution of the production of the early modern commentaries on the *Sphaera* of Johannes de Sacrobosco

Finally, the dominance of Latin over other languages is the clearest indicator of the function of these books within the university teaching context (Fig. 1.4). This does not necessarily imply that treatises compiled in different languages, in many cases one-to-one translations of books published in Latin, were not used for teaching, but probably not at the universities. Other kinds of educational institutions, for instance in Portugal, used both manuscripts and printed books that were not written in Latin, as Henrique Leitão has shown (Leitão 2008). It is interesting to notice that, in spite of the fact that the majority of books produced in local tongues are in Italian, the first Italian book did not appear on the market before 1537, at which point books had already been produced in Portuguese (first edition: 1509), German (first edition: 1516), and French (first edition: between 1525 and 1529), with a printed version of the medieval commentary of Nicole Oresme (1320–1382).

Finally, concerning the dynamics of production, this is not constant over time but it relevantly increases around 1550 and keeps this peak until about 1580 (Fig. 1.5). In this specific interval, while Paris and Venice remain dominant centers of production, their relevance strongly decreases in favor of other centers, especially Wittenberg—almost as productive as Venice but by means of only a few publishers and printers—and Antwerp.

## 2 The Authors of the Commentaries as a Social Network

The corpus of *Sphaera* commentaries lends itself to being analyzed as a series of at least two overlapping networks: an economic one, whose protagonists are the printers, publishers, and booksellers (supported by a network of distribution all over the continent), and a “semantic” one, wherein the circulation and transformation of knowledge are dynamically interlinked. The role of authors in this context appears to be fairly aleatory at first sight. Yet some external (to the corpus) information from historical sources can be found that testifies to direct relationships between different authors of *Sphaera* commentaries, and the outlines of a social network can be partially reconstructed from this information. For instance, it is known that Élie Vinet (1509–1587) and Pedro Nuñez (1502–1578) were in contact with each other.<sup>11</sup>

<sup>11</sup> For the connection between Élie Vinet and Pedro Nuñez, identified as a weak tie, see (Valleriani 2017).

However, it is neither realistic nor methodologically possible to reconstruct all the relevant social relationships by following this procedure. It is possible, however, to approach the subject by applying limitations to the research field as well as taking steps to identifying where the author of a given commentary is positioned within the social network and then trying to profile who they were.

Authors in the network are people who must have had a connection with a particular publisher to publish their text. The publisher or printer is conceived of here as a point of convergence in the network; his workshop represents a sort of social micro-region populated by employees—press-men, correctors, and engravers—in addition to many relevant external figures, such as creditors, book-sellers, representatives, and, in the case of the academic book market, representatives of educational institutions.<sup>12</sup> The advantage of taking the printer's workshop or the publisher's office as a starting point is that one can systematically approach the question of whether a social network indeed exists amongst the authors by looking at a set of bibliographic metadata for the editions constituting the corpus.

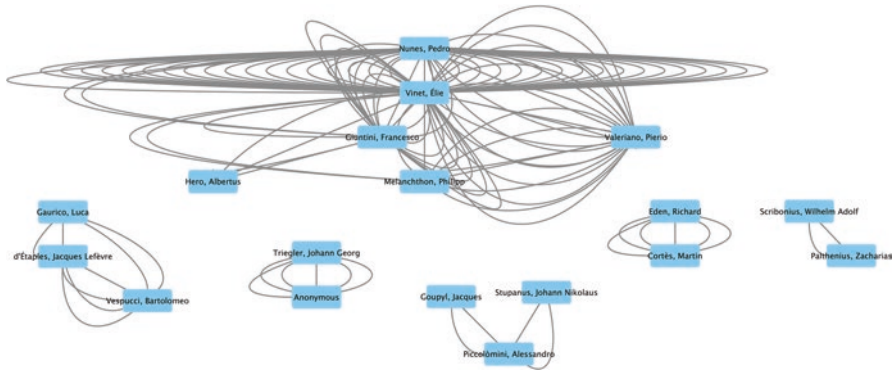
A first limitation to the study is represented by the fact that only the so-called 'credited authors' can initially be considered. Credited authors are those whose names are detectable on the title pages, frontispieces, colophons, or in the long incipit that characterizes the fifteenth-century incunables. This means that some authors will be left out. A cursory analysis of the treatises that have been defined as compilations reveals namely that those editions contain more texts (by more authors) than what the title pages or even the tables of contents declare. The anthological work mentioned above published in Venice in 1531 by Lucantonio Giunta, for instance, mentions 13 authors in the table of contents but contains texts authored by fifteen scholars—among them Campanus of Novara (1220–1296), who is not mentioned.

The case of Campanus, moreover, points to a second vital limitation, namely, in linking the dates of birth and death of the authors to the date of publication of the specific edition bearing their names. Obviously, if the credited authors are dead, no social relationship can be assumed between them and the publisher. This research is therefore executed in reference to all editions of the corpus and not in reference to the publishers themselves—that is, their lifetimes or periods of activity.

A search for pairs of authors who were both mentioned in one edition and both alive at the time of its publication results in 120 relationships, which appear in the impressively small number of 36 editions. In other words, the publication process of only 36 out of 359 editions could have involved some sort of exchange between more than one scholar and a publisher, and therefore between the scholars by way of the publishers. One way to explain this astonishing result is through a phenomenon well known to (especially economically-oriented) historians of the early modern book, although systematic studies have not yet been completed. It seems that the first generations of printers and publishers were particularly reluctant to publish

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<sup>12</sup> Isabelle Pantin has been able to demonstrate how early modern publishers of academic textbooks were producing their books in accordance with or by means of an exchange with the scholars and representatives of educational institutions that were within their market. For more information, see (Pantin 1986, 1998) and (Chap. 9).



**Fig. 1.6** Potential social relationships among the authors of the commentaries on the *Sphaera* of Johannes de Sacrobosco reconstructed by choosing authors who were alive when the editions containing their texts were published and when more than one author simultaneously contributed to the same edition. The humanist Élie Vinet comes out as the most central figure

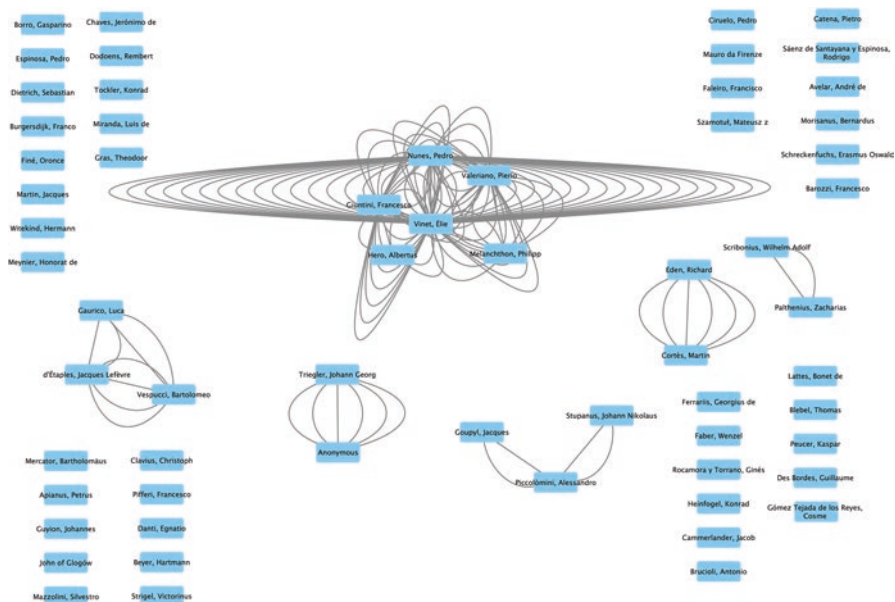
texts by contemporary authors and scholars.<sup>13</sup> This tendency, which makes sense if one assumes that there was no demand for contemporary authors, can be recognized in the editorial history of the commentaries on Sacrobosco's *Sphaera*, too. Indeed, until 1550, only two works appeared in which more than one living scholar appeared as a credited author, and these were in fact the two peculiar anthologies printed in Venice in 1508 and 1531 mentioned above. The living authors involved were Bartolomeo Vespucci, Jacques Lefèvre d'Étaples, and Luca Guarico (1475–1558). This tendency suddenly changed thanks to the almost herculean efforts of basically one man, whom Isabelle Pantin calls the first publisher specialized in scientific books in Western history (Pantin 1998): Guillaume Cavellat (ca. 1500–1576), active in Paris. The first followers of Cavellat's style arrived 11 years later in London (Richard Jugge, ca. 1514–1577) and twelve years later in Venice (Girolamo Scoto, 1505–1572).

The resulting social network inferred in this way is made up of six components (Fig. 1.6). Three are pairs of authors, two are between three authors, and the final one involves six scholars: Élie Vinet, Francesco Giuntini (1523–1590), Albertus Hero (1549–1589), Pierio Valeriano (1477–1560), Pedro Nuñez, and finally Philipp Melanchthon (1497–1560), whose social contacts with the rest of those mentioned through the Catholic publisher Cavellat should be considered improbable. If the

<sup>13</sup>The number of publications of texts of contemporary authors quickly increased, beginning in the 30s of the sixteenth century. The change of tendency was due to the new legal protections means for printed books that favored new books and did not consider the so-called 'common books,' a category of books to which academic works such as Sacrobosco's belonged. In order to obtain the legal protection, the books had to display substantial novelties which finally resulted in the publication of a quickly increasing number of commentaries written by contemporary scholars. For more information on such normative aspects, see (Nuovo 2013, Chap. 6, esp. 212–14).

parameter of centrality of this network of eighteen actors is then calculated, it turns out that Élie Vinet is positioned at the center of all potential exchanges.<sup>14</sup>

If the analysis is expanded to consider all those authors who were alive at the time of publication of their texts but who appear to be mentioned only together with Johannes de Sacrobosco (with whom there is no possible relationship) or just alone, the numbers suddenly acquire a different quality. The first case (author mentioned with Sacrobosco) involves another twenty-four scholars whose texts were published and re-published a total of 76 times. Within these new parameters, one sees that the intensity of publication enters its peak in the 1540s, although the number of publications of the previous period is much more significant. The major publisher until 1520 is Martin Landsberg (died ca. 1523) in Leipzig. In the second case, which mostly concerns the authors of adaptations for which the name of Sacrobosco is no longer mentioned on the title page but rather in the *proemium* (if at all), there are fourteen scholars appearing in a total of twenty-eight editions.<sup>15</sup>



**Fig. 1.7** Representation of all authors of commentaries on the *Sphaera* of Johannes de Sacrobosco who were alive when the editions containing their texts were published (fifty-eight authors) and potential relationships among them (involving only eighteen of them)

<sup>14</sup>A more precise reconstruction of the possible social network among the authors of the commentaries could be achieved by segmenting the editorial history into time windows of 40 or 50 years in order to be more sensitive to generational changes. This step, which would be necessary if the amount of resulting data had been significantly bigger, is not strictly necessary at this stage, as the few authors discussed here can be temporarily situated very easily.

<sup>15</sup>If one looks at the data from another angle, it appears that the three groups of publishers—those who acted as social intermediaries between scholars, those who worked one-to-one with a single

To sum up, only fifty-eight of 164 credited authors were (at least potentially) in active contact with their respective publishers over the course of the 178-year editorial history of commentaries on the *Sphaera*, and a very small portion of these authors might have been in contact with each other through the common engagement with the same publishers (Fig. 1.7).

Such social segmentation, in spite of the basic similarity of their work in terms of content and intention, can now be further investigated by trying to reconstruct these authors' intellectual profiles. The following relies on the papers in this book.

### 3 Profiling the Authors

A quick overview of the authors of scientific commentaries in the early modern period makes clear that their profiles cannot be placed in simple and well-defined categories. Even against the background of a smaller field, as the only scientific commentaries under consideration here were written in the same framework (cosmology) and in reference to the same original text (Sacrobosco's *Sphaera*), the variety that emerges certainly cannot be circumscribed by simple—perhaps even anachronistic—dichotomies such as natural philosophers versus astronomers, as Edward Grant has suggested (Grant 2009, 46–59).

Starting with their educational backgrounds, the spectrum immediately enlarges to encompass mathematics, logic, and astrology, as well as medicine, theology, and natural philosophy. Thus, all possible subjects of the academic curriculum are represented, with the notable exception of juridical studies. This aspect displays once more the vitality of Sacrobosco's text from an intellectual point of view, as this text came to be considered the test bench for entering the scientific discourse during this long period. As a matter of fact, the centrality of the *Sphaera* was imparted to the future authors of the commentaries when they were still students at the universities. The full integration of this text into the leading pedagogical model in Europe at that time, the quadrivium,<sup>16</sup> made it a kind of crossroads in the pursuit of all fields—and fittingly so, because cosmology was the pivot of the entire knowledge system (Valleriani 2017). While it is true that contemporary disputes such as disagreement over the reality of the planetary orbs (Chap. 6) can only be explained by the fact that

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scholar and remained close to Sacrobosco's text, and those who worked one-to-one with a single scholar but published adaptations—do not significantly overlap, though they were involved in the same book market.

<sup>16</sup>The quadrivium, as conceived by Boethius, was followed in the European universities of the early modern period with a degree of flexibility (Moyer 2012). Especially the subject of music (in its original form, which included the *musica sphaerarum*) had quickly declined and perhaps disappeared altogether by the beginning of the sixteenth century. Nevertheless, the classic Boethian division was still considered an efficient taxonomy even as the nature of the content of the individual disciplines went through profound transformations.

both astronomers (i.e., mathematicians) and natural philosophers were involved, this still does not exhaust the potential reach of the commentaries, which contained knowledge ranging from technological innovations on clocks and observational instruments to theological disquisitions.

Against such an educational background, it is easy to imagine that the institutional activities in which the authors of the commentaries were involved over the course of their lives were at least as heterogeneous as the educational background itself, if not even more so, albeit with some common denominators. Among the common denominators, the most relevant is the institutional engagement of the authors: As it turns out, they were all university lecturers. However, they were not only lecturers in astronomy and/or cosmology. Clearly, most of the authors of the commentaries were active in the frame of the quadrivium, and as such they were often employed to teach subjects related to mathematics. Many of them, however, were teaching different subjects, too. Pedro Ciruelo (1470–1554), for instance, also taught dialectics and theology after having been professor of astrology; Francesco Capuano was also lecturer in philosophy; John of Glógow (1445–1507) taught logic and philosophy, as did Franco Burgersdijk (1590–1635), who additionally gave classes in ethics. Turning our attention to the more practical undertakings related to geocentric cosmology, for instance, cosmography, geography, cartography, and nautical astronomy, plenty of *Sphaera* commentators, especially from the Iberian Peninsula (Chap. 7), can be identified who used both their publications and their classrooms as forums to discuss the latest geographic discoveries, which unfolded continuously. Working with the *Sphaera* was therefore also a means to reflect upon the most groundbreaking of early modern activities, namely, the exploration of the earth's surface.

Moreover, as active academicians, it is not rare to find the same figures involved in the process of reforming the curriculum of studies. Famous in this respect are the French scholars Jacques Lefevre d'Étaples and Oronce Fine (1494–1555) (Chaps. 2 and 8). Both of them insisted on a mathematical turn in the pedagogical framework of their time. However, it was not only about more or better mathematics; increasingly, it concerned more practical applications of mathematics, forging in this way a common spirit, or a shared scientific identity, between them and many of the Iberian authors of *Sphaera* commentaries. Also involved in a process of re-shaping curricula was Burgersdijk, who did not, however, act in favor of any particular subject but rather worked to create a textbook that accorded with the political and religious conditions of a Calvinist society (Chap. 11).

While some of them, such as Francisco Faleiro and Jerónimo de Chaves (1523–1574), were working with agencies like the Spanish House of Trades, and others, such as Capuano and Pedro Avelar, entered religious orders, another significant activity of the authors of the commentaries outside the universities seems to have been their involvement with printing workshops. As Isabelle Pantin has shown, printers were fundamentally connected to these university lecturers and authors of commentaries because they received from them the information and content necessary to design whatever editions they planned to put on the market next (Chap. 9).



But from another perspective, for instance, by looking at the activities of Lefèvre d'Étaples and Fine, it becomes evident that such a connection was so close that these roles sometimes overlapped. Looking at the census of treatises on the *Sphaera*, there are several people who appear to be both the printers or publishers and, at the same time, authors of the textbooks. The most relevant among them is certainly Petrus Apianus (ca. 1501–1552).

The intellectual profiles of the authors of the commentaries are best investigated if the content of their commentaries is also scrutinized. True, the scientific content was influenced by a series of external factors, such as the economic interest of the printers, as already mentioned, as well as by the kind of institution in which the authors were teaching. The example of the two editions of the commentary on the *Sphaera* by Capuano, for instance, shows that the content of his texts changed according to his audience: first the students of the faculty of arts, and later the clerics of the religious order of St. Augustine (Chap. 4).

In spite of this difficulty, however, an overview of the commentaries reveals that the variety of the topics they cover perfectly matches the heterogeneity of the educational backgrounds of the scholars and of their teaching subjects.

The commentaries here examined delve into astronomy, cosmography, geography, geometry and arithmetic, medicine, astrology, theology, logic, philosophy, as well as technological applications of these knowledge domains, especially the design of mathematical instruments. It is not easy to say which of these subjects were prevalent, if any. The content of individual commentaries depended very much on their particular authors and on the context (time and space) in which they were active.

Certainly, many commentaries facilitated better connections between the standard disciplines of the quadrivium (Chap. 5). The most relevant examples to this effect are given by commentaries that dealt with geometry. Specific and different classes were dedicated to the study of Euclidean geometry, but it was nevertheless a subject to which the commentators on the *Sphaera* of Sacrobosco dedicated increasing space in their editions. As exemplified by the case of John of Glogów, authors of the commentaries also devoted themselves to the establishment of a new planetary astronomy based on the *Theorica planetarum* of Georg von Peurbach. The same question of the philosophical and scientific status of astronomy—that is, where it stood in the scientific context of the early modern period—was discussed by Capuano and Fine, for instance. Philosophical questions of this sort, associated with the ongoing process of mathematization, resulted in frequent discussions concerning the reality of the orbs and of the cosmological system delineated in these treatises (Chaps. 6, 8 and 9): The lathe depicted in Lefèvre d'Étaples's 1495 commentary is a symbol for the ontological interpretation of mathematics in general, as pointed out by Richard Oosterhoff (Chap. 2).

The discussion surrounding the reality of the orbs and the general development in favor of an ontological interpretation of mathematics was accompanied and perhaps supported by the increasing connection of cosmology and geography, a link

that implied the *practical* reality of the inhabited zones, and therefore the necessity to grasp them mathematically. In this vein, cosmography emerged as a mathematically codified discipline, whose fundamental task was to map the great celestial spheres onto the earth's surface. The treatises on the *Sphaera* were objects that absorbed and furthered this tendency, beginning in 1495 (Chap. 2). An entire new genre emerged specifically dedicated to cosmography, whose texts also belong in part to the corpus of the treatises on the *Sphaera*, though they increasingly freed themselves from such a traditional background, quickly moving toward the more practically and technologically-oriented frameworks of nautical astronomy and the design of mathematical instruments (Chap. 7). Finally, the increasing relevance of cosmography (Chap. 8) might have worked to re-shape the identity of the commentary tradition of Sacrobosco's *Sphaera* to emphasize practical knowledge. Such a long transformative process thus began with an appeal for a realistic interpretation of mathematically-defined planetary orbs and resulted in diminishing the centrality of ontological lines of questioning: it became useful knowledge—it worked well, and that sufficed.

In fact, the practical turn had already been realized in the late medieval period, but at that stage it was confined to another field: medicine. The authors of the early modern *Sphaera* commentaries still associated cosmology with medicine, but their commentaries only rarely become explicit in this respect. The same authors dealt with proper medical knowledge in other works, and the *Sphaera* commentaries of this period simply refer the reader to them, if the subject is mentioned at all. Much more relevant as a subject of the commentaries is astrology, the discipline that bridged cosmology and medicine. It was astrology that allowed cosmology to be the conceptual and scientific nucleus of the whole knowledge system. Astronomy, astrology, and medicine together constituted a circle around cosmology, and all possible connections between them and with the center were exploited. Because of the 1494 prohibition of judicial astrology, which was enacted at the University of Paris, the debate about the epistemic fundament of the discipline, its scientific character, and its usefulness became very vivid at least during the first phase of the sixteenth century (Chap. 3). The availability of increasingly precise tables, useful for the mathematical workflow required to locate heavenly objects, only supported the refinement of the discipline in mathematical terms. During the first phase of the sixteenth century, this process combined perfectly with the simultaneous practical turn toward cosmography. Both frameworks made similar ontological assumptions and applied similar criteria of truth while using mathematical models and workflows, and both had the goal of asserting something useful about the real world—the earth and its inhabitants. It is conceivable that the process of mathematization that necessarily accompanied the cosmographic turn is the final explanation for this great expansion of the medieval knowledge system. In the early modern period, the circle of knowledge pivoted on cosmology expanded to involve geography, nautical astronomy, and technological developments, all harmoniously connected to each other and elegantly expressed by the tradition of commentaries on the *Sphaera*.

As is well known, however, this system later came undone. While cosmology, mathematical and nautical astronomy, and technology increasingly joined together

and became the knowledge of specialized personnel such as pilots, astrological medicine was increasingly marginalized (Thomas 1971, chap. 3). Both these knowledge clusters eventually exited the universities. The first one entered new schools for the education of specific professions,<sup>17</sup> while astrological knowledge became increasingly insignificant in the curriculum of most universities over the course of the seventeenth century.

Most of the commentaries printed between 1472 and 1650 were destined for the academic book market, that is, they were conceived as textbooks for students. From the perspective of the authors of those commentaries, however, the function of these texts was much broader. In line with the practical turn mentioned above, the treatises also played an important political role: they offered the authors of the commentaries an opportunity to make a confessional statement (MacLean 2012), an aspect that becomes evident when the corpus is investigated in its entirety.

Writing a commentary on cosmology was a convenient occasion to profess adherence to Christianity. Authors such as Francesco Capuano and Pedro Ciruelo, for instance, mentioned explicitly that knowing the structure of the cosmos is a way to admire God's creation. For this reason, the treatise was also an occasion for dissimulation in matters of confessional belonging. The case of Pedro Avelar, who was an active member of a secret Jewish confessional group and as such brutally persecuted by the Catholic Inquisition in Portugal, is exemplary in this regard.

For him, publication was an opportunity not only to teach, but also to keep up a front of religious conformism (Chap. 10). The *Sphaera* was never under serious attack by the Congregation or the Inquisition, though several editions were indeed controlled and some of their content censored (Sander 2018). Nevertheless, the text was definitely an object of political control. Several perspectives show that this was the case. The first example chronologically is the case of the production of textbooks in Wittenberg. When Philipp Melanchthon designed the curriculum, he chose books and commentaries for confessional reasons and their function was made explicit (Chap. 9). The famous Letter to Grynaeus moreover, published 64 times in the corpus of the printed commentaries on Sacrobosco's *Sphaera*, shows that Melanchthon's commitment to astrology was appreciated well beyond the geographic boundaries of the Reformation. The second famous example is the commentary on the *Sphaera* by Christophorus Clavius (1538–1612). The book, first published in 1570 and later re-published seventeen times, was intended as part of a curriculum conceived in the frame of the Jesuit *Ratio studiorum*—that is, against a confessional background (Lattis 1994, 1–29). Thirdly, there is the example of Franco Burgersdijk, who, in recompiling the treatise in the wake of Clavius's commentary, dressed it up to suit the Calvinist *School Order* (Chap. 11). Finally, the process of integrating knowledge that helped make sense of the great journeys of exploration—and on occasion helped facilitate the journeys themselves (Valleriani

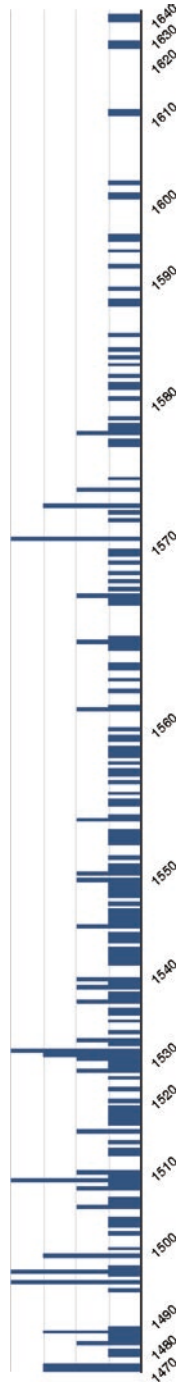
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<sup>17</sup>The Portuguese *Aula de esfera*, a school dedicated to the education of pilots, was indeed operative much earlier, during the sixteenth century. However, this was an exception, as all the other political and geographic entities of Europe entered the planetary nautical market later; they systematized the necessary knowledge in the seventeenth century.

2017; Crowther et al. 2015) (Chaps. 7 and 10)—not only lent credence to the claim that the treatise was useful but also represented an opportunity to celebrate “Christian knowledge.” In the rhetoric of the time, this furthermore served as a justification for Christian navigators to brutally conquer the planet.

## 4 The Publishers and Future Research

The great changes and developments that can be detected in the corpus of the early modern printed commentaries on the *Sphaera* of Sacrobosco are clearly related to the regional, temporal, and intellectual context in which these commentaries were conceived and written. The profiles of the authors are therefore indispensable for understanding this evolution of knowledge. Against the background of the entire corpus of historical sources, the present volume considers about 43% of them (Fig. 1.8). By means of an interactive map (<https://sphaera.mpiwg-berlin.mpg.de/doi-visualisation-authors-volume>), moreover, it is possible to explore the way the contributions of this volume deepen the investigation of the sources. The entire period covered by the corpus is considered, and the number of sources investigated at given time intervals is indeed proportional to the dynamic of production of these treatises which increases around the half of the sixteenth century. Nevertheless, as book historians have recently disclosed (Nuovo 2013; MacLean 2009) and as historians of science are increasingly becoming aware (Valleriani 2017) (Chap. 9), the final decisions on the content of these treatises did not simply emerge from the milieu of scholars. It was in fact the publishers who had the last word on all aspects of the books’ publication—their form *and* content. Indeed, these publishers engaged in intellectual, institutional, and economic negotiations with authors, professors, and other institutional representatives for each edition within the corpus—generally speaking, the same applies for every book they published. By laying more emphasis on the booksellers and printers—on the shifting commercial, material, and intellectual landscapes on which the corpus of printed *Sphaera* commentaries came into existence—it might be possible to enrich the investigation undertaken in this chapter. Future research will be undertaken to investigate the social network of the publishers as a way to account for the similarities among these editions!



**Fig. 1.8** The diagram displays the historical sources belonging to the corpus of the editions of Sacrobosco's *Tractatus de sphaera* that are mentioned in the present volume. The picks show the frequency of mentions, the size of the columns the number of historical sources in a given time windows and the size of empty spaces along the time lines the sources that are not mentioned. The timeline is not linear as the lengths of the time intervals is determined by the number of historical sources published in that specific time interval. For a more detailed and interactive map, see <https://sphaera.mpiwg-berlin.mpg.de/doi-visualisation-authors-volume>

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