Chapter 9
Borrowers and Innovators in the History of Printing Sacrobosco: The Case of the In-Octavo Tradition

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Abstract The Sacrobosco editions constitute a textual tradition wherein innovation owed to the interaction of two types of actors: borrowers, responsible for chains of related editions, and innovators, who wrote relatively original commentaries. This can be observed in the "in-octavo tradition," a series of editions printed in several European towns, which began with Apianus's 1526 *Sphaera* and endured until the seventeenth century. Different kinds of innovation were produced in it (concerning the layout, the illustration, and different kinds of textual additions). This successful attempt at standardization produced a kind of manual that always retained an essential part of its original features while remaining capable of evolution. This evolution was due to close cooperation between the publishers and mathematicians, and to the fact that the former, with a few exceptions, kept control over the process, and combined innovation with the artful practice of reusing borrowed material.

1 Introduction

The advent of print culture greatly facilitated the building of textual traditions. The great number of manuscripts of Johannes de Sacrobosco's (died ca. 1256) *Sphaera* were copied in codices containing variable sets of texts—with or without illustrations, with or without different kinds of commentary, and with numerous variants on the original text itself. Many of these manuscripts were copied from earlier ones, so it is possible to reconstruct certain lines of transmission, but a stemma would be impossible to achieve. Confronted with "legions" of manuscripts, Lynn Thorndike contented himself with collating twenty significant manuscripts and inventorying the principal commentaries (Thorndike 1949). With the printed editions, in contrast, it is possible to make a census of all those still in existence and to study their

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interrelations.[1] Very few of them were completely unrelated to the others, as their authors, editors, and publishers were more or less aware of the other editions available on the market. Thus, the entire body of Sacrobosco editions, with its different branches—some of which eventually became trunks of their own[2]—can be studied as a textual tradition. In this frame, we can observe more precisely how innovations occurred. I thus intend to focus on the interaction between two types of actors that contributed to the transmission of the Sacrobosco tradition: borrowers, responsible for long chains of related (if not identical) editions, and innovators, who chose to write commentaries that were, up to a certain point, original, and as a consequence signed their contributions personally.

2 The Dialectic of Tradition and Innovation: The In-Octavo Editions

In the case of the Sacrobosco editions, borrowers and innovators worked together in close collaboration. This is probably linked to the fact that booksellers were, as a rule, particularly involved in the publication of the treatises of the sphere, and that they understood the art of combining innovations with well-tried materials as crucial to commercial success. These booksellers had to respond to the specific demands of the teachers of mathematics (as well as to the vaguer demands of a larger clientele), as they depended on these teachers for achieving the mathematical part of the work; but they kept much more control over the whole process than in the case of more sophisticated scientific works. In some instances (Oronce Finé (1494–1555), Peter Apian (1495–1552)), the mathematicians were also competent in book design, book printing, and even book selling, which contributed to blurring the distinction between the roles.

Quite often, the more innovative writers of commentaries tended to bury the original text under a considerable amount of new data and arguments, or even to depart from the original pattern, so that their claims for full authorship prevailed over their linkage to the tradition. That was the case with Oronce Finé (Chap. 8), Francesco Maurolico (1494–1575),[3] and many others, notably the authors of oversized treatises intended as *summae* of cosmological knowledge rather than simple

[1] For a census of the printed editions of treatises of Johannes de Sacrobosco's *Tractatus de sphaera*, see the Database produced by the project *The Sphere. Knowledge System Evolution and the Shared Scientific Identity of Europe*: https://sphaera.mpiwg-berlin.mpg.de/database. Accessed June 2019. See also (Valleriani 2017).

[2] From the beginning of the printed tradition of the *Sphaera*, some editors and commentators (for instance Jacques Lefevre d'Étaples and Oronce Finé in France) took this manual as a basis for developing topics that had been perfunctorily treated by Sacrobosco, notably cosmography and mapping (Chaps. 2 and 8). Ultimately, that lead to the publication of books detached from the Sacrobosco tradition, entitled *Cosmographiae*.

[3] Maurolico's *Cosmographia*, published in Venice in 1543, was an adaption of the *Sphaera* in the form of a dialogue. There are very few studies on this part of Maurolico's work, only brief remarks in (Clagett 1974; Moscheo 1998; Rosen 1957). On the notion of adaption, see the introduction to this volume.

textbooks, which deeply transformed the field around 1570. These works were elaborated mostly for the use of teachers of astronomy, but they also originated from the desire to assert the mastery of Catholic mathematicians over the field of cosmology, which was then dominated by Lutherans.[4] Erasmus Oswald Schreckenfuchs (1511–1579), who published his commentary in 1569 (Schreckenfuchs 1569),[5] taught at the Catholic University of Freiburg im Breisgau and dedicated his work to Jacobus Curtius, Canon of the Cathedral of Constance, a patron and benefactor of the university; Christophorus Clavius (1538–1612), as is well known, published his *Sphaera* (first edition 1570) (Clavius 1570) to provide a summa of the orthodox cosmological doctrine for the use of Jesuit colleges.[6]

However, we can observe at least one long series of editions in which borrowing, copying, and imitating carried as much weight as innovating. This series, which I shall call the "in-octavo tradition," began with Apianus's 1526 edition and endured until the middle of the seventeenth century, though it dwindled down in the last decades of the sixteenth century due to the emergence of successful competing models of treatises on the *Sphaera*. Francesco Giuntini (1523–1590) was its last significant contributor, that is if we set aside the 1626 edition by Franco Burgersdijk (1590–1635), which revived the "in-octavo tradition" in extremis (Chap. 11). But Giuntini soon abandoned it to write two more original treatises on the *Sphaera* under his own name. This is a strong indicator that the tradition could not integrate highly idiosyncratic projects.

I shall describe the development of the "in-octavo tradition" both through time and space (since several printing centers in Europe were involved), and try to analyze the different kinds of innovation that were produced in it. These innovations concerned the commentary, the illustration, and the layout and editing (including the formulation of titles). It is often tough to determine whom exactly they ought to be attributed to, but the following inquest should at least improve our understanding of the type of actors involved, and of their principal aims and motives.

3 The Predecessors: The Venetian Incunabula and the Leipzig Editions

The *Sphaera* was probably first printed in Venice in 1472 or earlier (Sacrobosco ca. 1472a);[7] the first dated edition appeared in Ferrara in 1472 (Sacrobosco 1472b). These first editions were without commentaries and had no printed diagrams, but

[4] On the rivalry between Catholic and Lutheran mathematicians, see (Pantin, 1999).

[5] Schreckenfuchs was also the author of a huge commentary on Peuerbach's *Theoricae planetarum* with innovative diagrams. See (Mosley 2004).

[6] On the original version of Clavius's commentary and on its successive revisions, see (Lattis 1994).

[7] This Venetian edition is undated, but a manuscript note in the Library of Congress copy shows that it was published before 8th of May 1472. It could be anterior to the Ferrara 1472 edition, which is revised and has a more elaborate layout (with the use of subtitles).

some blank spaces (two in the Venice edition, three in the Ferrara edition) allowed the insertion of manuscript drawings. Other editions followed, and from 1478 onwards, some printed figures were added.[8] The complete set of the 'Venetian Sacrobosco diagrams' first appeared in the revised edition printed by Johannes Santritter (before 1460–after 1498) in 1488. This Santritter 1488 edition originated a tradition. It was copied by other Venetian printers and book-sellers, notably Ottaviano Scoto (ca. 1444–ca. 1499) and Melchior Sessa (active 1505–1555).[9]

The Venetian editions, from the 1488 Santritter edition onwards, contained significant corrections to the original text and at least four important additions: a description of the armillary sphere, a preliminary treatise of geometry, an excursus on the constellations at the end of chapter II, and a large note concerning domification (the construction of the *figura caelestis* for the horoscopes) in chapter III. The books were small quartos,[10] of which the *Sphaera* occupied around forty pages, followed by two other texts: Johannes Regiomontanus's (1436–1476) *Disputationes contra Cremonensia deliramenta* and Georg von Peuerbach's (1423–1461) *Theoricae novae planetarum.*[11] The long-line layout was dark and dense, and the white spaces quasi-inexistent. Some detached subtitles and, above all, numerous images helped the readers to find their way through the text. These images were small and purely descriptive (lettered geometrical diagrams were avoided). Some of them derived from a long manuscript tradition.

Indeed, a significant minority of the manuscripts of the *Sphaera* had been illustrated,[12] and a kind of iconographical tradition had even been established as early are the second half of the thirteenth century. The diagrams were always related to the same parts of the text, that is, mainly to the first and fourth chapters, and to a lesser extent the third chapter. Some of them had very ancient sources and had been transmitted through the manuscript traditions of late Antiquity texts, notably Calcidius's *In Timaeum* (fourth cent.) and Macrobius's *In somnium Scipionis*

[8] In 1478, Franciscus Renner from Heilbronn and Adam Burkardt from Rottweil printed in Venice two different editions with three diagrams (the elementary and celestial spheres; the climes; the solar and lunar eclipses). In 1482, still in Venice, Erhard Ratdolt published a new edition that added a fourth figure (an armillary sphere). In 1485, Ratdolt released another edition with twenty-two small new diagrams and some improvements to the existing diagrams.

[9] The Santritter edition was used as a model for the editions printed in Venice by [Bonetus Locatellus] for Octavianus Scotus, 4th of October 1490, for Melchior Sessa, 3rd of December 1501 and 3rd of December 1513, and by Jacobus Pentius for Sessa, 24th of December 1519.

[10] The dimension of the small quarto page is about 180 × 140 mm (145 × 115 mm for the printed text).

[11] Regiomontanus's and Peuerbach's texts do not begin on the recto of the first folio of a quire, which indicates that they were not meant to be sold or bound separately.

[12] Only seven of the twenty manuscripts described by Thorndike (see Footnote 1) are with diagrams and only five of these seven have what could be considered as a 'complete set.'

(first quarter of the fifth cent.), of which the earliest surviving manuscripts are from the ninth century.[13]

In the following list, we have underlined the diagrams for which prototypes can be traced back to the thirteenth and fourteenth centuries (or even earlier). Of course, for each type of diagram, there existed a quantity of variants. Further research on the fifteenth century manuscripts of the *Sphaera* would be necessary to identify the sources of the diagrams in the first illustrated editions of the *Sphaera*. This list is the brief census of the diagrams that illustrated the text of Sacrobosco in the Venetian incunabula, from the Santritter 1488 edition onwards (Table 9.1).

Even before the turn of the century, other types of treatises on the *Sphaera* appeared in which Sacrobosco's text was accompanied by commentaries, sometimes collected in massive in-folio volumes (Sacrobosco 1495b, 1498, 1499a, b). Other diagrams were conceived for these publications, often more purely geometrical than in the series above described, and new elements were added, notably samples of astronomical tables. At the same time, however, the idea of providing the students with handy textbooks was carried forward. This intention was most apparent in a series of tracts printed in Leipzig starting in 1486 (Sacrobosco 1486, ca. 1487, [1489], and so on). The volumes were small quartos, and they contained no other text than the *Sphaera*, except for some of these editions which included a commentary by Wenceslaus Faber from Budweis (died in 1518) (Sacrobosco [ca. 1495a], 1499a, b, 1500, 1501a, b, 1503a, 1505, 1508). The *Sphaera* commented by Conrad Tockler (1470–1530) (Chap. 5) was published by the same printer in Leipzig, in the same format and with the same figures (Sacrobosco 1503b, 1509).

The layout of the Leipzig quartos was quite different from that of the Venetian incunabula. Large interlinear spacing facilitated note-taking. The text was divided by pilcrows, but there were no detached subtitles (other than the titles of see Chapter II, III and IV of *Tractatus de Sphaera* by Sacrobosco). The diagrams (which were revised and augmented around 1494) illustrated almost the same topics as those of the Venetian editions, but they were different in style; they were often best suited to give the reader a simple but concrete understanding of the basic cosmological phenomena. For instance, the revised iconography provided what is probably the first attempt, in any version of the *Sphaera*, to include a map in the diagram of the terrestrial zones (*Asia*, *Africa*, and *Europa* are crudely delineated in the northern habitable zone). Besides, some diagrams had no counterparts in the Venetian editions, like a series of seven diagrams in the third chapter that showed the variation of the horizon (and its consequences) for people living at different latitudes (Fig. 9.3) (Table 9.5).

[13] Late Ancient diagrams concern the concentric spheres of the world (see Chapter I of *Tractatus de Sphaera* by Sacrobosco), the terrestrial and celestial zones, the climes (see Chapter II of *Tractatus de Sphaera* by Sacrobosco), the *figura retrogradationis* (showing how the movement of the planet on its epicycle produces, as observed from the earth, cycles of direct motion, station, and retrograde motion), and the lunar and solar eclipses (see Chapter IV of *Tractatus de Sphaera* by Sacrobosco). On this iconographic tradition, see notably (Obrist 2004; Müller 2008).

Table 9.1 The diagrams in the Venetian editions from 1488. (NB: The diagrams that had ancient models are underlined)

Preliminaries	
1.	Armillary sphere: 1 large diagram
2.	Geometry: 24 small diagrams
Chapter I	
3.	The elemental and celestial spheres: 1 large diagram that shows the four elemental spheres (earth and water are separated, the former being completely surrounded by the latter), the seven orbs of the planets, the sphere of the fixed stars, and the ninth invisible sphere, divided into the twelve zodiac signs.[a]
4.	*Sphaera recta/sphaera obliqua*: 2 diagrams showing a circle and two diagonals (in the first diagram, the equator and the perpendicular right horizon, in the second, the equator and the oblique horizon).
5.	The four elemental spheres or orbs: 1 diagram. This time, the earth is shown as a small eccentric sphere, which, at its top, emerges from the surrounding orb of water into the orb of air.
6.	*De cæli revolutione*: 1 diagram. The diurnal revolution of heaven is symbolized by a semi-circle (with the earth at its center), within which fixed stars are shown in three supposedly successive positions: at the oriental horizon (*oriens*), at the meridian (*mer*), and at the occidental horizon (*occi*).
7.	*De cæli rotunditate*: 1 diagram. A circle and three regular polygons inscribed in it (triangle, square, and pentagon) to show that the sphere is "the most capacious" of all shapes and the best suited to enclose all natural things, and that, if the world were not round, "it would follow that some place would be vacant and some body without a place" (Thorndike 1949, 120).
8.	Effects of refraction: 2 diagrams. The first one is synthetic to the point of being illegible. It shows, first, the false hypothesis of a flat sky (in which case the stars would be nearer at the zenith), and, second, the reason why the stars look bigger at the horizon than at the zenith: the interposition of vapors that disperse the visual rays. In order to illustrate this phenomenon, the second diagram shows a piece of money immersed in water, and how it is enlarged.
9.	Quod terra sit rotunda: 2 diagrams. In the first one, the earth is surrounded by the circles of the moon and of the sun. These planets are in opposite positions, so that the moon must be eclipsed. That illustrates (not quite clearly) the fact that, as the earth is round, oriental people see lunar eclipses at an earlier hour than occidental people. The second diagram (Fig. 9.1) shows the earth surrounded by the circle of the fixed stars. Four men are walking around the upper hemisphere, from north (sept) to south (mer), and lines drawn from their position at the surface of the earth to stars at different positions on the outer circles symbolize the fact that southern observers do not see the same stars as northern observers.
10.	Quod aqua sit rotunda: 1 diagram. The visual ray (Radius visualis) from an observer on a ship at the top of the mast reaches without obstacle a signal on the seacoast (*Signum littoris*), while the visual ray from an observer on the deck is intercepted by the bulge of the water.
Chapter II	
11.	The equinoctial: 1 diagram. A circle that represents the world, the axis of the world, and the equator.
12.	*De zodiaco circulo*: 1 diagram. A circle that represents the world, the axis of the world, and the zodiac divided in twelve signs. The equator is not drawn, and the inclination of the zodiac with respect to the axis of the world is not correct.

(continued)

Table 9.1 (continued)

13.	Zodiacal signs: 2 diagrams illustrate two significations of "sign." The first one is a pyramid, of which the basis is the corresponding portion of the zodiac (in the eighth sphere), and the apex is at the center of the world. The second one is a crescent-shaped portion of the eighth sphere, of which the points are at the poles and the larger part is the corresponding portion of the zodiac.
14.	*De duobus coluris*: 1 diagram. In a circle that represents the world, the axis of the world, and both colures (equinoctial and solsticial).
15.	*De meridiano et horizonte*: 1 diagram.
16.	Celestial zones and circles: 1 diagram. In a circle that represents the world, the equator, the tropics, the polar circles, the zodiac, the axes of the equator and of the zodiac.
17.	Terrestrial zones: 1 diagram. The Arctic and Antarctic zones and the zone between the tropics are marked *Inhabitabilis*. The two zones between the tropics and the polar circles are marked *habitabilis*. In the lower habitable zone (in the northern hemisphere) a landscape is drawn.
Chapter III	
18.	*Ortus/occasus cosmicus, chronicus, heliacus*: 1 diagram. The circle of the sun (with the sun in two different positions, oriental and occidental), surrounded by a circle that represents the zodiac: on its oriental part, below and above the radiating sun, several stars are represented. Without reading the text, it is not easy to guess that this is a visual definition of the cosmic, acronychal, and heliacal rising and setting of the stars.
19.	What is necessary to understand the astronomical rising and setting: 1 diagram. How the equator, the zodiac, the right horizon, and the oblique horizon mutually intersect.
20.	*Dies naturalis*: 1 diagram. A circle that represents the zodiac surrounds the earth and the circle of the sun. The symbol of Aries is marked on the right, and the position of the sun is slightly below. That corresponds probably to the definition of the natural day: "the revolution of the equinoctial with as much as the sun covers meanwhile by its own movement against the firmament" (Thorndike 1949, 132).
21.	The circles of natural days: 1 diagram. A great circle of the world, the axis of the world, the polar circles, the tropics, the zodiac, and a crude representation of the spiral movement of the sun caused by the combination of its diurnal and annual motions.
22.	The great circles of the sphere: 1 diagram.
23.	The 12 celestial houses: 3 diagrams corresponding to three different ways of drawing an astrological chart. They illustrate the addition on the methods of domification.
24.	The shadows at the equator: 1 diagram. A hemisphere, delimitated by the line of the horizon, and a semi-circle that represents the zodiac, below it, the circle of the sun, with the sun at three different positions: at the zenith, at noon, when the sun is in either equinoctial point (according to the text), when the sun is in the northern signs, and when it is in the southern signs (again according to the text). These three suns cast the shadows of a tower surrounded by ramparts: the shadow is "perpendicular" in the first case, southern in the second one (*umbra austr*), and northern (*umbra bore*) in the third.
25.	Terrestrial zones and climates: 2 diagrams. One large diagram: a circle that represents the world, with the equator, the tropics, the polar circles, the zodiac, and the axis of the equator marked. In the northern hemisphere (north is below) the seven Ptolemean climes are drawn. One smaller diagram: the great circle that passes through the poles and the equinoctial points, the equator, lines drawn from the pole to the equinoctial points, and the seven climes: the geometrical significance of this diagram is not explained in the text.

(continued)

Table 9.1 (continued)

Chapter IV	
26.	Circles of the sun: 1 small diagram shows the eccentric deferent of the sun (and the sun on it), a larger circle that represents a great circle of the sphere (probably the ecliptic), and the centers of both circles.
27.	Moon's circles, *caput* & *cauda draconis*: 1 small diagram. A larger circle that represents a great circle of the sphere, probably the ecliptic, surrounds the eccentric deferent of the moon with its epicycle, and the equant circle, which has a different center than the deferent. The equant and the deferent intersect at two points, called the "head" and the "tail" of the Dragon.
28.	The stationary, direct and retrograde motions (*figura retrogradationis*): 1 small diagram. A larger circle that represents a great circle of the sphere, probably the ecliptic, surrounds the eccentric deferent of any planet (the sun and the moon excepted) with its epicycle, the equant circle, and the three centers of these circles. Tangents to the epicycle are drawn from the center of the world: that shows why a terrestrial observer sees a succession of stationary, direct, and retrograde motions as the planet rotates on its epicycle.
29.	The lunar eclipse: 1 diagram. The traditional diagram shows simply the disposition of the three globes (Sun, Earth, and Moon) and the production of the umbra cone. Here, the eclipse is represented in a broader frame: the ecliptic circle (with stars), the horizon, the deferent of the sun, the deferent and the equant of the moon are drawn. The sun is at the nadir, the moon at the zenith (and at one node of the Dragon), and a landscape is visible on the large earth.
30.	The solar eclipse: 1 diagram shows the deferent circle of the sun, the horizon, and the earth, moon, and sun in alignment. The earth, represented with terrestrial and maritime landscapes, is so large that two men are seen, silhouetted against the sky near the eastern and western horizon. A tangent to the earth passing through the border of the umbra cone of the moon marks the limit outside of which the eclipse is completely invisible.

[a]Concerning the diagram that shows the spheres of the elements and the celestial orbs, there is a discrepancy between the diagram, which corresponds to the original text of Sacrobosco (according to which the sphere is divided into nine celestial spheres), and the revised text of the Santritter edition and its followers that lists ten celestial spheres (Chap. 5).

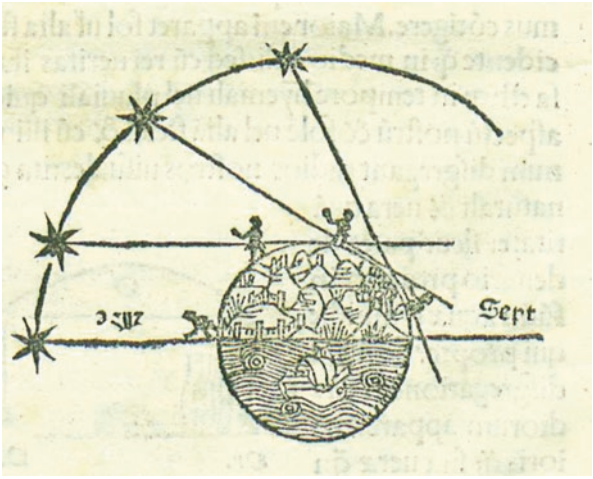

Fig. 9.1 *Quod Terra sit rotunda* (Table 9.1, n 9). From (Sacrobosco 1488). Deutsches Museum, München/Public Domain Mark

4 The Founder of the Tradition: Petrus Apianus (1526)

The new orientation towards pedagogical clarity, cosmographical realism, and interest in a more practical understanding of astronomy was accentuated in the edition printed by Petrus Apianus in Ingolstadt in 1526 (Sacrobosco 1526), which founded the in-octavo tradition. Apianus was then still at the beginning of his career. He had recently moved to Ingolstadt from Landshut where he had already published at least one world map, astrological *practica*, a book on a new kind of sundial (Apianus 1524a), and what was to become (after its revision by Gemma Frisius (1508–1555)) a best-seller, the *Cosmographicus liber* (1524), a manual based on Ptolemy's (second century) geographical knowledge that also contained abundant up-to-date information about land surveying, map projections, instrument making, and navigation (Apianus 1524b).[14] Moreover, Apianus's bias towards practicality showed itself in the way the book was printed: it was lavishly illustrated and contained volvelles (wheel charts) (Vanden Broecke 2000, 130–50). This kind of paper instrument, already used in the Middle Ages, had been introduced in printed books by Regiomontanus, followed by other mathematicians, instrument makers, and designers of astronomical books like Lazarus Behaim and Johann Stoeffler (1452–1531) (Regiomontanus (1472–1474?); Stoeffler 1514; Gingerich 1993, 63–74; Bennett 1998, 195–222; Rhodes and Sawday 2001; Kremer 2011; Schmidt 2011; Stijnman and Upper 2014).

This background must be kept in mind to better understand the new orientation around practicality given to the Sacrobosco printed tradition by Apianus's edition, which at first sight is a much less innovative book than the *Cosmographicus liber*. Indeed, Apianus refers to this earlier work in the *Ad lectorem* of his 1526 *Sphaera*. He adds that this new edition of the *Sphaera* has been conceived "because of the numerous correspondences that exist between geography and astronomy."[15] Indeed, if young students acquired a precise knowledge of the sphere and its circles via Sacrobosco, they would understand thoroughly the measures of Earth and heaven.[16]

The Apianus edition contained only the text of the *Sphaera*, slightly revised, without additions, notes, or commentary, and exhibited thorough editorial work. The layout was airier, using some paragraphs with first-line indents and blank interlinear spaces at the end of the chapters and of the sections in chapters. These chapters and sections had titles and subtitles printed in capital letters, and their set, more complete than in the Venetian incunabula (Table 9.2), better helped the reader in moving through the succession of topics in the text, and in grasping the logical organization of the treatise.

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[14] On Apianus, see (Röttel 1995).

[15] (Sacrobosco 1526, A1v):"…cum Geographia plurimum comercii habeat cum Astronomia…."

[16] (Sacrobosco 1526, A1v):"…visum est mihi haud inutile fore, si ingenuis adolescentibus primum omnium Astronomiae rudimenta praelegerem, Sphaeram IANI de Sacrobusto accuratissime interpretarer. Futurum tandem existimans ut ex sphaerae circulorumque ejus attenta cognitione, spaciorum terrae coelique absoluta notitia proveniret."

Table 9.2 Titles and subtitles in the Venetian editions from 1488 and in the edition of Apianus (1526)

Venetian editions	Apianus edition (1526) (NB: new subtitles are underlined)
	Prooemium auctoris
Divisio secundum accidens sphaerae	*Diffinitio sphaerae. Cap. 1*
Quae forma sit mundi	*Quae forma sit mundi*
	De coeli revolutione
	De coeli rotunditate
	Quod Terra sit rotunda
Quod aqua sit rotunda	*Quod aqua sit rotunda*
	Quod Terra sit centrum mundi
	De immobilitate Terrae
	De quantitate absoluta Terrae
De circulis ex quibus sphaera materialis componitur: et illa supercaelestis quae per istam imaginatur componi intelligitur. Capitulum secundum	*Capitulum secundum De circulis ex quibus sphaera materialis componitur: et illa supercaelestis (quae per istam imaginatur) componi intelligitur*
De zodiaco circulo	*De zodiaco circulo*
De duobus coluris	*De duobus coluris*
De meridiano et horizonte	*De meridiano et horizonte*
De quatuor circulis minoribus	*De quatuor circulis minoribus*
	De quinque zonis
**De caracteribus sphaerae decimae vel nonae et stellationibus octavae*	
** Quae signa quibus circulis dividantur*	
** Sequuntur figurae septentrionales*	
** Figurae Australes*[a]	
De ortu et occasu signorum et diversitate dierum et noctium et de diversitate climatum. Capitulum tertium	*Capitulum tertium De ortu et occasu signorum, de diversitate dierum et noctium, et de diversitate climatum*
De ortu et occasu signorum secundum astrologos	*De ortu et occasu signorum secundum astrologos*
De diversitate dierum et noctium quae sit habitantibus in diversis locis terrae	*De diversitate dierum et noctium quae sit habitantibus in diversis locis terrae*
	Quorum zenith est inter aequinoctium et tropicum Cancri
	Quorum zenith est in tropico Cancri
Quorum zenith est inter tropicum cancri et circulum arcticum[b]	*Quorum zenith est inter tropicum cancri et circulum arcticum*
Quorum zenith est in circulo arctico	*Quorum zenith est in circulo arctico*
Quorum zenith est inter circulum arcticum et polum mundi	*Quorum zenith est inter circulum arcticum et polum mundi*
Quorum zenith est in polo arctico	*Quorum zenith est in polo arctico*
De divisione climatum	*De divisione climatum*
De circulis et motibus planetarum et de causis eclipsium solis et lunae. Capitulum quartum	*Capitulum quartum De circulis et motibus planetarum, et de causis eclypsium Solis et Lunae*
	De statione, directione et retrogradatione
	De eclypsi Lunae

[a]The subtitles marked with an asterisk correspond to a long addition on the visible constellations of the eighth sphere and their correspondence with those of the ninth and tenth spheres.
[b]The first two subtitles «Quorum zenith est» are in the flow of the text.

Fig. 9.2 *Quod Terra sit rotunda*. From (Sacrobosco 1526, A6r). State Library Regensburg--999/ Philos.1325, urn:nbn:de:bvb:12-bsb11110162-1

However, the main improvement lay in the illustration. The diagrams of the Apianus edition bore an evident link of continuity to those of its Venetian and Leipzig predecessors in that they concerned the same topics, but they had all been redrawn. Several of these new diagrams were inspired by diagrams already present in the Venetian (Fig. 9.2) as well as the Leipzig editions (Table 9.5), but Apianus had found new visual solutions whenever the models at his disposal lacked clarity or relevance, or when they perpetuated out-of-date representations. An improved mastery of three-dimensional images provided better readability.

For instance, his figure of the elementary and celestial spheres (Table 9.1, No. 3) showed ten celestial spheres (instead of nine) according to the standard opinion of the astronomers at the beginning of the sixteenth century: it corresponded to the model adopted in the *Alphonsine Tables* and explained in Peuerbach's *Theoricae novae planetarum* (of which Apianus was to publish an edition in 1528). Thus, in Apianus's edition, the figure was more up to date than the text, which remained true to the original version and listed only nine celestial spheres.[17] Furthermore, in this diagram, like in that of the four elements (Table 9.1, No. 5), the sphere of earth was no longer included into the sphere of water, for earth and water formed one single

[17] The discrepancy in Apianus's work is the reverse of that in the Venetian editions, which modernized the text and kept the traditional figures.

sphere, according to the new representation of the terraqueous globe.[18] Such a representation was then still quite rare among *Sphaera* editions, for the printers reused the same woodcuts from edition to edition. It had first appeared in the edition supervised by Oronce Finé and printed in Paris by Vincent Quignon (active 1514–1557) for Regnault Chaudière (active 1509–1554) in 1516.[19]

More generally, the images were better distributed throughout all parts of the text (Table 9.5), and Apianus managed to replace diagrams that were not intelligible without the aid of the text with figures that made sense by themselves. To begin with, instead of the ambiguous diagram showing "The revolution of heaven" (Table 9.1, No. 6), there appeared the image of a celestial globe, the horizon of which separated the diurnal from the nocturnal sky (Sacrobosco 1526, A4v).

Indeed, Apianus created a coherent visual language with which his reader could become familiar, as the diagrams often constituted series. For instance, in chapter III, the figure of the "circles of natural days" (Table 9.1, No. 21) is followed by a series of eight diagrams that show what happens to the respective length of night and day (and to related phenomena) around the year under different latitudes (that is, different horizons).[20]

The figure of the "circles of natural days" (Apianus 1526, C1r), which inaugurates the series, shows the sphere of the sun, a small Earth at its center, the oblique track of the ecliptic, and the tight quasi-parallel (in fact spiral) circles that symbolize the path of the sun, day after day, as it follows the diurnal revolution of the heavens while progressing along the ecliptic of its own proper motion.

The next diagram (Apianus 1526, C1r) shows that in the "right sphere," that is at the equator, the horizon passes through the poles of the world and always divides the "circles of the days" into equal parts, so that nights are equal to days, whatever the position of the sun. The ecliptic and the earth are no longer visible, but we recognize the sphere and the band of solar spiral circles ("circles of the days"). These circles, drawn like lines, are vertically positioned, perpendicular to the line of the horizon (dividing night and day). Three of them are more heavily marked: the middle one (the path of the sun at the equinox that corresponds to the axis of the horizon) and those at both extremities (the solar path at the summer and winter solstices).

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[18] The change concerning the representation of the spheres of water and earth was a consequence of the navigation of Amerigo Vespucci along the east coast of Brazil in 1501, which proved that the southern hemisphere was not immersed in water. Joachim Vadianus was probably the first to infer that the earth constituted one single sphere with the water, from which it "partly emerged," doing so in a letter to Rudolf Agricola that was published for the first time in Wien in 1515. See (Randles 1980, 44–48; Grant 1994, 635–37).

[19] In the (Chaudière 1516) edition (and in the 1519, 1524, and 1527 re-editions), the terraqueous globe is represented in the diagram of the four elements (a2v), but not in the diagram of the elementary and celestial spheres (a2r). In the *Sphaera* printed in Wien in 1518 by Johann Singriener for Lucas Alantsee, the terraqueous globe, with a map drawn on it, figures in the diagram of the elementary and celestial spheres (a3r, a6v).

[20] This part of chapter 3, entitled "on the variation of phenomena according to latitude," is not illustrated in the Venetian editions; in the Leipzig editions, it is illustrated with seven diagrams, which have only remote links to Apianus's diagrams (Fig. 9.3).

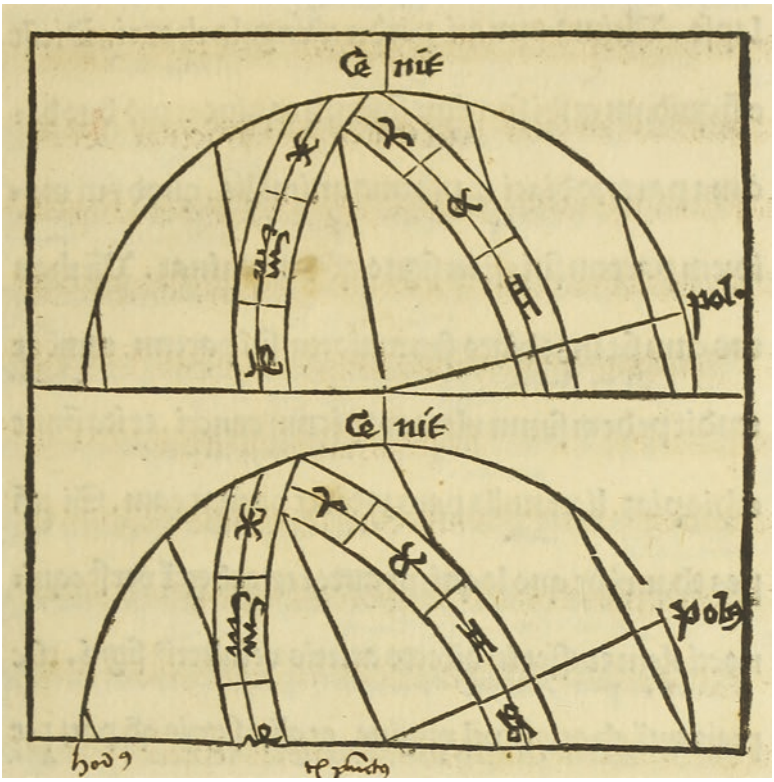
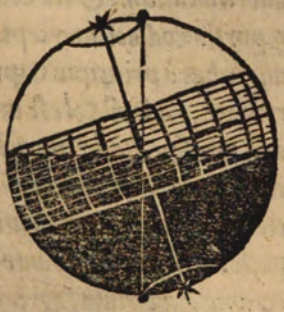


Fig. 9.3 *Opusculum spericum cum figuris optimis et novis*. When the zenith is between the Equator and the Tropic of Cancer (first diagram), and on the Tropic of Cancer (second diagram). From (Sacrobosco 1494). Courtesy of the John Carter Brown Library

At the right and left extremities of the horizon line, small stars symbolize the north and south poles: the plan of the horizon coincides with that of the axis of the world. The band of the "circles of the days" is divided by twelve lines (portions of meridians), parallel to the horizon and equally spaced. They are numbered and symbolize the perfect equality of all diurnal and nocturnal hours, whatever the season, in the right sphere (*sphaera recta*).

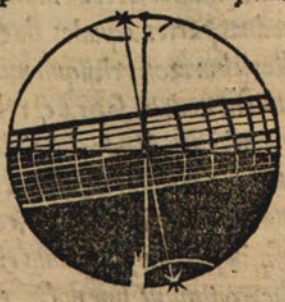
In the seven next diagrams, the basic elements are the same, but the respective positions of the horizon (with its axis), the axis of the world, and the "circles of the days" vary, as the text describes what happens to people "whose zenith is" at different latitudes (Fig. 9.4). Thanks to the consistency of the visual language, the principle of the variation of the duration of day and night (and of the direction and length of shadows) is easier to grasp. Apianus's effort towards transforming the traditional *Sphaera* into a modern manual capable of transmitting useful and applicable cosmological knowledge ended there, but this effort was to be pursued by followers and imitators.

tem, & reliqua deprimitur ſub horizonte ſubito, & hoc eſt quod dicit Alphraganus q̃ ibi occidũt repente ſex ſigna, & reliqua ſex oriũtur cũ toto æquinoctiali. Cum aũt eclyptica ſit horizon illorum, erit tropicus Cancri totus ſupra horizonta, & totus tropicus Capricorni ſub horizonte, & ſic Sole exiſtente in primo puncto Cancri, erit illis una dies 24. horarũ, & quaſi inſtãs pro nocte, quia in inſtanti Sol tranſit horizonta, & ſtatim emergit, & ille cõtactus eſt pro nocte. Ecõuerſo contingit illis Sole exiſtente in primo puncto Capricorni. Eſt .n. tunc illis una nox 24. horarũ, & quaſi inſtans pro die.



QVORVM ZENITH EST INTER CIRculum arcticum & polum mundi.

Illis aũt quorum zenith eſt inter circulum arcticũ & polum mũdi arcticum, cõtingit q̃ horizon illorũ interſecat zodiacum in duobus p̃ctis æquidiſtantibus à principio Cancri, & in reuolutiõe firmamẽti contingit q̃ illa portio zodiaci intercepta, ſemper relinquitur ſupra horizontem. Vnde patet q̃ quàm diu Sol eſt in illa portiõe intercepta



D

Fig. 9.4 When the zenith is on the Arctic Circle (first diagram), and between the Arctic Circle and the North Pole (second diagram). From (Sacrobosco. 1526, D1r). State Library Regensburg--999/Philos.1325, urn:nbn:de:bvb:12-bsb11110162-1

5 The Model Perfected: The Wittenberg Editions

Apianus's *Sphaera* was never exactly copied, but the model it provided was soon imitated and improved. The University of Wittenberg, founded in 1502, was then at a critical juncture in its reformation process. The disorders provoked by radical reformers like Thomas Müntzer (ca. 1489–1525) and the Zwickau Prophets, notably the 1525 Peasant War, had convinced Martin Luther (1483–1546) and Philipp Melanchthon (1497–1560) of the necessity of founding a strong educational system in order to spread the teaching of moral philosophy, physics, the arts of language, and mathematical disciplines (Kusukawa 1995). The elaboration of new programs at Wittenberg and the publication of manuals, meant to be circulated in Germany and even throughout Europe, were the focus of this scheme.[21]

The publication of a new edition of the *Sphaera* took place in a still more particular context. Melanchthon, who was the professor of Greek at Wittenberg, was a strong advocate of mathematics. He thought it provided key knowledge for reading ancient texts, history, and geography. He furthermore grew more and more convinced that the attentive study of celestial signs was a Christian duty, as it helped to pursue a better understanding of God's providential governance. He expressed this conviction in a well-argued apology of astronomy and astrology addressed to Simon Grynaeus (1493–1541) and appended as a preface to the new edition of Sacrobosco prepared for the beginning of the 1531–1532 academic year (Sacrobosco 1531).[22] This letter to Grynaeus was written in August 1531 while Melanchthon was observing the return of Halley's comet, which made a deep impression on him (Kusukawa 1995, 124–34).

This momentous preface was instrumental in the success of the book,[23] whose other attractive features were borrowed from the Apianus edition. The Wittenberg editor imitated Apianus's airy layout, his clear subtitles, and his use of paragraphs. He even added several new paragraphs and introduced many interlinear blank spaces.[24] He suppressed a few diagrams[25] and copied the rest of them, either closely

[21] On the amazing transformation of the modest town of Wittenberg into one of the largest book production centers in Germany, thanks to the publication of religious pamphlets, in the first place, but also of educational manuals, see (Pettegree 2010, 91–106).

[22] On Melanchthon's vision of astrology, see notably (Caroti 1986; Müller-Jahncke 1998).

[23] On the success of Melanchthon's letter, see (Pantin 1987).

[24] The description of the colures (see Chapter II of *Tractatus de Sphaera* by Sacrobosco) in the Apianus edition (B2v), for instance, does not use a paragraph to separate the general description from what concerns each colure; it uses two asterisks instead ("…⁂ Colurus igitur distinguens solsticia…"). The Wittenberg 1531 edition (C3v) adds a paragraph and an interlinear blank, and it also keeps the asterisks (probably because their meaning was no longer understood). A second example: the beginning of the section on the natural days ("Ex praedictis etiam patet quod dies naturales. Est enim dies naturalis…") is only marked by an intralinear blank (before "Ex praedictis") in the Apianus edition (B8v). In the Wittenberg edition (D3v), a new paragraph, made more visible by an interlinear blank, begins at "Est enim dies." As a consequence of this airier layout, the text of the Wittenberg 1531 edition is printed on forty-three folios (instead of thirty-one in the Apianus edition).

[25] The diagrams on the effect of refraction, supposed to enlarge the image of the stars near the horizon, were suppressed.

(in almost all cases) or more freely, to improve their clarity.[26] In only one case, he followed another model.[27]

But the important thing was that the Wittenberg edition set a dynamic process in motion. The printers of the *Sphaera* had always worked for the universities that provided their first market. But in this case, the association and the cooperation were still closer. The regular reprinting of the Wittenberg *Sphaera* over decades shows that the printers had a monopoly on the production of textbooks for the University of Wittenberg and for other Lutheran universities, and that they were supposed to adapt this production to any change in the syllabus, with the aid and under the supervision of the professors. That was probably a good business model, and the large quantity of books produced year after year allowed the 'Wittenberg Sacrobosco' to be widely known and influential, even outside Germany: already in 1532, the Venetian bookseller Melchior Sessa copied the Wittenberg edition instead of reproducing one of the versions of the *Sphaera* that had been regularly printed in Venice since 1472 (Sacrobosco 1532).[28] Moreover, the low commercial risk and the easy access to teachers of mathematics created the favorable conditions for a smooth evolution. Moderate additions were progressively introduced, and two significant revisions took place before 1545.

In the 1531 edition, the additions were limited to four mnemonic Latin verses on the cosmic, acronychal, and heliacal risings and settings (*Mane vehit supra terram tibi cosmicus ortus…*), and to an extract of Regiomontanus's *Epitome* (III, 21) on "the double cause of the inequality of natural days" (*Dies naturales duplici causa inaequales esse*) (Sacrobosco 1531, F2r–F3r). The 1534 and 1536 Wittenberg editions (Sacrobosco 1534a, 1536) followed the 1531 edition line to line, but the next edition, in 1538, was carefully revised, with important changes in the layout and the subtitles, the addition of several notes,[29] and even some corrections to the text. Furthermore, at the end of the book, an extract from Alfraganus (Sacrobosco 1538, G6v–G8r)[30] followed the one from Regiomontanus. However,

[26] Examples of improved diagrams include two figures of the terrestrial zones in Apianus's edition: the first one is a crude geometrical diagram; in the second one, a kind of map covers all the space between the polar circles. In the Wittenberg 1531 edition, there is only one larger and more precise geometrical diagram, with the name of the zones inscribed.

[27] The image of the lathe that illustrates the definition of the sphere (Sacrobosco 1531, B1v) is closer to the diagram introduced by Jacques Lefevre d'Étaples in Parisian treatises on the *Sphaera* (Chap. 2).

[28] For a general view of the development of the in-octavo tradition, see the next sections.

[29] For instance: (Sacrobosco 1538, B1v): a note on Euclid's definition, which is quoted in Greek and translated; (D4v): a marginal note on 'CHRONICUS:' "Pro Chronico legendum [in Greek:] *akronuchos*…," with a quotation in Greek from Proclus's commentary on Hesiod; (F2v): a marginal note on the evaluation of the width of the first climate: "Unui gradui latitudinis, tribuuntur hoc loco 56. Milliaria et duae tertiae unius. Est enim hic locus omnino fere ex Alfragano desumptus."

[30] The text "De ortu et occasu Planetarum, et occultationibus eorum de sub radiis solis. Diff. xxiv" is taken from the edition printed in Nuremberg in 1537, with Regiomontanus's *Oratio habita Patavii in praelectione Alfragani* and a preface by Melanchthon: *Rudimenta astronomica Alfragani. Item Albategni…de motu stellarum*.

the more obvious additions concerned the diagrams, notably with the introduction of four volvelles.[31] This imitation of the device used in Apianus's 1524 *Cosmographia* signaled the moderate but significant tendency towards practicality (at least as far as pedagogical methods were concerned) that was to characterize the Wittenberg treatises on the *Sphaera*. The volvelles were all the more useful as pedagogical tools in that their movable parts, printed on a folded sheet at the end of the volume, had to be cut out and assembled by the reader. Besides, they were true paper instruments, meant to complement certain demonstrations or to show some of the elementary procedures of astronomical calculation. For instance, the second volvelle bears this caption:

> Instrument by which the roundness of Earth according to latitude [that is, from south to north] is proven, and by which all that the author says in the third chapter about the natural days is very easily understood.[32]

The underlying diagram (Fig. 9.7) shows a graduated circle (a meridian), the axis of the world, the southern star Canopus, "Helice" (that is *Ursa Major*), and the quasi-parallel circles (more exactly, spiral) that describe the daily motion of the sun as it progresses along the zodiac, from one tropic to the other. These circles are divided into equal portions by twelve numbered arcs (which are portions of meridians). The lines of the climes above the arctic circle are also drawn. The movable part of the volvelle is a half-disk, bearing the words "HORIZON" and "NULLA DIES SINE LINEA" ("Not a day without writing a line"), a proverb taken from Pliny (23–79) (*Natural history*, XXXV, 84), which is an admonition against laziness. This half-disk is meant to recover the part of the hemisphere under the horizon; a kind of paper alidade, showing the zenith, is attached to it (Fig. 9.8).

The next edition, in 1540, strictly followed the 1538 edition, with only one (probably accidental) change: the letter of Melanchthon was dated August 1540 (Sacrobosco 1540, A8v).[33] Then, in 1543, a new revision occurred leading to significant additions: in Chapter III of *Tractatus de Sphaera* by Sacrobosco, an "Annotatio" on the three causes of the inequalities of natural days (with a new diagram) (Sacrobosco 1543b, E2r), two more marginal notes on the climes (Sacrobosco 1543b, F4v, F5r), and a "Table of the maximal lengths of the natural days in every latitude between the arctic circle and the pole."[34] Aside from this, the extract from Alfraganus at the end of the book was replaced by a brief treatise on the "Poetical

[31] On the probable author of the revision of the 1538 Wittenberg edition, Georg Joachim Rheticus, and on the changes to the illustration and the subtitles, see *infra*.

[32] (Sacrobosco 1538, B8r): "Instrumentum quo et rotunditas terrae secondum latitudinem probatur, et facillime omnia ea., quae autor in tertio capite de diebus artificialibus tradit dijudicantur."

[33] The change to the date of the preface was probably a mistake that originated in the printer's shop (because of the habit of making the date of the preface match with that of the printing). In the next Wittenberg editions (1543, 1545a, and so on) the initial date (1531) was restored. However, the error was transmitted to Paris and Antwerp editions (Table 9.3).

[34] (Sacrobosco 1543b, F1v–F2r): "Tabula maximorum dierum naturalium ad singulas elevationes poli habitantium a circulo arctico usque ad polum arcticum."

risings of the stars" (*De ortu poetico*), which provided all the information needed to inventory and to interpret the astronomical passages in classical texts. The *De ortu poetico* was accompanied by two astronomical tables printed on two folded sheets (Sacrobosco 1543b, G3v–I7v).[35]

Thus, thanks to the Wittenberg editions, the series of small treatises that derived from the edition of Apianus fully became a tradition: the transmission of the model, always clearly recognizable, was kept alive by its ability to evolve, unjeopardized by changes and additions.

6 The Development of the In-Octavo Tradition

The success of the Wittenberg *Sphaera* launched a long-lasting movement. During the rest of the century, about seventy editions following the same model, more or less improved and with different sets of additions, were printed in several European towns. It will be clearest to present the progress and ramification of this tradition in tabular form (Table 9.3).

In the first column, the editions that were used as models are listed, for they introduced major innovations that were adopted by later editions. Each of these editions is identified by the initial letter of the town where it was printed, followed by a number. For instance, "W3" (for "Wittenberg 3") means the third model of edition (with a particular set of texts and of diagrams) that was published in Wittenberg. The relationship between this model and its predecessors is briefly indicated in underlined notes. If the model-edition in question was reproduced in the same town without significant changes, the dates of the editions are given

[35] The tables are referred to in G7v ("Huc pertinet Tabula continens ingressum Solis in XII signa Zodiaci") and G8r ("Huc referatur Tabula quae habet gradus eclipticae cum quibus stellae insigniores olim oriebantur et occidebant"). They have disappeared from most copies.

below (and the names of the booksellers if they were different from the editors of the preceding editions).

In the second column, the editions that copied a model are described according to the same principles. They are placed in front of the model they copied, and the variants they could introduce are briefly indicated in underlined notes. The editions that showed significant variants but were not copied, or that transmitted limited variants but not a whole model (notably Paris 2–5 and Cologne 2), are in this second column.

In the third column, publications are mentioned that were linked to the Sacrobosco editions, but were outside the "in-octavo tradition" proper.

Table 9.3 The in-octavo tradition 1526–1601[a]

Innovative editions used as models (Main variants and additions are underlined)	Following editions (Main variants are underlined)	Sideways publications
Ingolstadt 1 [I1] 1526. *Sphaera Iani de Sacrobusto*, ed. Petrus Apianus: P. Apianus.		
Wittenberg 1 [W1] 1531. *Liber Johannis de Sacro Busto de sphera. Addita est praefatio…*: Joseph Klug. = I1 revised + Melanchthon's preface + extract from Regiomontanus. New iconography (see above and Table 9.6). 1534a; 1536.	**Venice 1 [V1] 1532**: M. Sessa**;** 1534b; 1537a, b: F. Bindoni; 1541; 1541: M. Sessa; 1545c; 1553a: F. Bindoni. = **W1**. **Venice 2 [V2]** 1548: *Sphaera…Addita sunt quaedam ad explanationem eorum quae in Sphaera dicuntur facentia*: M. Sessa; 1550a; 1552; 1554; 1557a; 1561a; 1564c: F. Rampazeto; 1572a: Sessa; 1577a; 1580; 1587; 1594; 1601a. = W1, but Melanchthon's preface is replaced by a short treatise of elementary geometry (with diagrams).	

(continued)

Table 9.3 (continued)

Innovative editions used as models (Main variants and additions are underlined)	Following editions (Main variants are underlined)	Sideways publications
Wittenberg 2 [W2] 1538. *Joannis de Sacro Busto Libellus de Sphaera. Ejusdem autoris libellus, cujus titulus est Computus…Cum praefatione…et novis quibusdam typis, qui ortus indicant*: J. Klug. = W1 revised and augmented, with new diagrams (and four volvelles) ± extract from Alfarganus + Sacrobosco, *De anni ratione*. 1540 (**= W2**, but the date of the preface has been accidentally modified: "August 1540" instead of "August 1531").	**Paris 1 [P1]** 1542/1543.[b] *Joannis de Sacrobusto de Sphæra liber. Plurimis novis typis auctus et illustratus. Praemissa Philippi Melanchthone doctiss. praefatione…*: J. Loys and G. Richard. **= W2**, copied from the 1540 edition[c], without *De anni ratione*. **Antwerp [A1]** 1543a**.** *Joannis de Sacro Busto Libellus de Sphaera. Ejusdem authoris libellus, cujus titulus est Computus…Cum praefatione…* **= W2**, copied from the 1540 edition like P1. **Paris 2 [P2]** 1545b**.** *Sphaera Ioannis de Sacrobosco typis auctior quam antehac, atque ex diligenti manu scriptorum impressorumque codicum collatione castigatior, praemissa… praefatione…*: **J.** Loys & G. Richard. Follows W2 and P1 with significant changes in the layout (the text is divided into books and chapters), and numerous additions: some anonymous *scholia*, two new diagrams, several marginal references and a biographical note: *J. de Sacrobosco vita*. **Antwerp 2 & Louvain 1 [A2 & L1]** 1547: M. Nutius for J. Richard and J. Waen. = W2 without Melanchthon's preface and without Sacrobosco, *De anni ratione*. New dedication to Hieronymus Ruffaut. Imperial privilege (8th of March 1547). Antwerp: J. Richard: 1551; 1559; 1561b.	1546. *La Sphere*, transl. Martin de Perer: J. Loys.

(continued)

Table 9.3 (continued)

Innovative editions used as models (Main variants and additions are underlined)	Following editions (Main variants are underlined)	Sideways publications
Wittenberg 3 [W3] 1543b**.** *Joannis de Sacro Busto Libellus de Sphaera. Accessit ejusdem autoris Computus ecclesiasticus et alia quaedam in studiosorum gratiam edita*: P. Seitz. W2 revised and augmented, with one new diagram + *De ortu poetico.* 1545a: V. Creutzer; 1549: J. Krafft; 1550b; 1553b; 1558; 1561d; 1563; 1568; 1574a: P. Seitz; 1578a: heirs of P. Seitz; 1601b: Z. Schurer and J. Krafft.	**Paris 3 [P3] 1549/1550.** *Sphaera… typis auctior…***:** T. Richard for G. Cavellat. Follows both W3 and P2. All additions are cumulated. **Paris 4 [P4]** 1550c**.** *Sphaera…typis auctior…cum annotationibus, quae locis aliquot obscuris magnam lucem afferent*: G. Cavellat. P3 + numerous new anonymous annotations + changes in the lay-out (the folios are numbered) **+** G. P. Valeriano: *Compendium in sphaeram.* Royal privilege (27th of March 1550 n.st.) **Paris 5 [P5] 1551.** *Sphaera…typis auctior…cum annotationibus, et scholiis doctissimi uiri Eliae Vineti, quæ locis aliquot obscuris magnam lucem afferent*: G. Cavellat, 1551. P4 + letter from Vinet to Tacitus (1550) + changes in the lay-out (the division into books and chapters is abandoned) + new *Scholia* by Vinet (which are not discernable from the older annotations that are still there). New layout: the division in chapter introduced in P2 disappears.	

(continued)

Table 9.3 (continued)

Innovative editions used as models (Main variants and additions are underlined)	Following editions (Main variants are underlined)	Sideways publications
Paris 6 [P6] 1555/1556.[d] *Sphaera…emendata. Eliae Vineti…scholia in eamdem sphaeram, ab ipso auctore restituta. Adiunximus…*: G. Cavellat. Follows P5, but Vinet's *Scholia* are revised and marked 'Scholium Vineti;' almost all the older notes are removed. + Pedro Nunez, *Annotatio in extrema verba capitis de climatibus*, transl. by Vinet. New privilege: 6th of February1555 n.st. **[P6b]** 1557b/**1558/1559**.[e] Paris: G. Cavellat. Follows P6, with some corrections, and the order of the texts has been slightly modified: Nuñes's *Annotatio* is printed first. 1561. **[P6c]** 1562a. Paris: G. Cavellat**.** Follows P6b, but the names of Melanchthon and Grynaeus have been suppressed. The letter becomes "Praefatio." 1564b.	**Venice 3 [V3]** 1562b**.** *Sphaera… emendata. Eliae Vineti Santonis scholia…*: G. Scoto. Follows P6, but the letter by Melanchthon has been suppressed. 1569; 1574; 1586. **Cologne 1 [C1]** 1566a**.** *Sphaera… emendata*: M. Cholinus. = P6c. **Paris 7 [P7]** 1569a**.** *Sphaera… emendata…*: J. de Marnef and G. Cavellat. Follows P6c, but Vinet's *scholia* are all printed together at the end of the *Sphaera.* 1572b; 1577b: J. de Marnef and widow Cavellat; 1584. **Cologne 2 [C2]** 1581**.** *Sphaera… emendata…*: M. Cholinus. Follows C1 and P6c + a dedication by Albertus Hero to Paulus Kuechovius (Cologne 04–03–1581) + *scholia* by Hero. 1591: G. Cholinus; 1594a.	1570. *La sphère*, transl. Guillaume des Bordes with some of Vinet's *Scholia*. Paris: J. de Marnef and G. Cavellat. 1576; 1584.
Lyons 1 [Ly1] 1564a/**1567**.[f] *Sphaera…emendata, Cum additionibus in margine, & indice rerum & locorum memorabilium, & familiarissimis scholijs, nunc recenter compertis, & collectis à Francisco Iunctino***:** S. Barbier for the heirs of J. Giunta. P6 without *De ortu poetico.* + Dedication by Giuntini to Thomas de Guadagne (Lyons, 15.06.1564) + a large commentary by Giuntini (with some new diagrams) + new appendices + an Index. Privilege: 10th of January 1564 n.st.	**Antwerp 3 [A3]** 1566b**.** *Sphaera… emendata…*heirs of A. Birckman and J. Richard. Follows **Ly1**, without Valeriano's *Compendium* and without the index. **Antwerp 4 [A4]** 1573. *Sphaera Ioannis de Sacro Bosco emendata. In eandem Francisci Junctini Florentini et Eliæ Vineti Santonis Scholia*: J. Bellere. = Ly1 + Sacrobosco, *Algorismus*.	
	Antwerp 5 [A5] 1582. *Sphaera… emendata. In eandem…Iunctini… Vineti…et Alberti Heronis scholia*: J. and P. Bellere. = A4 + Hero's *scholia* from C2.	

(continued)

Table 9.3 (continued)

Innovative editions used as models (Main variants and additions are underlined)	Following editions (Main variants are underlined)	Sideways publications
	Lyons 2 [Ly2] 1578b. *Sphaera… emendata a Fr. Iunctino Theologo…, qui etiam in capite libri adjunxit Principia Geometrica…In calce libri habes Scholia Eliae Vineti*: F. Tinghi. With Vinet's *Scholia* printed as in **P7** + Giuntini, *Principia geometrica*. No other text.	Giuntini, Francesco. 1577–1578. *Commentaria in Sphaeram Joannis de Sacrobosco*. Lyons: F. Tinghi, 2 vols.
Cologne 3 [C3] 1601c. *Sphaera… emendata…*: G. Cholinus. Follows C2 + some notes taken from Clavius's commentary + some anonymous comments + a poem by Thomas Abel, physician and professor of mathematics, perhaps the editor of the volume.		

[a]In this table, only true editions are listed. In some towns, particularly in Paris, the practice of re-issuing earlier editions with a new date on the title was quite common. As the products of this practice ("separate issues" in English, "émissions" in French) had strictly no impact on tradition, they are not taken into account to prevent skewing the statistics. Editions posterior to 1601 are not listed here.

[b]1542 is the date at the colophon; 1543 is the date on the title page.

[c]The 1540 Wittenberg edition copies line for line W2, with one exception: all marginal notes are inserted into the text, and the preface is dated 1540 (instead of 1531).

[d]1555 on the "achevé d'imprimer;" 1556 on the title-page.

[e]1557. Two reissues with the date modified: 1558, 1559.

[f]1564. Reissue with the date modified: 1567.

This tabular presentation shows that the development of the tradition was not chronologically linear. For instance, the tracts published in Venice by the Sessa firm until 1601 (V1 and V2) reproduced (with nonessential variants) a model conceived in Wittenberg in 1531 (W1); whereas in the same town, the Scoto firm published, from 1569 to 1586, a *Sphaera* (V3) that followed a 1556 Parisian model (P6).

It also shows that the rhythm of the innovations was rather rapid up to 1556, at which point it slowed down, and that the initiative of the innovations passed from town to town.

Thirdly, the analysis of these progressively introduced changes suggests that it would be quite misleading to make a sharp distinction between innovations and borrowed material: in the in-octavo tradition, the innovation process was largely a braiding process in which old and new materials, either produced inside the tradition or borrowed from outside, were closely interlocked. All these indications will be examined further, as they bring us back to the initial question: what kinds of actors were mostly responsible for the changes?

7 Publishers Versus Mathematicians

My point is that the evolution of the in-octavo tradition was the result of close cooperation between the publishers and the mathematicians, but also that the former, with a few exceptions, kept control over the process, which accounts for the longevity of this tradition.

7.1 The Shift from Town to Town

As we have seen, in the in-octavo tradition, the power to innovate passed from town to town. Almost each time, the existence of close cooperation between mathematicians and publishers figures as an important factor. At first (between 1531 and 1543), the most creative publishers were in Wittenberg; afterward in Paris. Between 1564 and 1582, the main feature of the editorial landscape was a kind of rivalry between Lyons and Antwerp, while Cologne also entered the game.

In the cases of Wittenberg and Paris, the main causes of the shifts are apparent. Apianus, the founder of the tradition, was simultaneously a printer and a mathematician, but he did not work in association with a university, and his interest in astronomical textbooks (the *Sphaera* in 1526 and Peuerbach's *Theoricae novae* in 1528) soon dwindled, as he embarked on a career at the imperial court. Then, around 1530, the reform of the university of Wittenberg experienced a significant turning point, as we have seen. Melanchthon supervised an editorial program that produced several innovative textbooks, notably in astronomy, written or edited by the professors and printed at the university print shop. The Wittenberg innovations, which did so much to give the in-octavo tradition its identity, were thus an exception in that their principal initiator was neither a mathematician nor a bookseller, but the reformer of the university syllabuses. However, when his efforts in this field had borne fruit, Melanchthon turned his attention to other priorities, such as the reform of the teaching of philosophy (the first version of his *Initia doctrinae physicae* was to appear in 1549). Moreover, the Wittenberg mathematicians, notably Kaspar Peucer (1525–1602), went on to publish alternative models of astronomical textbooks (Peucer 1550), and the publication of successive editions of the *Sphaera*, which remained in use, became simple routine work.

Paris had become one of the main centers of the European book trade during the first decades of the sixteenth century. It had benefited from the importance of its university and from the decline of Venice, which had been the center of the book world in the fifteenth century, but was now handicapped by a succession of political and economic crises. Major proponents of mathematical humanism were then teaching in Paris, notably Jacques Lefèvre d'Étaples (ca. 1450–1536) (Chap. 2) and his disciples, and in the next generation Oronce Finé (Chap. 8). These scholars were convinced of the necessity of spreading their ideas through the publication of innovative books, and could rely on their relationship with different interconnected milieus to do so: the Art Faculty and the Parisian col-

leges, the humanists engaged in pedagogical reform, the courtly circles that supported the foundation of the *Collège royal*, and prestigious printers able to assert themselves in the European market, namely Henri I Estienne (active 1502–1520) and Simon de Colines (active 1520–1546). Then, towards the end of the 1540s, less distinguished booksellers decided to widen the range of mathematical books offered on the market in order to attract new customers: Jean Loys, Guillaume Richard, and above all Guillaume Cavellat.[36] Their first targets were students, and they eagerly copied the pocket-sized textbook published in Wittenberg. They could furthermore count upon the cooperation of teachers who were willing to revise the annotation while preparing their own lectures: from 1545 to 1556, five editions of the *Sphaera* (P2 to P6) were published in Paris with significant additions and changes.

The move to Lyons (Ly1) was short-lived and probably mainly due to the initiative of the astrologer Francesco Giuntini, who wished, as we shall see, to affirm his mastery of all astronomical knowledge, starting with the *Sphaera*. At first, the in-octavo tradition probably appealed to him as an easy way to enter the field. But he abandoned it as soon as he saw that it offered too narrow a framework and did not permit him to expand his ambitions.

Antwerp was a "commercial megapolis" (Pettegree 2010, 250), and each time a kind of book proved successful, Antwerp booksellers often tried to enter its market. Until 1561, Jean Richard had on several occasions published two variants of the Wittenberg editions (A1 and A2). In 1566, in association with the heirs of Arnold I Birckmann (died 1542), he published, with some suppressions, a copy of Ly1 (A3). Then, in 1573, another Antwerp bookseller, Jean Bellere (1526–1595), issued a new edition (A4) that combined A3 and the Paris 1556 edition (P6). Finally, in 1582 (A5), the same Bellere still added Albertus Hero's (1549–1589) notes that had been printed in Cologne the preceding year (C2). This practice of combining borrowed material, which needed little mathematical expertise, can barely be called innovation. In any case, these attempts were not successful, as the in-octavo tradition was already declining.

The Cholinus firm in Cologne resorted to similar practices: it first followed a Parisian model (C1); then it freshened it up by adding some modest *scholia* written by Albertus Hero (C2). The masterpiece was achieved by Goswin Cholinus (active 1588–1610) in 1601 (C3): he published a new version of the *Sphaera emendata* that looked like a patchwork of diverse material, for an anonymous mathematician[37] had added to Elie Vinet's (1509–1587) and Hero's *scholia* several extracts from Clavius's commentary, some new notes (under the heading "Commentarius"), and even one *scholium* of Giuntini, one extract from Peuerbach's *Theoricae*, and two new (but not original) diagrams.

[36] On Cavellat's career, see (Pantin and Renouard 1986).

[37] This anonymous editor of the Cholinus edition was perhaps Thomas Abel, a physician and professor of mathematics, who wrote a poem "De hoc libro sphaerico emendato," printed between Hero's 1581 dedication and the beginning of the *Sphaera*.

7.2 Editorial Policies and Clustered Publications

For printers and booksellers, the publication of the *Sphaera* was as a rule part of a larger editorial program that included printing several mathematical and cosmological textbooks. Thus, as we have seen, Peter Apian began by editing a *Cosmographicus liber* in 1524, even before he settled as a printer in Ingolstadt. In 1529, he published a modified version of the *Cosmographiae introductio* of Mathias Ringmann (1482–1511) and Joannes Waldseemüller (ca. 1470–ca. 1521) (Ringmann and Waldseemüller 1529). He published the *Sphaera* in 1526, then Peuerbach's *Theoricae novae planetarum* in 1528, according to the same editorial principles (Peuerbach 1528). The printers of the university of Wittenberg imitated first Apianus's *Sphaera* (1531), then Apianus's *Theoricae novae* (1535); both editions were copied by Melchior Sessa the elder in Venice, in 1532 (the *Sphaera*) and 1534 (the *Theoricae*).

In 1538, the Wittenberg editors adopted the coupling of the *Sphaera* and Sacrobosco's *De anni ratione*, alias *Computus ecclesiasticus*, which was largely imitated by printers outside Germany, either in one volume or two separate editions. Other works, partly complementary to the *Sphaera*, partly redundant with it, were published in parallel by the same firms, such as Hartmann Beyer's (1516–1577) *Quaestiones novae in sphaeram*, an adaption of the *Sphaera*, first printed in Frankfurt (1549), then reproduced in Wittenberg (1550) and in Paris (1551) (Beyer 1549, 1550, 1551). From around 1550 on, as we have seen, the Wittenberg publishers continued to print regularly the 1543 model of the *Sphaera*, but they minimized the impact of obsolescence by printing, in parallel, the works of the actual professors in mathematics, Kaspar Peucer and Sebastianus Theodoricus (Sebastian Dietrich) (died in 1574) (Theodoricus 1563, 1564).[38]

The Parisian bookseller Guillaume Cavellat, active from 1549 to 1575, had in his catalogue a remarkable set of mathematical and astronomical textbooks (Pantin and Renouard 1986; Pantin 1988). He seems to have been keen to find new titles in this field. He was also responsible for important changes in the Sacrobosco in-octavo tradition, notably the adjunction of Pierio Valeriano's (1477–1558) *Compendium in Sphaeram*. Numerous similar examples—too many to enumerate—show that the publication of the *Sphaera* has to be evaluated in the context of booksellers's editorial policies.

7.3 Anonymity Versus Signature

Until the first publications of Elie Vinet's *Scholia* (Paris, 1551, P5), the changes and additions to the text and the illustration were always anonymous, with the noticeable exception of Apianus's founding work. For instance, there were some *scholia* in W2 and W3, and P1, P2, P3, and P4 added new ones, but their authors did not sign their names.

[38] Theodoricus's adaptions of the *Sphaera* were reprinted in Wittenberg in 1567, 1570, 1573, 1578, and 1583.

The case of the Wittenberg editions is interesting. They were published under the authority of Melanchthon, who wrote the preface, but certainly did not supervise the editorial work. For W2 (1538) and W3 (1543), this work may probably—at least partially—be ascribed to Georg Joachim Rheticus (1514–1574), then titular of the chair of lesser mathematics in Wittenberg, before and after his momentous stay with Nicolaus Copernicus (1473–1543) in Frombork.[39] In any case, Melanchthon remained the inspiration for the evolution of the Wittenberg treatises on the *Sphaera*. The addition, in W3, of the small anonymous treatise *De ortu poetico*, which gives technical explanations on heliacal, acronycal, and cosmical risings and settings followed by a number of poetical quotations with commentary, corresponded exactly to Melanchthon's conception of what ought to be the *lectio poetarum* (Ben-Tov 2009). Thus, in Wittenberg, the anonymity of the editors and commentators responded to a conscious policy: all publications displayed the pedagogical views of the university, under the authority of Melanchthon. However, the adaptions later published in Wittenberg by Kaspar Peucer and Sebastianus Theodoricus (Sebastian Dietrich) bore the name of their authors.

Indeed, in the second part of the century there came a change. As a probable result of a more competitive situation, the publishers now obviously recognized that signatures added value to their editions. A signature, often strengthened by a dedication,[40] highlighted the novelty of an edition and could warrant the request for a privilege. In March 1550, Guillaume Cavellat obtained a royal privilege for the printing of the *Sphaera*, which expired in March 1555. In France, as a rule, it was impossible to obtain a second privilege for the same work without demonstrating that the edition had been significantly improved, as the criterion of newness had been, since the origins of the system, essential in the granting of privileges (Armstrong 1990, 92–99).[41] Cavellat successfully applied for a privilege for the *Sphaera Joan. De Sacro Bosco emendata cum scholiis Eliae Vineti*.[42] The heirs of Giacomo Giunta (1487–1546) in Lyons also obtained a royal privilege for the

[39] The 1538 edition (W2) adds an edition of the *De anni ratione*, with a preface by Melanchthon addressed to A.P. Gasser. This preface states that the editorial work for the *De anni ratione* was done by Caspar Borner, but that the idea for the addition was Rheticus's. The intervention of Rheticus in W2 is thus documented. In a letter to Paul Eber (1 March 1562), Rheticus affirmed that he had "prepared the *Sphaera* and *Computus* for the press" in 1550 and complained of having been miserly paid (then, the W3 model was firmly installed in Wittenberg and the supervisor's work was routine). From the summer of 1542 on, Rheticus no longer taught in Wittenberg, but before that date the supervision of the printing of mathematical textbooks had been part of his job (Rosen 1970, 1974).

[40] Vinet wrote a dedication to Johannes Tacitus (P4), and Francesco Giuntini one to Thomas de Guadagne (L1). Even Albertus Hero wrote a dedication to Paulus Kuechovius (C2), though the few *scholia* he added to those of his predecessors were quite small indeed.

[41] A great change occurred in the French book-privilege system in February 1566, when the ordinance of Moulins (art. 78) stipulated that it was henceforth mandatory to publish under royal privilege. However, this still concerned "nouveaux livres." See (Saugrain 1744, 357–58).

[42] This privilege was first used in P6 (1555/1556). It is worth noting that Vinet's *scholia* had first been printed by Cavellat in 1551 (P5) under the first privilege. But P6 was *emendata* and added, for the first time, Pedro Nuñes's *Annotatio in extrema verba capitis de climatibus* translated by Vinet.

treatise of the sphere "corrigé et augmenté par maistre François Junctini professeur en Mathematique."[43]

When no author was available, a bookseller could write the dedication himself and obtain a privilege. That was the case with Jan Waen (active 1545–ca. 1565), who dedicated to Hieronymus Ruffaut (died 1563), abbot of Saint-Vaast in Arras, a reprint of W2 (and A1), but without Melanchthon's preface, under an imperial privilege (A2 & L1, 1547).[44] Thus, the decision for signature or for anonymity responded to editorial policies and commercial strategies. It was for the bookseller to decide which signatures were worth displaying. On the title page of the Cologne 1601 edition (C3), there is only one new name (in addition to those of Sacrobosco, Vinet, Hero,[45] Pierio Valeriano, and Pedro Nunez): that of Clavius. The Cholinus were the printers of the Jesuits in Cologne and used their emblem as their mark. The names of Giuntini and Peuerbach appear inside the volume, but not that of the author of the new "commentarii," who probably also supervised the organization of the new textual patchwork—unless we identify him as Thomas Abel, who discreetly signed his name under a poem at the end of the introductory part of the book.

7.4 *The Large Range of Innovations and the Importance of the* mise en texte

Innovation in the in-octavo tradition concerned a large range of elements. The additions, substitutions, and corrections in the *scholia* were viewed as fundamental—that is why the names of Elie Vinet, Francesco Giuntini, and even the modest Albertus Hero were displayed on the title-pages. So were the improvements in the illustration (as we shall see below).

The text itself was frequently submitted to revision. The corrections were superficial and only meant to improve the clarity of the style. At first, they were mainly due to the fact that nobody held the original author in particular respect. But, with the Parisian editions, a 'humanist turn' progressively occurred. The title of the 1545 edition printed by Jean Loys (P2) already boasted that the text was "more correct, thanks to the diligent collation of manuscript and printed exemplars" (*ex diligenti manuscriptorum impressorumque codicum collatione castigatior*), and this evolution lead to the production in 1555/1556 of a *Sphaera emendata* (P6) that enjoyed great success: until the end of the century, all the new editions (and their imitations) retained this phrase at the beginning of their titles.

[43] Privilege of Ly1.

[44] Imperial privileges could be granted to "republication as well as new publication, although in most cases even republication was claimed to be an improved and enlarged version of the first edition" (Maclean 2012, 140). On imperial privileges and their use in the Netherlands, see (Gompel 2011, 61–64). There, as in France, in the first part of the sixteenth century, book-privileges were mainly meant to protect the commercial interests of the beneficiaries; afterwards, they became mainly instruments of censorship.

[45] Vinet's and Hero's dedications are printed at the beginning of the volume, in addition to Melanchthon's letter, now an anonymous preface.

Indeed, the titles played a role in the innovation process: there never was a new model of edition without a new title—in turn faithfully copied in the imitations of this model. The new titles always advertised the innovations: the *scholia* and the improvement in the text, as we have seen,[46] but also the changes in the illustration[47] and other additions: "addita est praefatio…Philippi Mel. ad Simonem Grynaeum" (W1), later "Cum praefatione…" (W2) and "Praemissa praefatione…" (P1); "with a small treatise of the same author entitled the Comput" ("Ejusdem autoris libellus, cujus titulus est Computus…," W2); "and other materials printed to please the students" ("et alia quaedam in studiosorum gratiam edita," W3). On V2's title-page appear the words: "with some additions that help to explain what is told in the *Sphaera*" ("Addita sunt quaedam ad explanationem eorum quae in Sphaera dicuntur facentia"), which means that the preface of Melanchthon has been replaced by a short treatise of elementary geometry. The addition, in P4, of Valeriano's *Compendium in Sphaeram* is also advertised, as is that of Pedro Nunez's *Annotatio* in P6. Even the new *marginalia* and the index introduced in the 1564 Giuntini edition (Ly1) are signaled: "Cum annotationibus in margine, et indice rerum et locorum memorabilium."

This highlighting of the index and the *marginalia* shows that what the French historians of the book analyze as the elements of the "mise en texte" and "mise en livre" (Martin and Vezin 1990; Martin 2000) was viewed as an integral part of the innovation process. For instance, the Apianus and the Wittenberg editions had no running titles, and their pages were unnumbered. Guillaume Cavellat, in 1550 (P4), was the first to number the folios and add running titles.

As we have seen, the editors of the in-octavo editions, from the beginning, improved the clarity of the divisions of the text, using more subtitles, interlinear blanks, and other typographical devices. In this respect, W1 had already made progress in comparison to I1. Then W2 changed the wording of the subtitles (some of them became short summaries) and introduced a hierarchy between them to mark more clearly the logical structure of the text. For instance, in the last part of Chap. 2 (Table 9.4).

Table 9.4 The subtitles of the last part of chap. I in W1 and W2

W1	W2
QUOD TERRA SIT ROTUNDA QUOD AQUA SIT ROTUNDA	DE TERRA I Terram cum aqua globum constituere
QUOD TERRA SIT CENTRUM MUNDI DE IMMOBILITATE TERRAE	II Terram esse centrum mundi, hoc est, in medio universi sitam et velut punctum respectu firmamenti esse, immobilemque consistere.
DE QUANTITATE ABSOLUTA TERRAE	III Ambitum terræ, et ex eo Diametrum invenire.

[46] The anonymous *scholia* of P3 were mentioned in the title too: "with notes that throw much light on somewhat obscure passages" ("cum annotationibus, quae locis aliquot obscuris magnam lucem afferunt").

[47] W2: "with new figures that explain the risings [of the zodiacal signs]" ("et novis quibusdam typis, qui ortus indicant"), echoed in P1 by "with the addition and illustration of numerous new figures" ("Plurimis novis typis auctus et illustratus").

From 1545 (P2) on, the Parisian editions adopted an important innovation: the four chapters became four books, each divided into numbered chapters. However, this tendency to modernize the *Sphaera* was checked by the humanist turn operated by Elie Vinet. In 1551 (P5), the *Sphaera* returned to the original division into four chapters.

7.5 The Illustration: Scientific and Commercial Issues

From 1526 to 1538, the principal innovations concerned the illustration (Tables 9.5 and 9.6). Apianus and the anonymous editor or editors of Wittenberg did all the work, and the result was deemed so satisfactory that their successors simply copied their set of diagrams. Only Franco Burgersdijk, in 1626, was to undertake a complete reworking of the illustration (Chap. 11).

The creation of the complete set of diagrams that illustrated the in-octavo *Sphaeras* from 1538 to 1620 was progressive. Its authors borrowed from their predecessors (the Venetian incunabula, the Leipzig quartos, and above all the Apianus edition), but also from books outside this strict tradition. Thus, the editor of W2 (1538) borrowed fifteen diagrams from Oronce Finé's *Protomathesis*, published in Paris in 1532. As a result, some figures of a type that had previously been excluded from the tradition were introduced into it: four true geometrical diagrams meant to explain the ascensions of the signs (in Chapter III of *Tractatus de Sphaera* by Sacrobosco). However, as we have seen, the more striking innovation of W2 was the arrival of four volvelles, of which the different parts were printed on folded sheets bound at the end of the volume—the reader had simply to cut the parts and assemble them.

If we set aside a few additions that were not retained for long in the tradition, the iconography of the in-octavo editions was thus conceived between 1526 and 1538, with a strong dynamic of innovation. It was the main contribution of the German mathematicians to this tradition, and their work in that field was so well received by the public that a certain commercial logic cemented this contribution's place in future publication. The typical set of diagrams and volvelles of the in-octavo tradition was such a success that to modify it was out of the question. It could even be used as an identifying trademark.

The main reason why iconographical innovation ceased at an early stage in the in-octavo tradition was thus probably commercial. Such immobility could have represented a detrimental shortcoming, as it was indicative of a lack of serious mathematical work on the text: the invention of new diagrams was bound to happen as soon as mathematicians worked on a text and made commentary. However, this did not happen in this case, thanks to the particular character of Sacrobosco's short introduction to cosmology, whose large and enduring success was due to its completeness, the clarity of its style, but also its avoidance of all mathematical complexities. The *Sphaera* was more descriptive—even narrative—than demonstrative. As Thorndike has observed, it achieved a happy compromise between the literary tradition, derived notably from Macrobius's *Commentarii in somnium Scipionis*, and a then (in 1220) recent and more scientific approach to cosmology, permitted by the first translations of Arabic astronomers. Rival manuals composed at around the

Table 9.5 The diagrams from the Venetian incunabula to the Apianus edition[a]

Venetian incunabula[b] V	Leipzig 1486 Le1	Leipzig 1494– & Faber von Budweis (1495–) Le2	Apianus 1526 I1
Preliminaries			
Armillary sphere: 1	1 different	1 different	1 different (title)
Geometry: 24 diagrams	0	2 (copied from V?)	0
Chap. 1	**Chap. 1**	**Chap. 1**	**Chap. 1**
Diffinitiones 0	1 new	0	3 new
4 elementary and 9 celestial spheres: 1	1 different (1 elementary and 9 celestial spheres)	1, between V and Le1 (1 elementary, 9 celestial spheres)	1 new (terraqueous globe, air, fire, and 10 celestial spheres)
Sphaera recta/obliqua: 1	1 new	= Le1, but simplified	2 new
Elemental spheres: 1	1 new	1 different from Le1	1 new
De caeli revolutione: 1	1 similar to V	2 new	1 new
De caeli rotunditate: 1	3 new	3 similar to Le1	4 new
Effects of refraction: 2	0	0	2 (linked to V)
Quod terra sit rotunda: 2 (Fig. 9.1)	2 new	2: 1 similar to V; 1 similar to Le1	2 new (linked to V) (Fig. 9.2)
Quod aqua sit rotunda: 1	1 new	1 similar to V	1 new
Quod terra sit centrum mundi: 0	1 new	1 similar to Le1 (clearer)	1 new
De immobilitate terrae: 0	0	0	0
De quantitate terrae: 0.	0	0	0
Chap. 2	**Chap. 2**	**Chap. 2**	**Chap. 2**
0	Celestial circles	1 new	0
The equinoctial: 1	0	0	1 new (linked to V)
De zodiaco circulo: 1	0	0	1 new (linked to V)
Zodiacal signs: 2	4 (2 similar, 2 new)	4 similar to Le1	4 new (linked to Le1/2)
De duobus coluris:1	0	0	1 new
Meridian and horizon: 1	2 new	2 similar to Le1	1 new
Celest. zones & circles: 1	0	0	0
Terrestrial zones (with landscape): 1	1 new	1 new (with a map)	2 new (1 with landscape and map)
Chap. 3	**Chap. 3**	**Chap. 3**	**Chap. 3**
Poetical risings and settings: 1	2 new	2 similar to Le1	1 new (unclear)
The circles to measure astronomical risings: 1	2 new	2 similar to Le1	2 new
Natural day: 1	0	0	0

(continued)

Table 9.5 (continued)

Venetian incunabula[b] V	Leipzig 1486 Le1	Leipzig 1494– & Faber von Budweis (1495–) Le2	Apianus 1526 I1
Circles of natural days: 1	1 new	1 much clearer	1 (= L2 reduced)
Circles of the sphere: 1	0	0	0
12 celestial houses: 3	0	0	0
Shadows at the equator: 1	7 new (*diversitas dierum*)	7 similar to Le1 but clearer (Fig. 9.3)	8 new (*diversitas dierum*) (Fig. 9.4)
Terrestrial zones and climes: 2	1 new	1 new, with a map	2 new (only climes, 1 linked to V) (Figs. 9.5 and 9.6)
Chap. 4	**Chap. 4**	**Chap. 4**	**Chap. 4**
Circles of the Sun: 1	1 new	1 similar to Le1	2 new
Moon's circles, *caput & cauda draconis*: 1	1 new	1 similar to Le1	2 new
Circles of other planets 0	0	0	1 new
Station, retrogradation: 1	1 new	1 similar to Le1	1 new
The lunar eclipse (1)	2 new	2 similar to Le1	2 new (+1: phases)
The solar eclipse (1)	2 new	2 similar to Le1 (with variants)	1 new

[a]In this table all diagrams indicating an imitation or an influence are underlined. They are described with "similar to" if the imitation is obvious or with "linked to" if the imitation is less complete
[b]For more details, see (Table 9.1)

same time, such as those of Robert Grosseteste and John Peckham, were far less successful, although they were more up-to-date, probably because they were too dryly technical and mathematical and less elegantly written, and because they suppressed the quotations of classical poets (Thorndike 1949, 21). Indeed, technicity was not banned altogether, as it subsisted in largely diffused commentaries very soon to be associated with Sacrobosco's *Sphaera*, like the one attributed to Michael Scot that was composed in the first half of the thirteenth century.

Thus, from the beginning up to the Renaissance, the successful formula was the association of a short, clear, and elegant treatise with commentaries that could afford further information. In the in-octavo tradition, as soon as the *Sphaera* was provided with a set of clear, precise, pedagogical, and (if possible) self-explanatory diagrams, the effort turned elsewhere. The editors made improvements of a different kind. They wrote pedagogical or erudite notes—notably to rectify some blunders owing to Sacrobosco's lack of humanist training, and to explain the meaning of a few Greek words.[48] And they also resorted to additions: the addition of a few modest

[48]The Paris editors were particularly keen on this point. For instance, the Wittenberg 1538 editor (W2) already tells, in a sober marginal note (D4v), that in Sacrobosco's text "chronicus ortus" means "achronichos," referring to Proclus's commentary on Hesiod, whereas the 1545 Paris editor

Table 9.6 From the Apianus edition to the Wittenberg editions[a]

Topics	**I1: Ingolstadt 1526** **Cf** Table 9.5**.**	**W1: Wittenberg 1531–1536 Crudely copied in V1 (Venice, 1532–1541, 1553), and, with some additions, in V2 (1548–1601)**	**W2: Wittenberg, 1538–1540** **P1–P2: Paris** 1542/1543, **1545**[b] **A1–L1: Antwerp and Louvain,** 1547**; Antwerp 1551,** 1559**,** 1561b **With one more diagram: W3: Wittenberg 1543 Copied with a few eventual additions in: P3–P7: Paris 1549–seventeenth cent.** **V3: Venice** 1562b**–1586** **Ly1–2: Lyons,** 1564a**,** 1578b **A2–A4: Antwerp** 1566b**–1582** **C1–C3: Cologne** 1566a**–**1601c
Preliminaries			
Armillary sphere	1new (title)	1 copied from I1 (title)	Id.
Geometrical diagrams	0	0	Id.
Chap. 1	**Chap. 1**	**Chap. 1**	**Chap. 1**
Diffinitiones	3 new	2 inspired by I1	Id. + 2 new
Elementary and celestial spheres	1 new: Elements, 10 celestial spheres	1 copied from I1	Id.
Sphaera recta / obliqua	2 new	2 copied from I1	Id.
Elemental spheres	1 new	0	0
De caeli revolutione	1 new	0	1 new +2 copied from Finé
De caeli rotunditate	4 new	4 copied from I1	Id. + 1 inspired by V + 1 inspired by Le2
Effects of refraction	2	0	2 copied from I1 ± 1 copied from Finé
Quod terra sit rotunda	2 (Fig. 9.2)	2 copied from I1	2 new **(= volvelles)**(Figs. 9.7 and 9.8)
Quod aqua sit rotunda	1 new	1 copied from I1	Id.
Quod terra sit centrum mundi	1 new	1 copied from I1	Id. ± 1 copied from Finé

(continued)

Table 9.6 (continued)

De immobilitate terrae	0	0	0
De quantitate terrae	0	0	2 new
Chap. 2	**Chap. 2**	**Chap. 2**	**Chap. 2**
Armillary sphere	0	1 (= title)	Id.
The equinoctial	1 new	0	1 copied from Finé
De zodiaco circulo	1 new	0	1 new **= volvelle**
			+ 1 copied from Finé
Zodiacal signs	4	4 copied from I1	Id. + 1 copied from Finé
De duobus coluris	1 new	1 copied from I1	Id.
De meridiano et horizonte	1 new	1 copied from I1	Id.
Terrestrial zones (with landscape)	2 new (1 with landscape and map)	1 new	Id. + 1 copied from Finé: terrestrial globe and celestial circles
Chap. 3	**Chap. 3**	**Chap. 3**	**Chap. 3**
Poetical risings	1 new (unclear)	1 copied from I1	**1 new = volvelle**
Circles to measure astronomical risings	2 new	2 copied from I1	Id.
De ascensionibus	0	0	4 copied from Finé
Dies naturalis	0	0	1 copied from Finé
Circles of natural days	1	1 copied from I1	Id.
De diversitate dierum…in diversis locis terrae	8 new (Fig. 9.4)	8 copied from I1	Id.
Terrestrial zones and climes	2 new (climes) (Fig. 9.5)	1 copied from I1	1 (with map) copied from Finé. (Fig. 9.6)
Chap. 4	**Chap. 4**	**Chap. 4**	**Chap. 4**
Circles of the Moon, nodes of the dragon	4 new	4 copied from I1	Id.
Circles of other planets	1 new	1 copied from I1	Id.
De statione, directione…:	1	1 copied from I1	Id.
The lunar eclipse	3 new	3 copied from I1	Id.
The solar eclipse	1 new	1 copied from I1	Id.

[a]In this table as in (Table 9.5) the diagrams copied from other editions (or inspired by them) are underlined. The new diagrams in W2 are in bold

[b]P2 (Paris, 1545b) adds two crude and completely redundant diagrams. The first one (in a note on Euclid's definition of the sphere) remains in the Paris editions until P5 (1551), the second one (on the solar eclipse) until P6 (1555/1556)

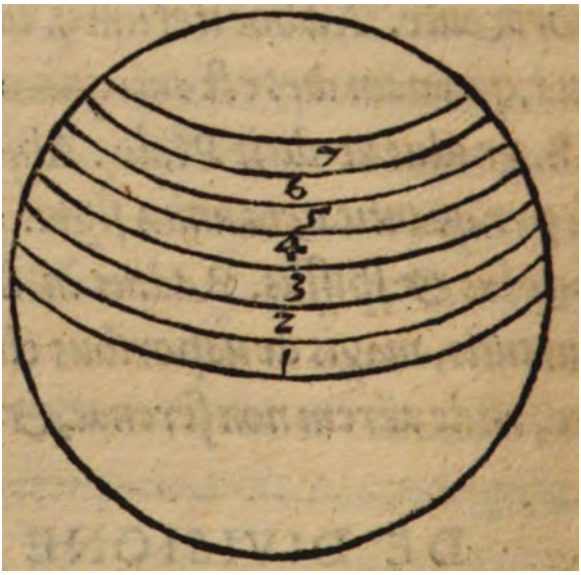


Fig. 9.5 *De divisione climatum*. From (Sacrobosco 1526, D2v). State Library Regensburg--999/ Philos.1325, urn:nbn:de:bvb:12-bsb11110162-1

tables inside the commentary,[49] and above all the addition of other texts to complement the *Sphaera*.[50]

8 The Limits of the Tradition: The Case of Francesco Giuntini

This cumulative process had its limits. The control of the publishers over the evolution of this tradition fostered innovation to a certain degree; but it could also hinder it. The iconography, as we have seen, consisted of a fixed set of diagrams; the additions were welcome, but only if they could fit into the handy format of the in-octavo textbook; the original contributions of skilled commentators were sought-after, provided that they let the model remain recognizable. The ideal new edition in the in-octavo tradition was an improved item that continued on the lines of previous

(P2) expands on this topic in a long note ("Corrupta scriptura…" D5r). Then Elie Vinet, in 1551 (P5), writes a new version of the note with more erudite details (34r). The 1550 Paris editor (P4) adds some notes on difficult words, like "Archetypus" (B7r) and "Diaphanum" (B8r).

[49] In W3, the table of the longest natural days for all degrees of latitude between the arctic circle and the pole appeared (Sacrobosco. 1543b, F1v–F2r), and in P2 a table of the climes (Sacrobosco. 1545b, F3v). The first massive addition of tables occurred thanks to Giuntini, but never to appear again in further editions (see *infra*).

[50] For a general view of additions, see (Table 9.3).

Fig. 9.6 *De divisione climatum*. From (Sacrobosco 1538, F4r). Bavarian State Library Munich—Astr.u. 154, urn:nbn:de:bvb:12-bsb00020992-1

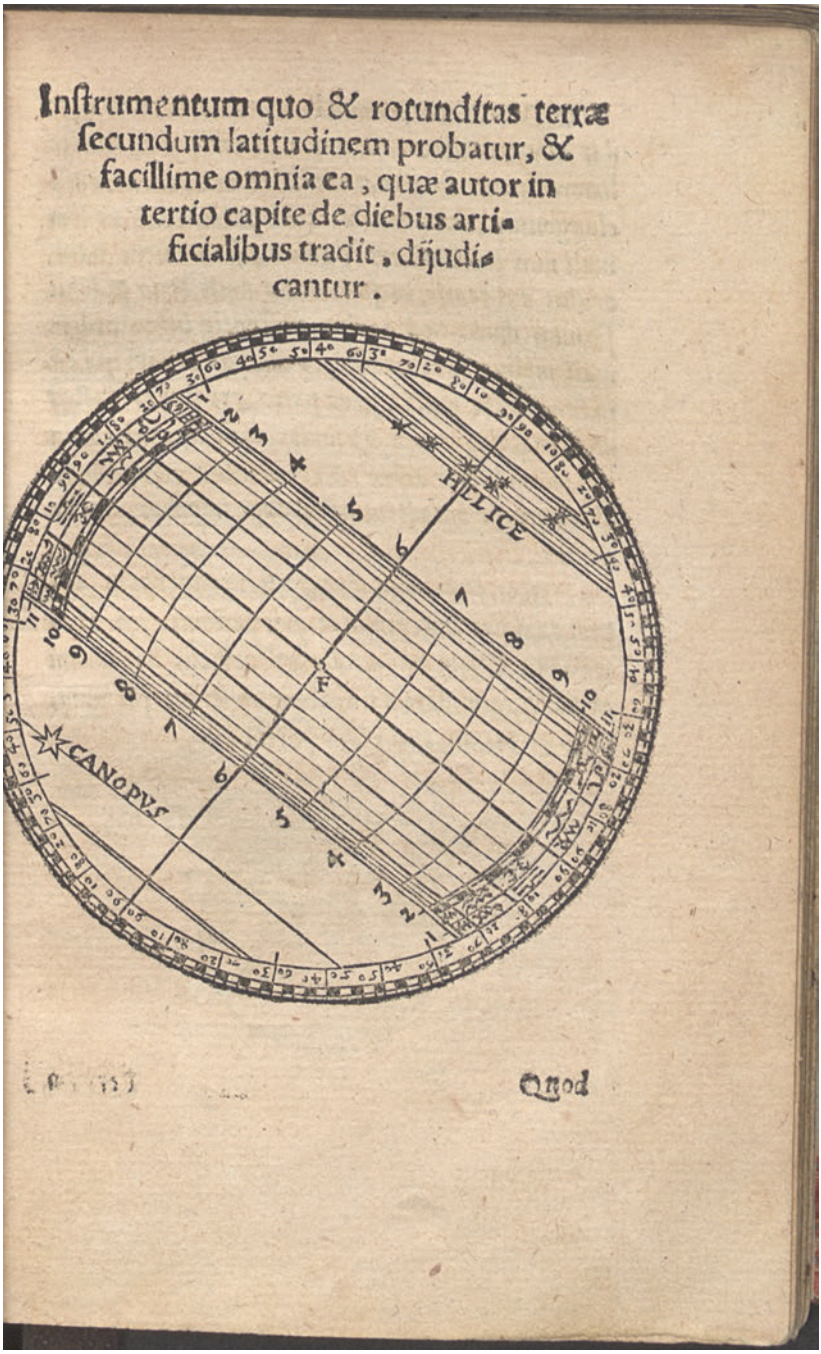


Fig. 9.7 Unmounted volvelle. From (Sacrobosco 1538, B8r). Bavarian State Library Munich—Astr.u. 154, urn:nbn:de:bvb:12-bsb00020992-1

Fig. 9.8 Mounted volvelle. From (Sacrobosco 1543b, B8r). Staats- und Stadtbibliothek Augsburg—Math 745, urn:nbn:de:bvb:12-bsb11267683-6

editions. The case of Francesco Giuntini shows that more ambitious projects were bound to leave this framework.

Francesco Giuntini, a Florentine by birth, had been a Carmelite priest and a doctor of theology. His assiduous practice of astrology and, above all, his Protestant sympathies led him into trouble. In 1561, he went to Lyons as a religious exile, publicly renounced his heresy, and entered a new career as a mathematician and astrologer with the support of the Italian colony in Lyons. After a time, he won the patronage of royal officers and even began to aim higher.[51] His first commentary on Sacrobosco was published in 1564, when he was still at the beginning of this successful second career (Sacrobosco 1564a). It fit into the framework of the in-octavo tradition, which likely appeared to him a good medium to widen his fame outside the Lyons circles. The presence of Melanchthon's preface in praise of astrology (which had to be printed without the name of its author) probably appealed to him as well (Sacrobosco 1564a, 3r–7v).

In the dedication of the work to Thomas de Gadagne (ca. 1539–1594), lord of Bellegarde, Giuntini states that Filippo Tinghi (died 1580), a Florentine printer and bookseller settled in Lyons, has asked him to emendate the *Sphaera* and add some "very brief notes" ("brevissimis notis") to explain the difficult passages, a demand which he has eagerly answered out of his zeal for promoting such a universally useful science as astronomy (Sacrobosco 1564a, 2r–v). Indeed, the "very brief notes" were to consist of innumerable *marginalia*, abundant *scholia* (even lengthier than Vinet's, and printed in bigger type), and long technical appendices, which concerned the method of determining the polar altitude at any location in the northern hemisphere,[52] the method of determining longitudes,[53] the method of determining the duration of natural days at different latitudes,[54] and instructions for the calendar (Sacrobosco 1564a, 143–46). The Giuntini edition thus brought into the in-octavo tradition a noticeable amount of material borrowed from other types of treatises on the *Sphaera*—adaptions or huge commentaries in which the original text was buried. Whereas the standard in-octavo model included only two modest tables, as we have seen, Giuntini added a series of tables (none of them original), which transformed the original textbook into an introduction to astronomical practice and calculation.[55]

[51] On Giuntini's career, see (Ernst 2001; Pantin 2013).

[52] (Sacrobosco 1564a, 117–27): "Quomodo altitudo poli Aquilonaris et aequatoris sit investiganda."

[53] (Sacrobosco 1564a, 128–29): "Quomodo Astrologi invenerunt locorum longitudines."

[54] (Sacrobosco 1564a, 136–42): "De quantitate diei et noctis, ortu et occasu Solis."

[55] The tendency to transform the original textbook into an introduction to astronomical practice and calculation, already present in Lefevre's and Finé's work on the *Sphaera* (Chaps. 2 and 8), had been reinforced in many adaptions and 'hypercommentaries' of Sacrobosco, notably those of (Schreckenfuchs 1569) and (Clavius 1570).

A table of the measures of the earth (perimeter, diameter etc.) in different units of measurement (leagues, miles, etc.).[56]
A table to compare the measures of the obliquity of the ecliptic by Ptolemy, Albategnius, etc. until Johannes Werner. (Sacrobosco 1564a, 41–42)
A table of the cosmic and chronic risings and settings of the twelve zodiacal signs. (59)
Two tables of the astronomical risings and settings of the zodiacal signs under the right sphere, measured in arcs of the equator, and in hours and minutes. (66–67)
A table of the astronomical risings and settings of the zodiacal signs under the oblique sphere, measured in arcs of the equator and calculated for each of the eight climes. (70–71)
For the determination of latitudes (first appendix), a table of the true position (*verus locus*) of the sun at midday for each day of the year according to the Prutenic Tables[57] (119–20), a table of the equation of the sun[58] (123), and a table of the declination of the sun. (125)
A table of the longitudes and latitudes of the principal towns of the world (130–36)
For the determination of the length of natural days, a table of the semi-diurnal arcs and of the latitudes of the sun at midday under different latitudes. (139–42)
Two calendar tables. (243, 246)

Giuntini was not satisfied with this first work on the *Sphaera* and he planned more ambitious publications, both to attract the attention of more important patrons and to advance the project he took most to heart: asserting the complete legitimacy of astrology as an integral part of the science of the stars, and as the science of Providence, perfectly compatible with the Catholic faith, even under the new Tridentine rules.[59] In 1573, he dedicated to Catherine de'Medici (1519–1589), the queen mother, the first version of his *Speculum astrologiae* (Lyons: Filippo Tinghi), which contained a series of astrological treatises and new astronomical tables (*Tabulae resolutae*). Then he published a two-volume commentary on the *Sphaera* in 1577–1578, which rivaled that of Clavius, though it was far less methodical and much more digressive (Giuntini 1577–1578).[60] Its most exceptional feature was the space it devoted to astrological and theological questions. The content of the former commentary was immersed into this new one, which still retained the typical diagrams conceived in Wittenberg (mixed with new ones), and even the in-octavo format, but, all the same, no longer belonged to the tradition founded by Apianus. The

[56] (Sacrobosco 1564a, 30): "Tabula quantitatis terrae secundum Ptolemaeum et experientiam."

[57] On Giuntini's reliance on Erasmus Reinhold's "Copernican tables," though he had otherwise no Copernican sympathies, see (Omodeo 2014, 136–39; Proverbio 1997).

[58] The equation of the sun (*aequatio Solis*) is the arc of the ecliptic between the true position (*verus locus*) of the sun, determined by a line issued from the center of the world and passing through the center of the body of the planet, and its mean position (*medius motus*) determined by a line issued from the center of the world and parallel to a line issued from the center of the eccentric deferent of the Sun and passing through the center of the body of the planet. All these notions are part of the knowledge taught in the *Theoricae planetarum*.

[59] Although the Council of Trent had hardened the control of the practice of astrology, Giuntini felt confident that he could promote this practice by using the same arguments as those developed by Melanchthon. On Giuntini's astrology, see (Thorndike 1941, 129–33; Pantin 2013).

[60] One volume of Giuntini's work is dated 1577, the other one 1578, but both were issued together. This commentary was reprinted in 1583 as part as the second in-folio volume of the much enlarged new version of the *Speculum astrologiae* (Lyons: Filippo Tinghi).

same year (1578), Filippo Tinghi published a new edition of the *Sphaera emendata* (Ly2). The *scholia* added in 1564 had been removed from it, replaced by a short treatise of elementary geometry. Giuntini's commentary and the in-octavo tradition had parted company for good.

9 Conclusion

In this paper, I focused on a kind of collective authorship, which was responsible for the development of a long-running tradition that developed from 1526 until the seventeenth century. I chose the privileged example of the in-octavo tradition to provide an interesting point of view on the means, the ways, and even the rhythm of innovation in the Sacrobosco field. This tradition was a successful attempt at standardization, producing a kind of manual that was able to retain, for over half a century, an essential core of original features even as it continued to evolve. This success proves the efficiency of a commercial model. The never-relenting interest in this particular model of *Sphaera* among a succession of booksellers in several European countries was certainly a motor for innovation: it would not have been possible to perpetually reprint the same book without drying up the market. It was necessary to innovate, at least to a certain extent, to gain enough new customers. But on the other hand, the constraints of the tradition, the obligation to retain the model, and the weight of trade imperatives imposed a limit on innovation, which, at the end, made decline inescapable. Between Giuntini's intervention and Burgersdijk's late attempt at reviving the tradition in 1626 (Chap. 11), no significant innovation occurred: the Wittenberg 1538 (W2) and the Paris 1555/1556 (P6) models were still printed, either in a repetitive manner (in Paris and Venice), or with different attempts at refreshment (in Antwerp and Cologne). In the second part of the sixteenth century, the concurrence of numerous new types of tracts on the *Sphaera* had marginalized the type studied in this paper.

In spite of the importance of the German mathematicians who conceived a remarkable set of cosmological pedagogical diagrams (following Melanchthon's educational plan), and in spite of the patient work of annotation achieved by a succession of professors (notably Elie Vinet), the actors who did most to support first the dynamic of the tradition, then its longevity, were probably the printers and booksellers: they did not write commentaries, but in many cases[61] they acted as intermediaries between the authors and the public, and they managed to keep control over the process. Innovation, as they conceived it, was a braiding process: it was often achieved through the artful combination of diverse borrowed material. In this way and in this specific instance, the printers and booksellers were largely responsible for blurring the distinction between borrowers and innovators.

[61] Not in all cases printers acted as intermediaries: as we have seen, in Wittenberg, the printers followed the instructions of the university.

References

Editions of Sacrobosco's Sphere Anterior to the In-Octavo Tradition

Sacrobosco. ca. 1472a. *Tractatum de spera*. Venice: Florentius de Argentina. http://hdl.handle.net/21.11103/sphaera.100685.
———. 1472b. *Spaera mondi*, ed. Pietro Buono Avogaro. Ferrara: Andreas Belfortis. http://hdl.handle.net/21.11103/sphaera.101122.
———. 1478a. *Spera mundi*. Venice: Franciscus Renner from Heilbronn. http://hdl.handle.net/21.11103/sphaera.100686.
———. 1478b. *Spera*. Venice: Adam Burkardt from Rottweil. http://hdl.handle.net/21.11103/sphaera.100687.
———. 1482. *Sphericum opusculum*. Venice: Erhard Ratdolt. http://hdl.handle.net/21.11103/sphaera.100692.
———. 1485. *Sphericum opusculum*. Venice: Erhard Ratdolt. http://hdl.handle.net/21.11103/sphaera.101123.
———. 1486. *Spericum opusculum*. Leipzig: Drucker des Capotius.
———. ca. 1487. *Spericum opusculum*. Leipzig: Martin Landsberg. http://hdl.handle.net/21.11103/sphaera.101126.
———. 1488. *Spaerae mundi compendium*. Venice: Johannes Santritter. http://hdl.handle.net/21.11103/sphaera.100822.
———. 1489. *Spericum opusculum*. Leipzig: Conrad Kachelofen. http://hdl.handle.net/21.11103/sphaera.100266.
———. 1490. *Sphaera mundi*. Venice: Bonetus Locatellus for Octavianus Scotus. http://hdl.handle.net/21.11103/sphaera.101124.
———. 1494. *Opusculum spericum cum figuris optimis et novis*. Leipzig: Martin Landsberg. http://hdl.handle.net/21.11103/sphaera.100271.
———. ca. 1495a. *Opusculum spericum cum notabili commento*, comm. Wenceslas Faber von Budweis. Leipzig: Martin Landsberg. http://hdl.handle.net/21.11103/sphaera.100886.
———. 1495b n.st. *Textus de Sphera*, comm. Jacques Lefèvre d'Etaples. Paris: Wolfgang Hopyl. http://hdl.handle.net/21.11103/sphaera.101126.
———. 1498. *Uberrimum sphere mundi comentum*, comm. Pierre d'Ailly and Pedro Sanchez Ciruelo. Paris: Jean Petit. http://hdl.handle.net/21.11103/sphaera.100038.
———. 1499a. *Opusculum spericum cum notabili commento*. Leipzig: Wolfgang Stöckel. http://hdl.handle.net/21.11103/sphaera.100888.
———. 1499b. *Sphaera mundi*, comm. Cecco d'Ascoli, Franciscus Capuanus de Manfredonia, Jacques Lefèvre d'Etaples, with Peuerbach, *Theoricae novae planetarum*, comm. Franciscus Capuanus. Venice: Simone Bevilaqua. http://hdl.handle.net/21.11103/sphaera.100265.
———. 1500. *Opus sphericum…figuris et notabili commento illustratum*, comm. Wenceslas Faber von Budweis. Cologne: Heinrich Quentell. http://hdl.handle.net/21.11103/sphaera.100891.
———. 1501a. *Opus sphericum…figuris et perutili commento illustratum*, comm. Wenceslas Faber von Budweis. Cologne: Heinrich Quentell. http://hdl.handle.net/21.11103/sphaera.100023.
———. 1501b. *Sphaera mundi*. Venice: Melchior Sessa. http://hdl.handle.net/21.11103/sphaera.100892.
———. 1503a. *Opus sphericum…figuris verissime exculptis et interpretatione familiari…illustratum*, comm. Wenceslas Faber von Budweis. Cologne: Heinrich Quentell. http://hdl.handle.net/21.11103/sphaera.100024.
———. 1503b. *Textus Spere materialis…cum lectura Magistri Conradi Norici*, comm. Conrad Tockler. Leipzig: Martin Landsberg. http://hdl.handle.net/21.11103/sphaera.100931.
———. 1505. *Opus sphericum…figuris verissime exculptis et interpretatione familiari…illustratum*, comm. Wenceslas Faber von Budweis. Cologne: Heinrich Quentell. http://hdl.handle.net/21.11103/sphaera.100028.

———. 1508. *Opus sphericum…figuris verissime exculptis et interpretatione familiari…illustratum*, comm. Wenceslas Faber von Budweis. Cologne: Heirs of Heinrich Quentell. http://hdl.handle.net/21.11103/sphaera.100183.
———. 1509. *Textus Spere materialis…cum lectura Magistri Conradi Norici*, comm. Conrad Tockler. Leipzig: Martin Landsberg. http://hdl.handle.net/21.11103/sphaera.101042.
———. 1513. *Sphaera mundi*. Venice: Melchior Sessa. http://hdl.handle.net/21.11103/sphaera.101023.
———. 1516. *Mundialis sphere opusculum*. Paris: Vincent Quignon for Regnault Chaudière. http://hdl.handle.net/21.11103/sphaera.100991.
———. 1518. *Opusculum de sphaera*. Wien: Johann Singriener for Lucas Alantsee. http://hdl.handle.net/21.11103/sphaera.100883.
———. 1519. *Sphaera mundi*. Venice: Jacobus Pentius for Melchior Sessa. http://hdl.handle.net/21.11103/sphaera.100992.

Editions in the In-Octavo Tradition (1526–1601)

———. 1526 **[I1]**. *Sphaera…per Petrum Apianum accuratissima diligentia denuo recognita ac emendata*. Ingolstadt: Petrus Apianus. http://hdl.handle.net/21.11103/sphaera.100070.
———. 1531 **[W1]**. *Liber de sphaera. Addita est praefatio in eundem librum Phlippi Melanchthonis ad Simonem Gryneum*. Wittenberg: Joseph Klug. http://hdl.handle.net/21.11103/sphaera.100138.
———. 1532 **[V1]**. *Liber de sphaera.* Venise: G.A. Nicolini da Sabio for Melchior Sessa. http://hdl.handle.net/21.11103/sphaera.100118.
———. 1534a. *Liber de sphera.* Wittenberg: Joseph Klug. http://hdl.handle.net/21.11103/sphaera.100085.
———. 1534b. *Liber de sphaera.* Venice: G.A. Nicolini da Sabbio for Melchior Sessa. http://hdl.handle.net/21.11103/sphaera.100179.
———. 1536. *Liber de sphaera.* Wittenberg: Joseph Klug. http://hdl.handle.net/21.11103/sphaera.101008.
———. 1537a. *Liber de sphaera.* Venice: Maffeo Pasini and Francesco Bindoni. http://hdl.handle.net/21.11103/sphaera.101059.
———. 1537b. *Liber de sphaera.* Venice: Giovanni Antonio Nicolini da Sabbio for Melchior Sessa. http://hdl.handle.net/21.11103/sphaera.101060.
———. 1538 **[W2]**. *Libellus de sphaera*. Wittenberg: Joseph Klug. http://hdl.handle.net/21.11103/sphaera.101106.
———. 1540. *Libellus de sphaera*. Wittenberg: Joseph Klug. http://hdl.handle.net/21.11103/sphaera.101025.
———. 1541a. *Liber…de sphaera. Addita est praefation in eundem librum Philippi Mel. Ad Simonem Grineum*. Venice: Francesco Bindoni and Maffeo Pasini. http://hdl.handle.net/21.11103/sphaera.100140.
———. 1541b. *Liber…de sphaera. Addita est praefatio in eundem librum Philippi Mel. Ad Simonem Grineum*. Venice: Giovanni Antonio Nicolini da Sabbio for Melchior Sessa. http://hdl.handle.net/21.11103/sphaera.100144.
———. 1542/1543 **[P1]**. *De sphaera liber. Plurimis novis typis auctus*. Paris: Jean Loys. http://hdl.handle.net/21.11103/sphaera.101027.
———. 1543a **[A1]**. *Libellus de sphaera*. Antwerp: Jean Richard. http://hdl.handle.net/21.11103/sphaera.100180.
———. 1543b **[W3]**. *Libellus de sphaera*. Wittenberg: Peter Seitz. http://hdl.handle.net/21.11103/sphaera.101029.
———. 1545a. *Libellus de sphaera*. Wittenberg: Veit Kreutzer. http://hdl.handle.net/21.11103/sphaera.100818.
———. 1545b **[P2]**. *Sphaera typis auctior, quam antehac, atque ex diligenti manu scriptorum impressorumque codicum collatione castigatior*. Paris: Jean Loys and Guillaume Richard. http://hdl.handle.net/21.11103/sphaera.101054.

———. 1545c. *Liber de sphaera*. Venice: Giovanni Antonio Nicolini da Sabbio for Melchior Sessa. http://hdl.handle.net/21.11103/sphaera.100145.
———. 1546. *La Sphere…traduicte de latin en langue francoyse*, transl. Martin de Perer. Paris: Jean Loys. http://hdl.handle.net/21.11103/sphaera.101030.
———. 1547 **[A2 & L1]**. *Sphaera*. Antwerp and Louvain: Martinus Nutius for Jean Richard and Jan Waen. http://hdl.handle.net/21.11103/sphaera.100917 [A2]. http://hdl.handle.net/21.11103/sphaera.100125 [L1].
———. 1548 **[V2]**. *Liber de sphaera. Addita sunt quaedam ad explanationem eorum, quae in sphaera dicuntur facientia*. Venice: Pietro Nicolini da Sabbio for Melchior Sessa. http://hdl.handle.net/21.11103/sphaera.101031.
———. 1549a. *Libellus de sphaera*. Wittenberg: Veit Kreutzer. http://hdl.handle.net/21.11103/sphaera.100136.
———. 1549b **[P3]**. *Sphaera typis auctior, quam antehac…atque ex diligenti manu…castigatior*. Paris: Thomas Richard and Guillaume Cavellat. http://hdl.handle.net/21.11103/sphaera.100137.
———. 1550a. *Sphaera. Addita sunt quaedam…*Venice: Pietro Nicolini da Sabbio for Melchior Sessa. http://hdl.handle.net/21.11103/sphaera.100163.
———. 1550b. *Libellus de sphaera*. Wittenberg: Johann Krafft. http://hdl.handle.net/21.11103/sphaera.100157.
———. 1550c **[P4]**. *Sphaera typis auctior, quam antehac…cum annotationibus*. Paris: Guillaume Cavellat. http://hdl.handle.net/21.11103/sphaera.100952.
———. 1551a. *Sphaera*. Antwerp: Jean Richard. http://hdl.handle.net/21.11103/sphaera.100161.
———. 1551b. *Sphaera typis auctior, quam antehac…cum annotationibus, et scholiis…Eliae Vineti*, comm. Elie Vinet. Paris: Guillaume Cavellat. http://hdl.handle.net/21.11103/sphaera.100181.
———. 1552. *Sphaera. Addita sunt quaedam…*Venice: Cornelio Nicolini da Sabbio for Melchior Sessa. http://hdl.handle.net/21.11103/sphaera.101045.
———. 1553a. *Liber de sphaera.* Venice: Francesco Bindoni. http://hdl.handle.net/21.11103/sphaera.100193.
———. 1553b. *Libellus de sphaera*. Wittenberg: Johann Krafft. http://hdl.handle.net/21.11103/sphaera.101102.
———. 1554. *Sphaera. Addita sunt quaedam….* Venice: Francesco Rampazetto for Melchior Sessa. http://hdl.handle.net/21.11103/sphaera.100164.
———. 1555/1556 **[P6]**. *Sphaera emendata. Eliae Vineti Santonis scholia…ab ipso autore restituta*, comm. Elie Vinet. Paris: Guillaume Cavellat. http://hdl.handle.net/21.11103/sphaera.100198.
———. 1557a. *Sphaera. Addita sunt quaedam….* Venice: heirs of Giovanni Padovani for Melchior Sessa. http://hdl.handle.net/21.11103/sphaera.101048.
———. 1557b **[P6b]**. *Sphaera emendata*, comm. Elie Vinet. Paris: Guillaume Cavellat. http://hdl.handle.net/21.11103/sphaera.100207. Reissues in 1558: http://hdl.handle.net/21.11103/sphaera.100210, and in 1559. http://hdl.handle.net/21.11103/sphaera.100819.
———. 1558. *Libellus de sphaera*. Wittenberg: Johann Krafft. http://hdl.handle.net/21.11103/sphaera.101049.
———. 1559. *Sphaera*. Antwerp: Jean Richard. http://hdl.handle.net/21.11103/sphaera.101107.
———. 1561a. *Sphaera. Addita sunt quaedam….* Venice: heirs of Melchior Sessa. http://hdl.handle.net/21.11103/sphaera.101066.
———. 1561b. *Sphaera*. Antwerp: Jean Richard. http://hdl.handle.net/21.11103/sphaera.101058.
———. 1561c. *Sphaera emendata*, comm. Elie Vinet. Paris: Guillaume Cavellat. http://hdl.handle.net/21.11103/sphaera.100211.
———. 1561d. *Libellus de sphaera*. Wittenberg: Johann Krafft. http://hdl.handle.net/21.11103/sphaera.101109.
———. 1562a **[P6c]**. *Sphaera emendata*, comm. Elie Vinet. Paris: Cavellat. http://hdl.handle.net/21.11103/sphaera.101067.
———. 1562b **[V3]**. *Sphaera emendata…ex postrema impressione Lutetiae*, comm. Elie Vinet. Venice: Girolamo Scoto. http://hdl.handle.net/21.11103/sphaera.101094.

———. 1563. *Libellus de sphaera*. Wittenberg: Johann Krafft. http://hdl.handle.net/21.11103/sphaera.101070.
———. 1564a [Ly1]. *Sphaera…emendata cum additionibus in margine…nunc recenter compertis et collectis a Francisco Junctino Florentino sacrae theologiae doctore*, comm. Elie Vinet and Francesco Giuntini. Lyons: Symphorien Barbier for Filippo Tinghi and the heirs of Giunta. http://hdl.handle.net/21.11103/sphaera.101071. Reissue with the date 1567. http://hdl.handle.net/21.11103/sphaera.101111.
———. 1564b. *Sphaera emendata*, comm. Elie Vinet. Paris: Guillaume Cavellat. http://hdl.handle.net/21.11103/sphaera.100110.
———. 1564c. *Sphaera. Addita sunt quaedam*…. Venice: Francesco Rampazetto. http://hdl.handle.net/21.11103/sphaera.100165.
———. 1566a **[C1]**. *Sphaera emendata*, comm. Elie Vinet. Cologne: Maternus Cholinus. http://hdl.handle.net/21.11103/sphaera.101076.
———. 1566b **[A3]**. *Sphaera emendata cum additionibus in margine*, comm. Elie Vinet and Francesco Giuntini. Antwerp: Jean Richard and the heirs of Arnold Birckmann. http://hdl.handle.net/21.11103/sphaera.101114. http://hdl.handle.net/21.11103/sphaera.101115.
———. 1568. *Libellus de sphaera*. Wittenberg: Johann Krafft. http://hdl.handle.net/21.11103/sphaera.101112.
———. 1569a **[P7]**. *Sphaera emendata*, comm. Elie Vinet. Paris: Guillaume Cavellat and Jérôme de Marnef. http://hdl.handle.net/21.11103/sphaera.100240.
———. 1569b. *Sphaera emendata…ex postrema impressione Lutetiae*, comm. Elie Vinet. Venice: Girolamo Scoto. http://hdl.handle.net/21.11103/sphaera.101040.
———. 1572a. *Sphaera. Addita sunt quaedam*…. Venice: heirs of Melchior Sessa. http://hdl.handle.net/21.11103/sphaera.101086.
———. 1572b. *Sphaera emendata*, comm. Elie Vinet. Paris: Guillaume Cavellat and Jérôme de Marnef. http://hdl.handle.net/21.11103/sphaera.100268.
———. 1573 **[A4]**. *Sphaera emendata*, comm. Elie Vinet and Francesco Giuntini. Antwerp: Gilles van der Rade for Jean Bellere. http://hdl.handle.net/21.11103/sphaera.100460.
———. 1574a. *Libellus de sphaera*. Wittenberg: Peter Seitz. http://hdl.handle.net/21.11103/sphaera.101056.
———. 1574b. *Sphaera emendata…ex postrema impressione Lutetiae*, comm. Elie Vinet. Venice: heirs of Girolamo Scoto. http://hdl.handle.net/21.11103/sphaera.100309.
———. 1577a. *Sphaera. Addita sunt quaedam*…. Venice: heirs of Melchior Sessa. http://hdl.handle.net/21.11103/sphaera.100478.
———. 1577b. *Sphaera emendata*, comm. Elie Vinet. Paris: widow of Guillaume Cavellat and Jérôme de Marnef. http://hdl.handle.net/21.11103/sphaera.100269.
———. 1578a. *Libellus de sphaera*. Wittenberg: heirs of Peter Seitz. http://hdl.handle.net/21.11103/sphaera.101116.
———. 1578b **[Ly2]**. *Sphaera emendata a Fr. Junctino…qui etiam in capite libri adjunxit Principia geometrica*, comm. Elie Vinet and Francesco Giuntini. Lyons: Filippo Tinghi. http://hdl.handle.net/21.11103/sphaera.100311.
———. 1580. *Sphaera. Addita sunt quaedam*…. Venice: heirs of Melchior Sessa. http://hdl.handle.net/21.11103/sphaera.100299.
———. 1581. *Sphaera emendata*, comm. Elie Vinet and Albertus Hero. Cologne: Maternus Cholinus. http://hdl.handle.net/21.11103/sphaera.100655.
———. 1582 **[A5]**. *Sphaera emendata*, comm. Elie Vinet, Francesco Giuntini and Albertus Hero. Antwerp: Pierre Bellere. http://hdl.handle.net/21.11103/sphaera.100898.
———. 1584. *Sphaera emendata*, comm. Elie Vinet. Paris: widow of Guillaume Cavellat and Jérôme de Marnef. http://hdl.handle.net/21.11103/sphaera.100324.
———. 1586. *Sphaera emendata…ex postrema impressione Lutetiae*, comm. Elie Vinet. Venice: heirs of Girolamo Scoto. http://hdl.handle.net/21.11103/sphaera.100325.
———. 1587. *Sphaera. Addita sunt quaedam*…. Venice: heirs of Melchior Sessa. http://hdl.handle.net/21.11103/sphaera.100300.
———. 1591. *Sphaera emendata*, comm. Elie Vinet and Albertus Hero. Cologne: Goswin Cholinus. http://hdl.handle.net/21.11103/sphaera.100326.

———. 1594a. *Sphaera emendata*, comm. Elie Vinet and Albertus Hero. Cologne: Goswin Cholinus. http://hdl.handle.net/21.11103/sphaera.100656.
———. 1594b. *Sphaera. Addita sunt quaedam….* Venice: heirs of Melchior Sessa. http://hdl.handle.net/21.11103/sphaera.100301.
———. 1601a. *Sphaera. Addita sunt quaedam….* Venice: heirs of Melchior Sessa. http://hdl.handle.net/21.11103/sphaera.100302.
———. 1601b. *Libellus de sphaera*. Wittenberg: Johann Krafft for Zacharias Schurer. http://hdl.handle.net/21.11103/sphaera.100646.
———. 1601c **[C3]**. *Sphaera emendata, aucta, et illustrata…nunc accessere R.P. Christoph. Clavii breves commentarii*, comm. Elie Vinet, Albertus Hero and Christoph Clavius, ed. Thomas Abel [?]. Cologne: Goswin Cholinus. http://hdl.handle.net/21.11103/sphaera.100327.

Large Commentaries on the Sphere

Clavius, Christopher. 1570. In *Sphaeram Ioannis de Sacro Bosco commentarius*. Rome: Vittorio Eliano. http://hdl.handle.net/21.11103/sphaera.100365.
Giuntini, Francesco. 1577–1578. *Commentaria in Sphaeram Joannis de Sacrobosco,* 2 vols. Lyons: Jean de Tournes for Filippo Tinghi, 1577–1578. http://hdl.handle.net/21.11103/sphaera.100921; http://hdl.handle.net/21.11103:sphaera.100393.
Idem. 1583. *Speculum astrologiae*, ed. Giuntini, Francesco, vol. II. Lyons: Filippo Tinghi. http://hdl.handle.net/21.11103/sphaera.101101.
Schreckenfuchs, Erasmus. 1569. *Commentaria in sphaeram*. Basel: Henricpetri. http://hdl.handle.net/21.11103/sphaera.101080.

'Adaptions' of the Sphere and Other Cosmological and Astronomical Books

Apianus, Petrus. 1524a. *Cosmographicus liber*. Landshut: Johann Weissenburger for Petrus Apianus.
———. 1524b. *Ein Kunstlich Instrument oder Sonnen Ur*. Landshut: Johann Weissenburger for Petrus Apianus.
Beham, Lazarus. 1476. *Buch von der Astronomie*. Cologne: Nicolaus Götz.
Beyer, Hartmann. 1549. *Quaestiones novae in sphaeram*. Frankfurt: Peter Braubach. http://hdl.handle.net/21.11103/sphaera.100645.
———. 1550. *Quaestiones novae in sphaeram*. Wittenberg: Heirs of Peter I Seitz. http://hdl.handle.net/21.11103/sphaera.101121.
———. 1551. *Quaestiones novae in sphaeram*. Paris: Guillaume Cavellat. http://hdl.handle.net/21.11103/sphaera.101038.
Dietrich, Sebastian, see Theodoricus.
Maurolico, Francesco. 1543. *Cosmographia in tres dialogos distincta*. Venice: heirs of Luca Antonio Giunta. http://hdl.handle.net/10.3931/e-rara-2055.
Peucer, Kaspar. 1550. *De dimensione terrae, et fontibus doctrinae longitudinis et latitudinis locorum*. Wittenberg: heirs of Peter I Seitz.
———. 1551. *Elementa doctrinae de circulis coelestibus, et primo motu*. Wittenberg: Johann Krafft. http://hdl.handle.net/21.11103/sphaera.100251.
Peuerbach, Johannes. 1528. *Novae theoricae planetarum*, ed. Petrus Apianus. Ingolstadt: Petrus Apianus.
Regiomontanus, Johannes. [1472–1474?]. *Kalender*. Nüremberg: Johannes Regiomontanus.
Ringmann, Mathias, and Joannes Waldseemüller. 1529. *Cosmographiae introductio cum quibusdam Geometriae ac Astronomiae principiis ad eam rem necessariis.* Ingolstadt: Petrus Apianus.
Stoeffler, Johann. 1514. *Tabulae astronomicae*. Tubingen: Thomas Anshelm.
Theodoricus, Sebastianus (Sebastian Dietrich). 1563. *Breve, perspicuum et facile compendium logisticae astronomicae.* Wittenberg: Hans Lufft.

——— (Sebastian Dietrich). 1564. *Novae quaestiones sphaerae, hoc est, de circulis coelestibus, et primo mobile*. Wittenberg: Johann Krafft. http://hdl.handle.net/21.11103/sphaera.101072.

Secondary Literature

Armstrong, Elizabeth. 1990. *Before copyright. The French book-privilege system 1498–1526*. Cambridge: Cambridge University Press.

Bennett, James A. 1998. Practical geometry and operative knowledge. *Configurations* 6 (2): 195–222.

Ben-Tov, Asaph. 2009. *Lutheran humanists and Greek antiquity. Melanchthonian scholarship between universal history and pedagogy*. Leiden: Brill.

Caroti, Stefano. 1986. Melanchthon's astrology. In *Astrologi hallucinati*, ed. Paola Zambelli, 115–121. Berlin: De Gruyter.

Clagett, Marshall. 1974. The works of Francesco Maurolico. *Physis* 16: 148–198.

Ernst, Germana. 2001. Giuntini, Francesco. In *Dizionario biografico degli Italiani*, vol. 57, 104–108. Rome: Treccani.

Gingerich, Owen. 1993. Astronomical instruments with moving parts. In *Making instruments count. Essays on historical scientific instrument*, ed. R.J.W. Anderson, J.A. Bennett, and W.F. Ryan, 63–74. Aldershot: Variorum.

van Gompel, Stef. 2011. *Formalities in copyright law. An analysis of their history, rationales, and possible future*. New York: Wolters Kluwer.

Grant, Edward. 1994. *Planets, stars, and orbs: The Medieval cosmos, 1200–1687*. Cambridge: Cambridge University Press.

Kremer, Richard. 2011. Experimenting with paper instruments in fifteenth- and sixteenth-century astronomy: Computing syzygies with isotemporal lines and salt dishes. *Journal for the History of Astronomy* 42: 223–258.

Kusukawa, Sachiko. 1995. *The transformation of natural philosophy. The case of Philip Melanchthon*. Cambridge: Cambridge University Press.

Lattis, James. 1994. *Between Copernicus and Galileo. Christopher Clavius and the collapse of Ptolemaic cosmology*. Chicago: The University of Chicago Press.

Maclean, Jan. 2012. *Scholarship, commerce, religion. The learned book in the age of confessions, 1560–1630*. Cambridge, MA: Harvard University Press.

Martin, Henri-Jean. 2000. *Mise en page et mise en texte du livre français. La naissance du livre moderne (XIV^{e}–XVII^{e} siècles)*. Paris: Cercle de la Librairie.

Martin, Henri-Jean, and Jean Vezin. 1990. *Mise en page et mise en texte du livre manuscrit*. Paris: Promodis.

Moscheo, Rosario. 1998. L'insegnamento delle matematiche nell'antico *Studium Messinese*: Francesco Maurolico. *Annali di Storia delle Università italiane* 2: 123–145.

Mosley, Adam. 2004. Tycho Brahe, Erasmus Oswald Schreckenfuchs and the mysterious planetary motion machine. In *Instruments of mystery*, ed. Patrick Boner, 14–26. Cambridge: Cambridge Whipple Museum of the History of Science.

Müller, Kathrin. 2008. *Visuelle Weltaneignung. Astronomische und kosmologische Diagramme in Handschriften des Mittelalters*. Göttingen: Vandenhoeck & Ruprecht.

Müller-Jahncke, Wolf-Dieter. 1998. Melanchthon und die Astrologie: Theoretisches und Mantisches. In *Melanchthon und die Naturwissenschaften seiner Zeit*, ed. Günther Frank and Stefan Rhein, 105–136. Sigmaringen: Thorbecke.

Obrist, Barbara. 2004. *La cosmologie médiévale. I. Les fondements antiques*. Florence: Sismel.

Omodeo, Pietro Daniel. 2014. *Copernicus in the cultural debates of the Renaissance*. Leiden: Brill.

Pantin, Isabelle. 1987. La lettre de Melanchthon à Simon Grynaeus: les avatars d'une défense de l'astrologie. In *Divination et controverse religieuse au XVI^{e} siècle*, 85–101. Paris: Cahiers V.L Saulnier.

———. 1988. Les problèmes spécifiques de l'édition des livres scientifiques à la Renaissance: l'exemple de Guillaume Cavellat. In *Le Livre dans l'Europe de la Renaissance*, ed. Pierre Aquilon et al., 240–252. Paris: Promodis.

———. 1999. New philosophy and old prejudices: Aspects of the reception of copernicanism in a divided Europe. *Studies in History and Philosophy of Science. Part A* 30–32: 237–262.
———. 2013. Francesco Giuntini et les nouveautés célestes. In *Celestial novelties, science and politics on the eve of the scientific revolution*, ed. Patrick Boner and Dario Tessicini, 85–104. Florence: Olschki.
Pantin, Isabelle, and Philippe Renouard. 1986. *Imprimeurs et libraires parisiens du XVI^e siècle: Cavellat – Marnef et Cavellat*. Paris: Bibliothèque nationale.
Pettegree, Andrew. 2010. *The book in the Renaissance*. New Haven: Yale University Press.
Proverbio, Edoardo. 1997. Francesco Giuntini e l'utilizzo delle tavole copernicane in Italia nel XVI secolo. In *La diffusione del copernicanesimo in Italia, 1543–1610*, ed. Massimo Bucciantini and Maurizio Torrini, 37–55. Florence: Olschki.
Randles, W.G.L. 1980. *De la terre plate au globe terrestre. Une mutation épistémologique rapide 1480–1520*. Paris: Armand Colin.
Rhodes, Neil, and Jonathan Sawday. 2001. Paperworlds: Imagining the Renaissance computer. In *The Renaissance computer: Knowledge technology in the first age of print*, 1–17. London: Routledge.
Rosen, Edward. 1957. Maurolico's Attitude toward Copernicus. *Proceedings of the American Philosophical Society* 101 (2): 177–194.
———. 1970. Rheticus' earliest extant letter to Paul Eber. *Isis* 61: 384.
———. 1974. Rheticus as editor of Sacrobosco. In *For Dirk Struik*, ed. R.S. Cohen et al., 245–248. Dordrecht: Reidel.
Röttel, Karl, ed. 1995. *Peter Apian. Astronomie, Kosmographie und Mathematik am Beginn der Neuzeit*. Buxheim-Eichstätt: Polygon-Verlag.
Saugrain, Claude-Marin. 1744. *Code de la librairie…avec les anciennes ordonnances*. Paris: Communauté des libraires.
Schmidt, Suzanne Karr. 2011. Printed instruments. In *Prints and the pursuit of knowledge in early modern Europe*, ed. Suzan Dackerman, 267–315. New Haven: Yale University.
Stijnman, Ad, and Elizabeth Upper. 2014. Color prints before Erhard Ratdolt. Engraved paper instruments in Lazarus Beham's *Buch von der Astronomie*. *Gutenberg-Jahrbuch* 89: 86–105.
Thorndike, Lynn. 1941. *A history of magic and experimental sciences*. Vol. VI. New York: Columbia University Press.
———. 1949. *The Sphere of Sacrobosco and its commentators*. Chicago: University of Chicago Press.
Valleriani, Matteo. 2017. The tracts on the *Sphere*. Knowledge restructured over a network. In *The structures of practical knowledge*, ed. Matteo Valleriani, 421–473. Dordrecht: Springer.
Vanden Broecke, Steven. 2000. The use of visual media in Renaissance cosmography: The cosmography of Peter Apian and Gemma Frisius. *Paedagogica Historica* 36: 130–150.