

Printed, Painted, and Illuminated: Venetian Visual Culture at the Dawn of Print (1469–1517)

by

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Dedication

The emotional labor of supporting me on this journey was arguably more of an endeavor than the dissertation itself. Therefore, I dedicate this humble work to many people. To Katherine Susca, for encouraging me through my first Michigan winter and in many other seasons of life. I would also like to thank Brenna Larson, whose early commitment to collaborate, rather than to compete, strengthened both of us and forged a rich friendship. To those who created community in London (even when distanced by pandemic): Carla Benzan, Stephanie Frampton, Stephanie Grimes, Felix Jäger, Lida Manukyan, Erin Piñon, and Andrew Sears, I am deeply grateful. To Julia and Gary Hodnett, I cannot adequately thank you for the love you have shown me. To my parents, Ray and Gail, thank you for supporting me and helping with my many, many, [many] moves. While they have taught me much, during this period of my life in particular my mom taught me how to make anywhere feel like home—usually while listening to Dolly Parton—and my dad taught me that some research is best reached by motorcycle. To my advisor, Professor Megan Holmes, this would not have been possible without your generous guidance and deep empathy. Finally, I dedicate this work, and life’s many labors to come, to Samuel Bull.

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Abstract

After movable type arrived in Venice in 1469, the Venetian print industry quickly established itself as the preeminent European center for the production of books. This was due to Venice's position as a nexus of essential elements including capital, materials, technological knowledge, labor, legal protections, and commercial distribution networks. By the end of the fifteenth century, roughly 150 Venetian presses turned out 4,000 editions—nearly twice the production of Paris, Venice's nearest rival. Thus, it is Venice, rather than Gutenberg's Mainz, that emerges as a key geography for understanding the innovative impetus of movable type upon illumination, woodblock illustration, and diagrams in early printed books, and also upon broader visual and material culture in this period.

This study is positioned between the history of art, the history of the book, and visual studies. While each chapter is organized as an individual case study, themes running through each investigation address Venetian publishing more wholistically. Proceeding chronologically, the chapters cover the crucial first decades of print in Venice. The work of the French émigré Nicholas Jenson covers the 1470s. Analysis of the German printer Erhard Ratdolt's sojourn in Venice addresses the 1480s. Finally, a consideration of the Florentine publisher Lucantonio Giunta analyzes from 1490 through the turn of the century.

Each chapter also focuses on a different business structure in the nascent industry. Jenson shifted from investment in single print runs to an investment firm that allowed him to weather the financial adversity of the volatile early industry. After losing his original partners to plague,

Ratdolt was printing under his name alone by 1482. Lucantonio Giunta was a publisher who coordinated capital, expert printers, editors, content, and illustration with little physical involvement in the production himself.

Finally, each chapter accesses a different mode of visual elaboration in relation to printed text: illumination in Jenson's presentation copies; diagrams in Ratdolt's geometric and astronomical texts; and woodblock illustration in the books created for Lucantonio Giunta. Analysis of the presentation copies given to investors in Jenson's firm demonstrates how he commissioned illumination of the highest quality to frame the new technology of movable type with ancient technologies of reproduction including coins, wax seals, and intaglio gems. These antique allusions visually convinced investors of the authority of printed classical works at a time when the printing press was feared to corrupt Latin through poor editorial practices. Erhard Ratdolt's use of the printing press to incorporate complex geometric and astronomical diagrams also considered the translucency of the paper support. As the paper folio is turned, diagrams aligned on either side become visible simultaneously, allowing for comparison and the production of knowledge. This interest in the interaction between paper and light is supported by a broader Venetian fascination in unexpected shifts in transparency and translucency in emerging technologies at this time, including oil paints and clear glass. In the final chapter, modular woodblock illustration in Lucantonio Giunta's publications is considered. From hand-held books of hours to choir books of record-setting size, the repetition of woodcut illustration established a symbolically activated and visually unified network of reuse across public and private space. The visual innovation prompted by the advent of movable type was not simply informed by Venetian visual culture, but rather participated in a complex ecology of visual production that was mutually responsive and evolving.

Chapter 1 Introduction: Printing with Movable Type in Venice

Within the Franciscan Basilica of *Santa Maria Gloriosa dei Frari* in Venice is an altarpiece painted by Titian known as the *Pesaro Madonna*. Commissioned by the Pesaro family, it was completed between 1519 and 1526, after the ethereal *Assumption of the Virgin* by Titian, which now hovers behind the high altar of the church. This altarpiece, located along the southeast aisle of the basilica, is often lauded for its intriguing organization of space, which places the Madonna at an oblique angle to the picture plane, in line with a viewer approaching from the nave (Figure 1).¹ Scholarly interest has also addressed the massive columns in the background of the painting that echo the architectural fabric of the basilica, yet serve only a symbolic function within the context of the image.² While these aspects of Titian's monumental painting are rightly addressed, we may follow the organization of depicted space to another conclusion.

The diagonal composition of figures creates a stable, equilateral triangle with Saint Peter at the apex and the two kneeling Pesaro donors below: Jacopo Pesaro, Bishop of Paphos, on the left and Francesco Pesaro on the right. A second, right triangle is created by means of the diagonal sight line from the Virgin above, to Saint Peter in the middle, to the bishop below. Finally, a mirrored right triangle is formed from a line extending the bishop's billowing red and gold banner, to Saint Peter, to Francesco Pesaro's richly patterned mantle. While this visual

¹ David Rosand, "Titian in the Frari" *The Art Bulletin* 53, No. 2 (June, 1971): 196–213.

² Rona Goffen, *Piety and Patronage in Renaissance Venice: Bellini, Titian, and the Franciscans* (New Haven: Yale University Press, 1986). Much attention has also been given to the adorableness of the infant angels above. For more on the "squeezable little foot" of the fleshy babies, see: Maria H. Loh, *Titian's Touch: Art, Magic, and Philosophy* (London: Reaktion Books, 2019), 103.

organization (Figure 2) may have informed viewers about the sacred and political hierarchies in which the Pesaro family positioned itself, more significantly for this study, it was anchored by what appears to be a printed book placed precisely at the geometric center of the lower composition.

The saint's right hand steadies the open book through a traditional gesture of blessing (Figure 3). Peter's index finger directs the eye to a four-line-high indentation in the text—an intriguing gap of creamy white paper at the center of a major altarpiece. It would be quite rare for a luxury manuscript to contain an empty space for an initial—usually adorned through illumination before completion. While this omission was more common for humble university or monastic manuscripts, there are few other markers of material humility in Titian's painting. It was, however, extremely common in early printed books for publishers to leave a large blank space with a small printed initial at the center for later customization. Should the book's owner choose to invest in hand-painted decoration, there would be space available; if not, the text still functioned perfectly well.³ A visual example of this phenomenon is provided by the earliest printed Bible in Italian, translated in 1470 by the Venetian Nicolò Malermi, a Camaldolese Monk, and printed by Adam de Ambergau in Venice as early as 1 October 1471 (Figure 4).

Why would Titian choose to depict an unadorned, *printed* book at the center of a major commission? Elsewhere in the painting his brush adeptly described lavish materials, including voided-velvet and painstakingly polished armor. Why not a luxurious manuscript? The presence of a printed book at the center of a major commission may have been a result of the dominant position Venice had achieved as the most productive center of European print by the first quarter

³ According to Lilian Armstrong, "Although printers soon began to set chapter headings in type, they continued to leave blank spaces for capitals throughout the 1470s." See: Sandra Hindman, ed. *Printing the Written Word: The Social History of Books, circa 1450–1520*. (Ithaca: Cornell University Press, 1991), 179.

of the sixteenth century. Furthermore, the anachronistic pairing of early Christian saint with printed book documents a moment in which the technology of movable type prompted image makers and viewers in Venice to reconsider critical aspects of visual representation.

If, as Bill Brown and others have rightly contended, *things* have agency then so too must the technology by which those things are created.⁴ The German philosopher Martin Heidegger understood technology—an amalgam of the manufactured things themselves as well as the needs and ends they serve—to be an “enframing” or a revealing.⁵ He offered as an example the technology of a hydroelectric plant, arguing that it must be understood not simply as a structure, but also as an impulse to enframe and reorder a river to serve human ends.⁶ Similarly, printing with movable type drew upon technologies already present throughout Europe, including the screw presses used in vinification, the fine metalworking skills of goldsmiths, and emergent use of oil-based paints and inks. Yet, the new possibilities it revealed required the innovative technology and its resulting products to justify themselves in order to gain social and capital investment. In part, this study demonstrates how publishers, readers, viewers, artists, and artisans were aware of and responsive to the distinction of print as an innovative medium. Printers addressed these concerns in manifold ways that instrumentalized the role of visual exposition on the printed page: through illumination and its established visual language of authority, through the promise of mathematical and scientific progress via printed diagrams and their interaction

⁴ Alfred Gell, *Art and Agency: An Anthropological Theory* (Oxford: Clarendon Press, 1998), 18. On the agency of objects, Bill Brown describes, “[...] the ways that inanimate objects mediate human relations and the ways that humans mediate object relations (generating differences of value, significance, and permanence) [...] thus the systems (material, economic, symbolic) through which objects become meaningful or fail to.” See: Bill Brown “Objects, Others, and Us (The Refabrication of Things)” *Critical Inquiry* 36, No. 2 (Winter 2010): 183–217.

⁵ “To enframe” is an archaic word form, which has been replaced by the more direct and simplified “to frame.” While the Meriam Webster Dictionary claims the two words have the same meaning, the Oxford English Dictionary distinguishes between the two. I have used “enframe” as it was given in the 1977 translation of Heidegger’s essay by William Lovitt. See: Martin Heidegger, “The Question Concerning Technology” in *The Question Concerning Technology and Other Essays*, trans. William Lovitt (London: Harper Colophon Books, 1977).

⁶ *Ibid.*, 16–17.

with the materiality of the codex, and through innovations in modular printing and woodcut illustration that were not only cost-saving but also served the needs of an expanded audience. The printed book, itself the result of an inherently intermedial technology, both informed and was informed by the complex visual ecology in which it was enmeshed. While this kind of mutual influence was exerted in numerous emerging print centers, Venice in particular offers a glimpse of a culture engaged with issues of intermedial translation and visual transformation across a spectrum from elite patronage to more popular and mundane material objects. Due to its unique nexus of resources and sheer volume of output, the influence of this Venetian visuality had an expansive reach that extended throughout its networks of distribution.

1.1 The Arrival of Movable Type in Venice and Legal Protection in the Early Print

Industry

The German printer Johannes da Spira (sometimes also written as Giovanni and rarely, John) arrived in Venice in the summer of 1469 from Speyer, Germany, bringing with him a new technology: movable type. Although he was given a five-year monopoly over all printing by the Venetian government, his death only a few months later created a power vacuum which drew printers to Venice to compete for a place in the burgeoning industry. By the end of the fifteenth century, roughly 150 Venetian presses turned out 4,000 editions—nearly twice the production of Paris, Venice’s nearest rival.⁷ By the end of the sixteenth century, it has been conservatively estimated that Venice had printed more than thirty-five million books, that is, nearly seventy percent of all European books produced at the time.⁸ Thus, Venice emerges as a key site for

⁷ Martin Lowry, *The World of Aldus Manutius: Business and Scholarship in Renaissance Venice* (Oxford: Basil Blackwell, 1979), 7–8.

⁸ Jane A. Bernstein, *Print Culture and Music in Sixteenth-Century Venice* (Oxford: Oxford University Press, 2001), 12.

tracing the rise of the industry, including administrative and regulatory responses to conditions set in motion by the new technology, printers and publishers eager to entice investors through hand-painted and illuminated presentation texts, and scientific and mathematical advancement taking place on the printed folio.

The industry that arose from printing with movable type fit neatly into pre-existing economic and commercial networks in Venice, including confraternities known as *scuole*. These organizations connected printers with craftspeople in related industries, which were already well-established in Venice, including goldsmiths, jewelers, and minters.⁹ Furthermore, the pre-existing system of international warehouses, or *fondachi*, provided housing for the laborers and materials required for large-scale publishing.¹⁰ Of these *fondachi*, the German warehouse or *Fondaco dei Tedeschi*, connected German capital to reserves of Italian paper and linked publishers to an increasingly specialized labor force of die casters, punch makers, press operators, and bookbinders.¹¹ The nearby University of Padua ensured a steady demand for classical and legal texts (Chapter 2) as well as mathematical and astronomical treatises (Chapter 3), with a ready supply of illuminators to adorn them.¹² Venetian currency, supported by a gold standard Ducat (*Ducato*) introduced in 1284 and relatively stable until the fall of the republic in 1797, offered publishers reliable purchasing power for goods and labor.¹³ Venice offered itself to

⁹ Cristina Dondi, "Printers and Guilds in Fifteenth-Century Venice" *La Bibliofilia* 106, No. 3 (2004), 234.

¹⁰ Suzanne Winter, ed. *Presenze Tedesche A Venezia* (Venice: Edizioni di storia e letteratura centro tedesco di studi veneziani, 2005).

¹¹ For the earliest transcribed documents from the *Fondaco dei Tedeschi*, see: Henry Simonsfeld, *Der Fondaco dei Tedeschi in Venedig und die Deutsch-Venetianischen Handelsbeziehungen*, 2 Vols (Stuttgart: Cotta, 1887, repr. 1968); For a more synthetic history of the *Fondaco*, see: Ennio Concina, *Fondaci: Architettura, arte e mercatura tra Levante, Venezia e Alemagna* (Venezia: Marsilio, 1997).

¹² Lilian Armstrong, *Renaissance Miniature Painters & Classical Imagery: The Master of the Putti and His Venetian Workshop* (London: Henry Miller, 1981).

¹³ Peter Spufford, Wendy Wilkinson, Sarah Tolley, *Handbook of Medieval Exchange* (London: Offices of the Royal Historical Society, 1986), 84. See also: Frederic C. Lane and Reinhold C. Mueller, *Money and Banking in Medieval and Renaissance Venice*. Volume I. Coins and Moneys of Account. (Baltimore: The Johns Hopkins University Press, 1985); and Leonardas Vytautas Gerulaitis, *Printing and Publishing in Fifteenth-century Venice* (London: Mansell information publishing, 1976), 1.

the new print industry as a city rich in financial and material resources, enjoying relative political stability, with a great store of artisanal knowledge; it also had long since developed distribution networks across the Alps and throughout the Mediterranean basin that facilitated an unprecedented production and distribution of printed books.¹⁴

Venetian trade guilds, known as *arti*, organized and regulated the activities of artists and artisans. In contrast to cities with similar guilds at the time, such as Florence and London, Venetian *arti* had no formal role in political representation.¹⁵ Perhaps because of this, devotional confraternities began to play a growing part in the self-organization and self-regulation of craftspeople in the second half of the fifteenth century.¹⁶ While all Venetian trade guilds had devotional confraternities as part of their organization, not all confraternities had corresponding guilds. In particular, printers—due to the relatively late introduction and rapid expansion of the industry—did not have their own guild in Venice. Instead, many foreign printers congregated around a confraternity known as the *Scuola di San Girolamo*, located near the metal foundry district (whose name later became synonymous with the first *Ghetto*). Many Italian printers joined the far larger *Scuola Grande di San Rocco*, near the church of *Santa Maria Gloriosa dei Frari*—the home of Titian’s altarpiece with which this chapter opened.¹⁷ As over 150 printers established their shops in Venice in this period, they spread throughout the city with some concentration in the *sestiere* of San Marco, specifically the parishes of San Zulian, San Salvador, and San Bartolomeo (see map, Figure 5). Not only did this mean that the new industry was comparatively more open to those wishing to become printers than those professions with

¹⁴ Martin Lowry, “Venetian capital, German technology and Renaissance culture in the later fifteenth century” in *Renaissance Studies* 2, No. 1 (March 1988), 6–8.

¹⁵ Richard MacKenny, *Venice as the Polity of Mercy: Guilds, Confraternities, and the Social Order, c. 1250–1650* (Toronto: University of Toronto Press, 2019), 9.

¹⁶ MacKenny, 15.

¹⁷ Cristina Dondi, “Printers and Guilds,” 229–265.

formalized guild membership, it also meant that the important regulatory function usually carried out by the guild fell to a legal system of privileges, granted by the Venetian government.¹⁸

Privileges had emerged as a legal instrument in the late Roman empire, as a law applied to an individual rather than to the whole population.¹⁹ As early as 1297, proto-patents were afforded to Venetian physicians producing medicines.²⁰ It was not until 1474, however, that the first general statute regulating the provision of patents for inventions was passed in Venice.²¹ This date is significant as it falls after the 1469 introduction of the technology of movable type into Venice. It also likely served as an impetus for the exponential increase in print privileges issued beginning in the 1480s and '90s. The 1474 statute protected investors against imitators for ten years, but required them to provide information regarding their inventions to the state, which was then free to appropriate and compete with them after the initial period had passed.²² Privileges issued in fifteenth-century Venice protected developers of high-tech, high-risk projects as diverse as improved windmills, new mines, or experiments with poisonous gas.²³ Arguments for privileges were heard by the powerful Venetian Council of Ten (*Capi del*

¹⁸ Erasmus is noted to have written that it was a great deal easier to become a printer than a baker. See: Martin Lowry, *The World of Aldus Manutius*, 8.

¹⁹ The *privilegium militum de civitate* indicated a law (*lex*) applied to an individual (*privata*) rather than the whole population, see: Giovan Battista Gasparini. "La Natura Giuridica dei Privilegi per la Stampa in Venezia." In *La Stampa degli Incunaboli nel Veneto*, 103–20 (Verona: S. Martino Buon Albergo, 1984), 104. See also: Marthe Paquant "'Privilège' étude lexicologique et lexicographique," in *Privilèges de librairie en France et en Europe: XVIe–XVIIe Siècles*, edited by Edwige Keller-Rahbé, 23–48 (Paris: Classiques Garnier, 2017), 51.

²⁰ Pamela O. Long, *Openness, Secrecy, Authorship: Technical Arts and the Culture of Knowledge from Antiquity to the Renaissance* (Baltimore: The Johns Hopkins University Press, 2001), 93–94.

²¹ In an earlier article Long states the correct date of 1474, however, in her 2001 book the date is transposed as 1447. This incorrect date was cited by Johns (2009). See: Pamela O. Long, "Invention, Authorship, 'Intellectual Property,' and the Origin of Patents: Notes Toward a Conceptual History" *Technology and Culture: The International Quarterly of the Society for the History of Technology* 32, no. 4 (1991): 846–84.

²² Adrian Johns, *Piracy: The Intellectual Property Wars from Gutenberg to Gates* (Chicago: University of Chicago Press, 2011), 20.

²³ Lisa Pon, *Raphael, Dürer, and Marcantonio Raimondi: Copying and the Italian Renaissance Print* (New Haven: Yale University Press, 2004), 44. See also: Michael Mallett, *Mercenaries and Their Masters: Warfare in Renaissance Italy* (London: The Bodley Head, 1974), 203–204.

Consiglio dei Dieci) composed of a rotation of male members drawn from Venetian nobility and, if granted, their decisions were inscribed in the records of the *Collegio Notatorio*.²⁴

The language of the privileges gives evidence of the esteem in which printing was held by society. Printed books, new print technologies, and typography are often referred to as “ornaments” to the city of Venice. On the 25th of May, 1498, Ottaviano dei Petrucci da Fosombrone received a privilege of twenty years—an exceptionally long duration, double the standard period—for finding a way to print polyphonic musical notation (*canto figurado*, see Chapter 4). In addition to praising Ottaviano as an ingenious man who took the utmost care, the technology was lauded as a great ornament (*grande ornamento*) to the Christian religion.²⁵ The printed book, in short, shaped by enterprising inventors and innovative technologies, came to be understood as a medium for the revelation of Venetian virtues and cultural values.²⁶

Print privileges also reveal the pressure faced by printers, constantly under threat from competitors due to the very nature of print.²⁷ A frequent line of argumentation within the print

²⁴ Privileges, originally held in the *Collegio Notatorio*, were eventually absorbed into the Venetian State Archive (*Archivio di Stato di Venezia*, hereafter ASV).

²⁵ ASV, Collegio Notatorio (CN), Registro (Reg.) 14, Fol. 174r.

²⁶ Clare Guest elucidates a fifteenth- and sixteenth-century understanding of ornament as the “radiance which illuminates virtue.” See: Clare Lapraik Guest, *The Understanding of Ornament in the Italian Renaissance* (Leiden: Brill, 2015), 3.

²⁷ In part, the regulation of printed texts by the Venetian Council of Ten sought to curtail the possibility of unnatural gains in order to foster a thriving print industry and, in turn, to bring greater prosperity to the Venetian city-state and empire. While originally dismissed as a “fruitless” area of research by G.B. Salvioni in 1876, by 1888 Rinaldo Fulin had identified and published summaries of 256 print-related privileges issued between 1469 and 1526. For more on the early, and severely flawed, study of privileges, see: G.B. Salvioni, “L’Arte della Stampa nel Veneto.” *Giornale degli Economisti* 4, no. 3 (December 1876): 191–212. Much of the subsequent interest in this body of privileges sought to make artificial distinctions and categorization between types of privilege, for example, whether they protected a technology or an individual printer. For further historiography of privileges, see: Carlo Castellani, *La Stampa in Venezia dalla sua Origine alla Morte di Aldo Manuzio Seniore* (Venice: F. Ongania, 1889), 17; Horatio Brown, *The Venetian Printing Press: An Historical Study Based upon Documents for the Most Part Hitherto Unpublished, with Twenty-Two Facsimiles of Early Printing* (London: Chiswick Press for John C. Nimmo), 1891; Leonardas Vytautas Gerulaitis, *Printing and Publishing in Fifteenth-Century Venice* (Chicago: American Library Association, 1976); Giovan Battista Gasparini, “La Natura Giuridica dei Privilegi per la Stampa in Venezia.” In *La Stampa degli Incunaboli nel Veneto*, 103–20 (Verona: S. Martino Buon Albergo, 1984); Christopher L.C.E. Witcombe, *Copyright in the Renaissance: Prints and the Privilegio in Sixteenth-Century Venice and Rome* (Leiden: Brill, 2004); Angela Maria Nuovo, “Naissance et Système des Privilèges à Venise du XVe au XVIe Siècle,” in

privileges is the metaphor that others may easily “pluck the fruit” (*cogliere tal frutto*) of unprotected texts. That is, competitors may reap the benefits of another’s work by simply recreating a previously published text without expending the effort and resources to discover an original source, edit it, or enhance it visually through commissioned woodcut decoration and illustration.²⁸ This common concern, associated with illicit gain and distilled through an agricultural metaphor, is articulated in a dedicatory poem accompanying the calendar published by Erhard Ratdolt and his associates in Venice in 1476—explicitly to defend their own printed edition, which was in fact derivative. The phrase is embedded in the line “Plucking this fruit should not be too grave (*Coglier tal frutto acio non grave sia*).” That is, reproducing a calendar originally produced by Regiomontanus should not be considered too grave an offense. While the concern of quickly benefiting from another’s labor appears to have arisen with the development of the print industry, the notion of unnatural gains was present throughout the Middle Ages in connection with the vice of usury. The moral objection to usury lay not simply in the lending of money, but in the sense that interest—or the derivation of profit from money alone—was unnatural.²⁹ Like usury, print created the possibility of *unnatural* (i.e. against what was seen as the natural order) profit, with little effort invested in the reproduction of an already-published text and little transformation of the original product.

Privilèges de librairie en France et en Europe: XVIe–XVIIe Siècles, edited by Edwige Keller-Rabbé, 331–47 (Paris: Classiques Garnier, 2017). Christopher L.C.E. Witcombe turned against the previous century of scholarship to suggest that, despite variations, the information provided in the documents only established one type of privilege.

²⁸ As Erika Squassina has stated: “Il problema di base era rappresentato dal fatto che, in un periodo di tempo non prevedibile, il prezzo di vendita delle copie di una prima edizione doveva non solo compensare lo stampatore del capitale investito, ma anche generare un guadagno. Altri stampatori potevo però pubblicare la stessa edizione e venderla ad un prezzo più basso rispetto a quello fissato dal primo stampatore, causandogli un grave danno economico.” See: Erika Squassina. “I Privilegi Librari a Venezia (1469–1545),” in *Privilegi Librari nell’Italia del Rinascimento*, 331–400 (Milan: Franco Angeli s.r.l., 2019), 335.

²⁹ Jacques Le Goff, *Your Money or Your Life: Economy and Religion in the Middle Ages* (New York: Zone Books, 2004).

Although the body of legal protections offers rich insight into early printing and publishing, there is a surprising lack of documentation of legal challenges or conflicts arising from the granting of privileges. No records of Venetian litigation around print privileges has been identified to date. In a well-rehearsed episode of early “copyright” claims pertaining to printed images, Marcantonio Raimondi—having left his native Bologna for Venice—encountered the woodcuts of Albrecht Dürer in the Piazza San Marco. Determined to bring their exceptional quality (and profit) to Italy, Marcantonio reproduced the images in copperplate, along with Dürer’s iconic monograph comprised of his initials. Learning of this, Dürer traveled to Venice to call upon the government to halt Marcantonio’s illicit work. The regulators allegedly reached a compromise in which Marcantonio could continue reproducing the work but without Dürer’s monogram.

Yet, aside from the two sets of Marcantonio Raimondi’s prints—with and without Dürer’s mark—the only written evidence for this oft-told tale comes from the second edition of Vasari’s *Lives of the Most Excellent Painters, Sculptors, and Architects (Le Vite de’ Più Eccellenti Pittori, Scultori, e Architettori)*, published in 1568.³⁰ It is possible that Vasari recorded an event for which no Venetian court proceedings have yet surfaced. It is more likely that Vasari was inspired by, or misconstrued, a ruling by the Nuremberg City Council of 3 January 1512.³¹ The incident describes a stranger attempting to sell various single-sheet graphic prints (*Kunstbriefe*) which bore Dürer’s monogram but were, “falsely copied after him.”³² The council

³⁰ Giorgio Vasari, *Le Vite de’ Più Eccellenti Pittori, Scultori, e Architettori* (Florence: Giunti, 1568), 294.

³¹ Elizabeth Broun, “The Portable Raphael,” in *The Engravings of Marcantonio Raimondi*, Innis Shoemaker and Elizabeth Broun eds., 20–46 (Lawrence Kansas: Spencer Museum of Art, 1981), 22, nn.6–7, which cites *Dürer Through Other Eyes: His Graphic Work Mirrored in Copies and Forgeries of Three Centuries* (Williamstown, Massachusetts: Sterling and Francine Clark Art Institute, 1975), 9.

³² Hans Rupprich, *Dürers schriftlicher Nachlass* (Berlin: Deutscher Verein für Kunstwissenschaft), Vol. I: Autobiographische Schriften (Briefwechsel) Dichtungen, Beischriften, Notizen und Gutachten, Zeugnisse zum persönlichen Leben, 244.

ruled that the prints be confiscated unless the anonymous venter removed Dürer's monogram.

As the Nuremberg date falls *after* the events described in Venice by Vasari, another possibility is that the Nuremberg Council followed the Venetian decision. Whether taking place in Venice or Nuremberg, the case illuminates the nascent claims of authors and image-makers over their work and the legal authority, albeit limited, of print privileges both within and beyond the city-states in which they were granted.

1.2 Revolution, Evolution, and Remediation

Scholarly debate on the technology of printing with movable type in Europe has centered around models of revolution versus evolution. Writing in 1979, Elizabeth Eisenstein heralded the printing press as an agent of change which, partially through its standardization of texts, brought about a revolution in communication.³³ This revolution, for Eisenstein, was an invisible factor that ushered in the Protestant Reformation and, later, the Scientific Revolution.³⁴ Support for this idea of faithful reproduction had come from William Ivins who asserted that the printing press created the first “exactly repeatable pictorial statements.”³⁵ Yet despite Ivins' work from the 1950s and two centuries of earlier scholarship, Eisenstein claimed that the technology of the printing press had received little theoretical attention and that what had been written was intended for specialists.³⁶ Later, Adrian Johns challenged Eisenstein's notions of standardization

³³Elizabeth Eisenstein, *The Printing Press as an Agent of Change*, 31, 44.

³⁴ Eisenstein, 29.

³⁵ William Ivins, *Prints and Visual Communication* (London: Routledge, 1953).

³⁶ Joseph Dane argues that Eisenstein innocently represents herself as a newcomer to the field of print in order to overlook the work of previous scholars. Dane cites the already vast literature published by the Gutenberg Society, the work of Paul Schwenke and others on the minutiae of typefonts, including: Joseph Ames *Typographical Antiquities* (1749), Thomas Frognall Dibdin, Robert Proctor's *Index to the Early Printed Books in the British Museum*, and *Catalogue of Books Printed in the Fifteenth Century Now in the British Museum*, E.P. Goldschmidt's work on Medieval and Renaissance book bindings, Hobson and Basil Odham of early bindings, Neil Ker's work on pastedowns as examples of foundational literature Eisenstein dismisses as too abstract. See: Joseph A. Dane, *The Myth of Print Culture: Essays on Evidence, Textuality and Bibliographical Method* (Toronto: University of Toronto Press, 2003), 12–13.

and fixity, demonstrating that fixity was a choice and not an inherent feature of printed works.³⁷ In addition to errors and accidental variation creeping into each edition, Johns also emphasized the intentional flexibility and pastiche possible with each publication: while the press may reproduce the same text, the precise form of text is contingent upon the decisions of editors and publishers. While there are now myriad models for understanding the introduction of print, in many ways these two models of revolution and evolution remain prominent. This can be seen in the title of a major exhibition at the Museo Correr in Venice (2018–19), *Printing R-Evolution 1450–1500* (Figure 6).

Also useful to this study is the model of “remediation” as advanced by media theorists Jay David Bolter and Richard Grusin, in which new media must justify their own existence by promising to reform and improve upon earlier works.³⁸ These remediations, according to Bolter and Grusin, inevitably call attention to the labor of their re-conception either through “hypermediacy” in which the medium is explicitly visible, or “immediacy” in which the medium disappears. Writing in 1999, the authors provided an example of “immediacy” with the newly popularized format of a webpage, which justified its existence by suggesting instant or unmediated access to information. In contrast, an outdoor concert with flashing lights, loud music, and pyrotechnics epitomized, for the authors, the concept of hypermediacy—new media announcing itself *as* media.³⁹ Throughout my investigation I identify examples of both immediacy and hypermediacy as strategies employed by printers to justify the new technology of movable type. At times, a single printed book may employ both strategies. For example, in the

³⁷ Adrian Johns, *The Nature of the Book* (Chicago: University of Chicago Press, 1998).

³⁸ Jay David Bolter and Richard Grusin, *Remediation: Understanding New Media* (Cambridge: Massachusetts Institute of Technology Press, 1999).

³⁹ The authors quickly suggest that the shift from manuscript to printed book represents one such remediation, but do not enter into greater detail. See: Bolter and Grusin, 69.

consideration of Euclid's *Elementa geometriae* published by Erhard Ratdolt in 1482, a glittering dedicatory letter printed with gold ink delights in its own materiality and dazzles with hypermediacy; in contrast, the printed geometric diagrams just a few folios away intimate an immediate access to information by concealing much of the labor of their creation—an elegant form of immediacy.

Alongside these more theoretical approaches to the book is a focus on the materiality and facture of the book as an object. This approach is owed largely to the French Annales School (*Group Annales*) with figures including Lucien Febvre, Henri-Jean Martin, and later Roger Chartier.⁴⁰ In *The Coming of the Book (L'Apparition du Livre)* Febvre and Martin considered, for the first time, visual and material qualities of the book such as the cultural significance of the evolution from gothic script to Roman type.⁴¹ Building on these notions, Donald McKenzie emphasized the material aspects of each individual copy of a book, calling for a shift from textual bibliography to what he deemed “analytical bibliography.”⁴² As McKenzie explained, “If a medium in any sense effects a message, then bibliography cannot exclude from its own proper concerns the relation between form, function, and symbolic meaning.”⁴³ Through the work of these two schools of thought, the consideration of the *technology* which brought about the printed book (Ivins, Eisenstein, Johns, et al.) as well as the significance of the *material* object itself (Febvre, Martin, Chartier, McKenzie, et al.) has come into focus. Yet, these historians have

⁴⁰ Lucien Febvre and Henri-Jean Martin, *L'Apparition du Livre* (Paris: A. Michel, 1958); Roger Chartier, *The Order of Books: Readers, Authors, and Libraries in Europe Between the 14th and 18th Centuries* (Stanford: Stanford University Press, 1994); Roger Chartier, *The Author's Hand and the Printer's Mind*. Trans. Lydia G. Cochrane. (Cambridge: Polity Press, 2014).

⁴¹ Febvre and Martin, *Coming of the Book* (1976), 87–90.

⁴² D.F. McKenzie, “The book as an expressive form” In *Bibliography and the Sociology of Texts*. (Cambridge: Cambridge University Press, 1999), 10.

⁴³ McKenzie also notes the etymological connection between text and the Latin verb *textere*, to weave, arguing that text refers to the web or texture of materials. See: McKenzie, 10 and 13–15.

concerned themselves largely with the book as a vehicle for *text* while generally disregarding its visual aspects beyond those specifically related to typeface.

In engaging with the visual appearance of incunabula, my study is positioned at the dynamic intersection of the history of the book and the history of art. This position, while interdisciplinary, is not novel.⁴⁴ Scholarship grounded in manuscript studies by Giordana Mariani Canova helped to define the field of Venetian illumination.⁴⁵ Most notable recent contributions from the perspective of print are the work of Susan Dackerman and Suzanne Karr Schmidt through their analysis of diagrammatic prints, printed instruments, and those prints inviting haptic interaction from viewers and users.⁴⁶ Important work on the history of color printing has also brought the study of print technology and art history into productive dialogue.⁴⁷ A rich discussion of the role of printed images in natural history, medicine, science, and colonization has allowed me to consider incunabula within broader visual contexts.⁴⁸

In a 2015 article in the journal *Word and Image*, Larry Silver identified a lacuna: art historians had scarcely attended to books printed in Venice beyond the famed works by Aldo Manuzio (often anglicized as Aldus Manutius). Silver entreated art historians to consider, “those

⁴⁴ In his letter of 5 February 1675 to Robert Hooke, Isaac Newton popularized a metaphor with origins from at least the twelfth century in stating that if he had seen further, it was because he was standing on the shoulders of giants (i.e., those whose scientific observations came before his own).

⁴⁵ Giordana Mariani Canova, *La Miniatura Veneta del Rinascimento (1450–1500)* (Venice: Alfieri, 1969).

⁴⁶ Susan Dackerman, *Prints and the Pursuit of Knowledge in Early Modern Europe* (New Haven: Yale University Press, 2011); Suzanne Karr Schmidt, *Interactive and Sculptural Printmaking in the Renaissance* (Leiden: Brill, 2018).

⁴⁷ Ad Stijnman and Elizabeth Savage, eds. *Printing Colour 1400–1700: History, Techniques, Functions and Receptions* (Leiden, Brill, 2015).

⁴⁸ Katharine Park, “Impressed Images: Reproducing Wonders” in *Picturing Science, Producing Art*, Caroline A. Jones and Peter Galison, eds. (London: Routledge, 1998), 254–271. Claudia Swan, “Making Sense of Medical Collections in Early Modern Holland: The Uses of Wonder,” in *Making Knowledge in Early Modern Europe: Practices, Objects, and Texts, 1400–1800*, eds. Pamela H. Smith and Benjamin Schmidt (Chicago: University of Chicago Press, 2008), 199–213. Daniela Bleichmar, *Visible Empire: Botanical Expeditions and Visual Culture in the Hispanic Enlightenment* (Chicago: The University of Chicago Press, 2012); Marcia A. Kupfer, Adam S. Kohen and J.H. Chajes, eds. *The Visualization of Knowledge in Medieval and Early Modern Europe* (Turnhout: Brepols, 2020).

other Venetian book illustrations.”⁴⁹ While I agree that Aldo may have received more than his share of attention, at least for now, much work had, in fact, already been done to address “other” Venetian illustration. Long before Silver’s 2015 call to action, Victor Masséna, the Prince d’Essling and Duc de Rivoli (1836–1910) undertook a six-volume catalogue of Venetian books with woodblock illustration entitled *Études sur l’art de la gravure sur bois à Venise: Les livres à figures vénitiens de la fin du XVe siècle et du commencement du XVIe* (1907–1915; published partially posthumously by Charles Gérard). In 1935, Arthur Mayger Hind published *An Introduction to a History of Woodcut: With a Detailed Survey of Work Done in the Fifteenth Century*, in which he focused extensively on the development of Venetian illustration. Hind periodized early printing in Venice, positing a “popular style” of simple, stark outlines and a later style emerging around 1490–1500 which he deemed the “classical style.”⁵⁰ Finally, and most pertinent to my study, Lilian Armstrong made monumental contributions to the field, from the 1980s until her death in 2021, as she sought to identify anonymous masters, attribute known works, and contextualize Venetian woodcuts and hand-illuminated printed texts within Italian and European styles.⁵¹ Mobilizing her connoisseurial eye, Armstrong was able to determine that manuscript illuminators frequently transitioned into designers and even cutters of woodblocks for printed illustrations. One such contribution, her chapter, “The Triumph of Caesar Woodcuts of 1504 and Triumphal Imagery in Venetian Renaissance Books,” in the exhibition catalogue *Grand Scale: Monumental Prints in the Age of Dürer and Titian*, edited by Elizabeth Wyckoff

⁴⁹ Larry Silver, “Those Other Venetian Book Illustrations” *Word and Image* 32, No. 12 (2015): 155–163.

⁵⁰ Arthur M. Hind, *An Introduction to a History of Woodcut: With a Detailed Survey of Work Done in the Fifteenth Century* (London: Constable and Company, 1935), Vol. II, 469–481.

⁵¹ Lilian Armstrong, *Renaissance Miniature Painters & Classical Imagery: The Master of the Putti and his Venetian Workshop* (London: H. Miller, 1981); Lilian Armstrong, *Studies of Renaissance Miniaturists in Venice* (London: Pindar Press, 2003).

and Larry Silver (2008), connected the well-known illuminations of Benedetto Bordon with woodblocks designed by the illuminator and likely carved by Jacob of Strasbourg.⁵²

In addition to these art historians working largely within book history, an early voice from the history of art calling for bridging these fields was Michael Baxandall, whose influential *Painting and Experience in Fifteenth-Century Italy* frequently drew upon early printed books to access the ways in which visual material was understood in its own period. In one of his better-known examples, Baxandall describes the gauging exercises printed in Filippo Calandri's *De arithmetica* in 1491 in Florence. In a printed exercise for merchants, the exterior measurements of a barrel were given in *braccia* (or the length of a forearm). With this information, an Italian merchant who was trained to visually estimate the cubic measurement of the container could “eyeball” the volume to 7 and 23,600/54,432 cubic *braccia*. To quote Baxandall, “It [was] a special intellectual world.”⁵³ He argued that the skills developed by any commercial person for surveying quantities would be the same skills employed by a painter to analyze painted forms. Furthermore, it would delight educated viewers to engage in visual puzzles of estimation, such as determining the quantity of luxurious fabric depicted in an unusually shaped hat worn by Niccolò da Tolentino in Paolo Uccello's painting of the *Battle of San Romano* (Figure 7).

Baxandall's social-historical approach to excavating and defining the “period eye” of fifteenth-century Florentine painters and viewers, albeit limited by gender and class, drew upon a wide range of media and knowledge. His understanding of fifteenth-century cognition of painted surfaces often relied on the skills contained in printed books, yet those books served only as the

⁵² Lilian Armstrong, “The Triumph of Caesar Woodcuts of 1504 and Triumphal Imagery in Venetian Renaissance Books,” in *Grand Scale: Monumental Prints in the Age of Dürer and Titian*, ed. Larry Silver and Elizabeth Wyckoff (New Haven: Yale University Press, 2008), 53–72.

⁵³ Michael Baxandall, *Painting and Experience in Fifteenth-Century Italy: A Primer in the Social History of Pictorial Style* (Oxford: Oxford University Press, 1972), 86.

key to unlock information encrypted by the painter in panels and frescos. While Baxandall briefly acknowledged that the period eye would apply to the deciphering of diagrams in printed books, he rarely placed paintings and printed books in equal exchange such that the book as a physical object might be informed by broader visual culture. For example, he acknowledges that the floor plan of the Holy Sepulcher printed in Milan in 1481 could readily be deciphered by an individual trained in the geometry presented in Euclid's *Elementa geometriae*, published in Venice in 1482 (Figure 8).⁵⁴ Yet, he stopped short of considering how Erhard Ratdolt's landmark printed edition of the first illustrated Euclid was itself encoded within a visual culture particular to its period and ambit.

Building upon Baxandall's approach, my study seeks to understand how the visual aspects of the emerging printed book not only informed broader visual culture, but also were participants in that culture by both drawing upon intermedial technologies and incorporating intermedial translation within their pages, prints, and covers. I propose that printed books participated in a network of visual connections and are, themselves, as encoded with visual and cultural meaning as paintings may be. To return to the evolutionary model of incunabula, I understand printed books as one element in a "complex adaptive system." As defined by Simon A. Levin, these systems are understood as "heterogeneous assemblages of individual agents that interact locally and that are subject to evolution based on the outcomes of those interactions."⁵⁵ Here, individual agents drive evolutionary change from the bottom up, so that system evolution—in our case, the development of visual and material culture—emerges from the interplay of these processes at diverse scales. Thus, it is not simply that printed books informed

⁵⁴ Baxandall, *Painting and Experience*, 30–31.

⁵⁵ Simon A. Levin, "Self-organization and the Emergence of Complexity in Ecological Systems" *BioScience* 55, no. 12 (December 2005), 1075–1079.

artists who painted complex images, nor a two-way street between painting and print, but rather a complex network that is interdependent and evolving, and inherently intermedial.⁵⁶

1.3 Venetian Print Categories, Graded Products, and Innovative Illustration

The chronological boundaries in the study of incunabula have traditionally been set at around 1454, with the earliest use of movable type in western Europe, and the end of that century. This is reflected in major catalogues and databases of incunabula including the *Gesamtkatalog der Wiegendrucke* organized by the *Staatsbibliothek zu Berlin* as well as the *Incunabula Short Title Catalogue* of the British Library. This end-date is acknowledged to be convenient rather than representing shifting historical realities. Within the context of Venice, Christopher Witcombe has pushed this date forward to 1510 to coincide with Vasari's chronological division of the phases of Venetian printmaking, based upon Marcantonio Raimondi's move from Venice to Rome around that time.⁵⁷ Another possibility in the Venetian context is 1515—the death of the great publisher Aldo Manuzio—as a possible close to this early chapter. Instead, I have chosen 1517 as *terminus ante quem*, as this date marks a legal shift in the process of granting print privileges. From 1469 through 1517, individual privileges were issued by the Council of Ten; at this juncture the Senate declared previous privileges unmanageable and void. After 1517, privileges required a two-thirds majority in the Senate and would only cover

⁵⁶ Deborah Howard and Alison Luchs, through their histories of architecture and sculpture respectively, have demonstrated that much innovative visual thinking took place in the book before assuming more public, visible, and costly forms such as building façades, tomb monuments, and monumental sculpture. See: Deborah Howard "Bellini and Architecture" in *The Cambridge Companion to Giovanni Bellini*, ed. Peter Humfrey (Cambridge: Cambridge University Press, 2004), 143–166, particularly 143. See also: Alison Luchs, *The Mermaids of Venice: Fantastic Sea Creatures in Venetian Renaissance Art* (London: Harvey Miller Publishers, 2010).

⁵⁷ Christopher Witcombe, *Copyright in the Renaissance: Prints and the Privilegio in Sixteenth-century Venice and Rome* (Boston, Brill 2004), 13.

new or previously unpublished titles. This effectively issued the first public legislation of copyright.⁵⁸

Extending the chronological scope allows me to analyze the ways in which early print developed beyond the turn-of-the-century mark. From the earlier end, this study offers greater insight into the work of those key printers and publishers who laid the economic, intellectual, and visual foundations for production of the printed book in Venice. While much of the language surrounding print was emergent at this time, and still unstable, I have found it useful to distinguish between printers and publishers. As I deploy the terms in this study, printers owned a physical printing press and, to some degree, had technical knowledge and a physical relationship to the production of the book. While publishers may have amassed such knowledge, they did not necessarily own the means of production. For example, Lucantonio Giunta, considered in Chapter 4, operated as a publisher in Venice for twenty years before purchasing a printing press. Instead, his business model was to connect specialized printers with capital and markets to produce the desired books, with their novel modular woodcuts and, in one line of product, musical notation. By reconstructing the efforts of the earliest figures and tracking how their efforts were taken up by later printers and publishers, I answer Larry Silver's call to address "those other" Venetian woodcuts by demonstrating what Aldo Manuzio inherited when he stepped into the Venetian publishing world in 1490, and thus offer a means of better contextualizing his achievements.

The language of the print privileges has proved to be critical to following the developments of print in Venice. My work has been, in part, inspired by Christopher L.C.E. Witcombe's *Copyright in the Renaissance*. Yet, in that study Witcombe intentionally limited his

⁵⁸ Witcombe, *Copyright in the Renaissance*, 15.

scope to only those privileges dealing with single-sheet, graphic print, while I have tried to elicit information about book publishing more generally. Though these legal documents offer frustratingly little information regarding the visual aspects of printed books, aside from a few references to the overall quality of paper to be used, they have proved to be important sources for this study in a number of ways, acting as an elastic form of public record. For example, the first print privilege granting a five-year monopoly to Johannes da Spira, incorporates biographical content into the legal document, such as the fact that, having chosen Venice above all other cities, Johannes moved there with his wife, children, and the rest of his family—information not necessary for the granting of an “industrial patent.”⁵⁹

This type of encomiastic speech can be seen in privileges associated with other major figures and their printing enterprises, including Aldo Manuzio’s invention of movable type for the Greek alphabet⁶⁰ and Ugo da Carpi’s alleged invention of chiaroscuro woodblock printing. The latter privilege, granted on 24 July 1516, records Ugo da Carpi’s first-person narrative of his life in Venice.⁶¹ These documents demonstrate not only the esteem with which certain beneficiaries were held in their time, but also the reason for that esteem which, as my research demonstrates, stems from significant technological innovation.

Using this notion of early modern innovation as a guide, I consider which categories of knowledge and related book publications were particularly lauded. In his foundational study of Venetian incunabula in The British Library—the largest repository of such printed material,

⁵⁹ A marginal note on this privilege, written in a different hand, gives further information that the privilege was annulled by the time of its recording by the Council of Ten due to Johannes’ death. The marginal note reads, “This has no strength, because the master and author is dead.” (*Nullis est vigoris, quia obit magister et auctor*). See: ASV, CN, Reg. 11, Fol. 55r. In this light, the text of the “monopoly” can be read as a type of public memorial or eulogy.

⁶⁰ASV, CN, Reg. 14, Fol. 137v.

⁶¹Io Ugo da Carpi, intagliador de figure di lingo sono stato longo tempo in la cita v[ost]ra preclarissima di Venetia, et ho consumato la mia zoventu in e[ss]a; et p[er] e[ss]ere venuta alla eta senile, et volendo io viver del solito executionne occupar voglio il viver di altri: nec et io voglio mi sia o[c]cupa et tolto Ingegno et exercitio mio. See: ASV, CN, Reg. 18, Fol. 39v.

largely due to the voracious collecting practices of King George III—Leonardas Vytautas Gerulaitis’ attempted to place the types of texts held there into five groups: classics, religion, law, philosophy (which included science), and writings in the vernacular.⁶² While these groups provide an instructive basis for an inquiry into print innovation, the overlaps and the lack of granularity in the definitions, particularly within the category of “the vernacular,” necessitates certain refinements and, above all, historicization of the divisions drawing on evidence from the period.

One of the richest sources for defining period distinctions comes from the fifteenth-century advertisements printed by publishers to announce the titles available for purchase. These documents are often referred to with the German term *Bücheranzeigen* (book advertisements). While few of these ephemeral paratexts are extant, rare survivals—sometimes included as binders’ waste and not discovered until centuries later—demonstrate how titles were organized according to genre or category of knowledge. The broadsheet published by Anton Koberger in Nuremberg in 1480 organizes book titles under categories including Theology, Sermons, and Medicine (Figure 9). Koberger’s firm operated throughout western Europe, supplying France, Spain, and Venice from a branch located in Lyon.

A number of important publishers’ advertisements survive from Venice as well. There are at least five book lists extant, if fragmentary, that were produced by French expatriate printer Nicolas Jenson—who operated one of the largest publishing houses in Venice (featured in Chapter 2). The sheets date to the second half of 1481 and were printed in two colors with titles in black ink and their categories in red, approximating the rubrication common in manuscripts

⁶² Leonardas Vytautas Gerulaitis, *Printing and Publishing in Fifteenth-Century Venice* (Chicago: American Library Association, 1976), 65.

and continued by early print (Figure 10). The partial surviving list of categories includes: humanities (*Libri i[n] studio hu[m]anitatis.*), civil law (*Libri iuris civilis*), and medicine (*In medici[n]e facultate*). Finally, a broadsheet published by Erhard Ratdolt in Venice in 1484 provides an even greater diversity of categories (explored in Chapter 3). Legible rubrics include: Theology, Logic, [illegible] and Poetry, Civil and Canon Law, Astronomy and Geometry, and Medicine (Figure 11).

These late fifteenth-century printers' lists appear to expand some commonly recognized categories and to condense others. For example, Ratdolt creates a separate category for poetry, rather than listing it under humanities; yet, he combines categories of astronomy and geometry under a single heading. More curiously, Jenson's list includes astronomical texts like those of thirteenth-century author Johannes de Sacrobosco within Humanities. A comparison with a contemporary library list is instructive. The Nuremberg humanist, physician, and cartographer Hartmann Schedel (1440–1514) made an inventory of his own collection of manuscripts and printed books which described 645 volumes divided into 18 subject groups. Schedel followed the seven liberal arts of medieval scholasticism but also included categories for philosophy, humanist texts (*ars humanitatis*), the works of Cicero, orators, poets, historians, cosmography, geography, medicine, juridical works, theological subjects, and German-language prayer books.⁶³ A later humanist, Konrad Pellikan (1478–1556) created a complex index for his library in Zürich, which allowed for multiple points of access from authors listed alphabetically to a subject index.⁶⁴ Like Schedel, Pellikan supplemented the seven liberal arts with humanist

⁶³ Bettina Wagner, *Worlds of Learning: The Library and World Chronicle of the Nuremberg Physician Hartmann Schedel (1440–1514)* (Munich: Bayerische Staatsbibliothek, 2015).

⁶⁴ Martin Germann, *Die reformierte Stiftsbibliothek am Großmünster Zürich im 16. Jahrhundert und die Anfänge der neuzeitlichen Bibliographie: Rekonstruktion des Buchbestandes und seiner Herkunft, der Büchheraufstellung und des Bibliotheksraumes* (Wiesbaden: Harrassowitz Verlag, 1994), 25.

categories, and theology. The sequence ran from the trivium and quadrivium to theology, philosophy, civil law, canon law, oration, history, poetry, geography, and finally superstition (to which he banished astrology).⁶⁵ Furthermore, unlike later medieval scribes—who often specialized in a given genre due in part to the complex abbreviations required to expedite copying—publishers produced texts across a wide range of intellectual domains, eventually hiring amanuenses to edit within specialized fields. This technological and organizational development in the reproduction of texts, together with the aforementioned expansion of intellectual interests and increased fluency in Greek of fifteenth-century humanists made the categorization of knowledge more fluid.

Although in flux at the time, a greater understanding of these period-derived categories enabled me to organize and to focus my search for visually innovative printed books with keener historic accuracy than the earlier categories proposed by Gerulaitis. My method has been to physically examine a wide range of early printed books produced in Venice and elsewhere, consulting multiple copies of single editions as well as variant formats. By working within these categories, I discovered sites of significant visual innovation within printed illustrations, hand-painted illuminations, and in other visual features of early printed Venetian books. Digital databases of photography were often helpful in narrowing my search, particularly during pandemic closures due to the Coronavirus (COVID-19) outbreak. When possible, however, I engaged with material codices firsthand. Through the close visual analysis of paper, watermarks, type, ink, rubrication, woodblock illustration, hand coloring, binding, elaborate covers, and any other material evidence available, my interests coalesced around certain foci. These were domains in which printers and publishers can be seen developing extremely sophisticated

⁶⁵ Zentralbibliothek Zürich, Ms. Car. XII 4 fol. 139, as published in: Martin Germann, *Die reformierte Stiftsbibliothek*, 68.

solutions to the problem of transmitting knowledge through the new technologies available. This included complex text-diagram relationships in geometric treatises, interrelated astronomical diagrams, the development of printed music, the challenges of maintaining spiritual significance in printed liturgical texts, and visually convincing investors of the authority of printed classical works at a time when the printing press was feared to corrupt Latin through poor editorial practices. Although every solution was unique to its task, each demonstrated a self-awareness of the technology of printing with movable type, similar to what Jun Nakamura has called “printedness” in his analysis of later prints and drawings in the Netherlands.⁶⁶

Comparative visual analysis, including looking at the same text as produced by various printers within and outside Venice proved fruitful. For example, I examined the astronomical treatise known as *Sphaera Mundi* published in multiple formats by different publishers in Venice, as well as editions produced in other print centers including Brescia, Milan, Paris, and Leipzig. This allowed me to narrow in on that which distinguished Venetian publishers’ approaches to complex astronomical diagramming.

I also found it informative to compare multiple copies of a single edition of a given work. When considering the reuse of woodblock illustration across the publications of Lucantonio Giunta, I examined numerous copies of the Book of Hours he published in 1501, which demonstrated that individual copies varied greatly—likely due to personal customization. The copies were printed on paper or parchment, illustrations varied from copy to copy, and there were varying degrees of hand coloring. Taking this approach further, I compared note-by-note variations across copies of the Graduals Giunta published in 1499/1501, which led to the identification of a large core of identical edits likely carried out by Francesco de Brugis, hired as

⁶⁶ Jun Nakamura, *Prints and Printedness: Mark Making, Meaning, and Perceptions of Print in the Seventeenth-Century Netherlands*. Ph.D. Dissertation, University of Michigan, 2022.

a musical editor, and a smaller number of idiosyncratic emendations probably made by local musicians.

In addition to the book historians' approach of comparing across editions and copies, my analysis was also informed by art historical considerations of materiality, facture, degree of ornamentation, and the economic conditions of production. One major decision was whether to print a book on parchment or paper. Those printed on parchment typically cost about six times more than those on paper.⁶⁷ Cristina Dondi has done extensive work to understand the financial ledger, known as a *Zornale* (i.e. diary), of the Venetian bookseller Francesco de Madiis, which contains hundreds of entries between 1484 and 1488.⁶⁸ While lavish, illuminated presentation copies were regularly printed on parchment and given as gifts from printers and publishers to their investors, parchment copies were more often valued for their durability in liturgical, legal, or instructional settings.

Dondi and her collaborators have also developed a tiered understanding of the cost of books in the later fifteenth century. The most expensive books cost more than one Ducat and often included large-size (folio), multi-volume publications of legal texts, philosophy, theology, and the Bible (as well as commentaries on these topics).⁶⁹ So-called "middle of the road" books sold for between one and three lire and usually included classical texts, physically smaller works on philosophy and theology, popular literature, and medicine.⁷⁰ Finally, the "cheapest and best-

⁶⁷ Cristina Dondi, "From the Corpus Iuris to 'psalterioli da puti' on Parchment, Bound, Gilt... The Price of Any Book Sold in Venice 1484–1488," in *Printing R-Evolution and Society 1450–1500: Fifty Years that Changed Europe*, ed. Cristina Dondi, 577–600 (Venice: Edizioni Ca' Foscari, 2020), 591.

⁶⁸ Cristina Dondi and Neil Harris, "Best Selling Titles and Books of Hours in a Venetian Bookshop of the 1480s: the *Zornale* of Francesco de Madiis" *La Bibliofilia* 115 (2013): 68–69.

⁶⁹ Dondi, 2020, 585.

⁷⁰ Dondi, 2020, 586–587.

selling books” were 10 soldi or less and included psalters (used to instruct abecedarians), books of hours, and similar moralizing religious material.⁷¹

My own analysis of the terms of the print privileges corroborates Dondi’s findings. A highly prized echelon of books containing scientific, mathematical, and local historical works, as well as books authored by noblemen received exceptional legal protections: these extended for more than 10 years and included fines for each counterfeit copy that were set anywhere from 25 Ducats to, at the most extreme, 1000 Ducats. A more common middle tier—the privileges often protecting classical works, legal texts, and commentaries—received the normative protection for 10 years with fines for each counterfeit copy set at 10 Ducats. Lastly, personal devotional texts, and “popular” texts in the vernacular received the lowest protection: less than 10 years or simply an unspecified amount of protected time and fines less than 10 Ducats—and often less than one Ducat—for counterfeit copies.

Given that the purchase price and legal protections follow this tiered structure, one might expect a similar hierarchy within the visual adornment of books, perhaps with levels such as: hand-colored woodblock illustrations, unadorned illustrations, and no illustration. This was not the case. Of the 483 books of hours sold by Francesco de Madiis during the period covered in the *Ziornale*, only four books were sold bound with additional gilded decoration and only three are described as containing woodcut illustrations (*istoriado*).⁷² Apart from the occasional historiated initial, decorated frontispiece, or diagram, Venetian woodblock illustration did not begin in earnest until the 1490s with the work of Matteo Capasca (see Chapter 4). For the upper tier of books, hand painted illumination was favored, as it had been before the advent of movable type.

⁷¹ Dondi, 2020, 588–589.

⁷² Dondi and Harris, 2013, 68–69.

The embellishment likely occurred after the books had left the bookseller and before being bound.

In a 1991 article, Lilian Armstrong focused on hand painted illuminations in Venetian incunabula of this earliest period and proposed three tiers. Although Venice had not been a major center of illumination in the first half of the fifteenth century, the arrival of the printing press attracted illuminators from northern Italy and many, such as Benedetto Bordon, worked between Venice and Padua. At the bottom of Armstrong's hierarchy are printed books with no illumination, only empty spaces where initials "should" be, as in the book held by Saint Peter painted by Titian at this chapter's opening.⁷³ Next are books that were "rubricated," in which chapter headings and initials were written by hand in blue or red ink—sometimes this included adornment of the first printed letter of each sentence with a single pen stroke. Then come embellishments not owed to scribes alone but to those who applied gold leaf and paint to decorated initials. At the next level of the hierarchy, were books that received an illuminated (if fairly standardized) border usually with white vines, festoons, or garlands of laurel. Many examples contain blank spaces for coats-of-arms at the *bas-de-page*, suggesting that they were illuminated on spec rather than through commission from the publisher. While some of these borders can be quite elaborate, others appear formulaic. Finally, the most elaborate illuminated incunables—in accordance with Dondi's scheme—were usually printed on parchment and adorned with a full-page illumination either facing the first folio of text or incorporating that text into an illusionistic scene. Many of these were given by printers and publishers to their financial investors (see Chapter 2).

⁷³ As these texts still functioned without illumination, I disagree with Armstrong's notion that they are "unfinished." Visually, however, they are the least adorned.

While no illustrated Venetian book is more well-known in this period than Aldo Manuzio's *Hypnerotomachia Poliphili*—first printed in Venice in 1499—woodblock illustration began to accompany Bibles, liturgical, and devotional books, as well as classical histories and scientific works at least a decade before. The sparse style of early Venetian woodblocks, which defined forms through strict outline, was deemed the “popular style” by A.M. Hind in his influential 1935 synthesis of the genre.⁷⁴ Hind distinguished between the earlier style and a later “classical style,” which developed more subtle parallel hatching, and *all'antica* costuming of figures.⁷⁵ Building upon this, Lilian Armstrong identified a corpus of “popular style” woodblocks as being by the hand of an anonymous master she deemed the Master of the Pico Pliny (or Pico Master), an illuminator of manuscripts who then turned to decorating printed books.⁷⁶ Armstrong also associated Hind's “classical style” with the illuminator-cum-printer Benedetto Bordon.⁷⁷ While woodcuts may be associated with named or anonymous masters, their collaboration with given printers or publishers can be more challenging to prove, as printers often sold much of their unwanted and bulky stock if they left Venice, as in the case of Erhard Ratdolt, or willed valuable blocks and letter punches to others upon their death, as documented for Nicolas Jenson.

Following the increase in the use of woodcut illustrations, new distinctions in the levels of elaboration emerged. While unpainted woodblock illustration enjoys the privilege of avoiding an “unfinished” categorization, as it is perfectly legible when monochromatic, the sparse outlines

⁷⁴ Arthur M. Hind, *An Introduction to a History of Woodcut: With a Detailed Survey of Work Done in the Fifteenth Century* (London: Constable and Company, 1935), Vol. II, 469–481.

⁷⁵ *Ibid.*, 475.

⁷⁶ Armstrong, *Heavenly Craft*, 27. Armstrong has identified an earlier printed *Biblia Italica*, which was published by Antonio di Bartolommeo Miscomini in 1477 (Vienna, Österreichisches Nationalbibliothek, Inc.5.D.22, fol. 11r) which contains a similar architectural frontispiece drawn in pen and ink and tinted with watercolors by the Pico Master which may have served as the prototype for the woodblock designs. For other copies of the 1477 *Biblia Italica*, see: ISTC No. ib00640500.

⁷⁷ Hind, *History of Woodcut*, 469. Armstrong, *Heavenly Craft*, 35.

of the early Venetian style invited both skilled and unskilled hands to “fill-in” printed decoration with color. The sporadic appearance of much of this coloring suggests it was completed by book owners, or in the case of instructional texts such as Aesop, merciless pupils who colored, doodled, and recreated the images of animals the books contained (Figure 12). Some hand coloring of printed illustration appears quite sophisticated and may in fact be symbolically motivated, such as the pallid appearance of an unpainted figure of Death in a Book of Hours otherwise replete with color (Chapter 4). Finally, extremely fine overpainting of woodblock illustration in a Gradual now in the Marciana blurs the categories of “hand coloring” and “illumination,” suggesting that the terms used today represent a distinction of skill rather than material or process (Figure 13).

While degrees of elaboration are most readily apparent in illumination and the colored woodblock illustrations that often adorned classical, legal, and liturgical texts, economic factors of production and intended audience are also visible in other classes of text, including astronomical texts. An extant copper-alloy indicator (*brachiolus*) affixed to an instrument in Erhard Ratdolt’s calendar published in 1483, may represent the lower end of production quality (Figure 14). The constituent elements appear to have been crudely snipped from a copper-alloy sheet and held together with ferrous rivets of varying sizes. At the other end of production are the highly finished indicators stamped or cast with ribbed lines for greater strength, appearing in calendars from the same producer (Figure 15). Here the rivets match the material of the *brachiolus* and the pins which allow the tool to pivot are stamped with a floral motif. Similarly, hand painted astronomical charts representing partial eclipses vary in quality from hastily applied paint that exceeds the printed circles to careful, illusionistic modeling built up through layers of ocher.

Together, these spectra, ranging across domains including cost, legal protection, illumination, hand coloring, and material facture, offer materials for a rich understanding of the position of printed books in Venice in this period. Each of the following chapters analyzes a printing firm working at the innovative forefront of book production, informing and informed by visual culture in Venice. While each may be taken as an individual case study, there are themes running through the chapters that draw them together so as to provide an expansive view of Venetian publishing. First, the chapters proceed roughly chronologically. The first two offer focused treatments of prominent publishers and their works in the crucial first decade of print in Venice (1470–1480), beginning with Nicholas Jenson and continuing with Erhard Ratdolt during his sojourn in Venice from 1476 to 1486. These are followed by an investigation of the collaborations of the publisher Lucantonio Giunta with various music printers from 1499 to 1517. Each chapter also draws attention to a different business model. Nicolas Jenson’s innovative structure shifted capital investment from single-title print runs to sustained funding through investment, which allowed him to plan publishing campaigns and to weather the financial adversity of the volatile new industry. Erhard Ratdolt, who lost his original German partners to plague, was printing under his name alone by 1482. Finally, Lucantonio Giunta operated as a publisher who coordinated capital, expert printers, editors, content, and illustration—with little physical involvement in the production. Each chapter, too, accesses a different mode of visual elaboration in relation to the printed word: illumination of the highest order in Jenson’s presentation copies; diagrammatic visual representation in Ratdolt’s geometric, astronomic, and calendrical texts; and lastly, woodblock illustration with varying degrees of hand coloring in the frequent reuse of the blocks created for Lucantonio Giunta.

Finally, by placing these publisher's works within historicized categories of knowledge and putting them in dialogue with elements in the broader visual culture, I demonstrate the ways in which the purveyors of the new technology of movable type were able to justify their work and allay various fears, including corruption of the Latin language, loss of capital, and trustworthiness in the accuracy of sources printed—all this during years of extreme competition and little regulation. The categories of book under consideration are not meant to be seen as the only ones in which innovation prompted by movable type took place, but rather illustrative cases that foreground a reading of this material from the perspective of new technology rather than reading it primarily from the perspective of manuscript culture. The methodology underpinning the case studies that follow can be applied to the study of other areas of printed knowledge and publishing houses within and beyond Venice, initiating a productive dialogue regarding the visual culture of technological innovation, which must simultaneously advertise itself as unique while also justifying new media in terms of previous forms.

1.4 Overview of Chapters

Chapter 2 explores the output of the French émigré printer Nicholas Jenson. While his book advertisements attest to publications across a wide range of subjects, Jenson's classical histories and legal commentaries are important for capturing a moment of visual transformation as illumination encountered the printed word. Many of his hand-illuminated, printed texts were presented as reciprocal "gifts" to investors in early print runs. Peter Ugelheimer, Jenson's major investor and business partner, accumulated a library of lavish texts printed on parchment and often illuminated by the finest artists in northern Italy. I argue that forms of illumination played a particularly significant role in justifying the claims of the new print technology in this transitional era.

I consider the first folio illuminations of many of Jenson's publications, a delightfully complex illusion in which the printed text was surrounded by trompe-l'oeil painting to appear as though it had been handwritten on a piece of torn and tattered parchment lifting off the page. This site of illumination played a particularly significant role in justifying the claims of the new print technology for influential investors. I then consider how these illuminations frame the texts within classical technologies of reproduction, including illuminations of coins, wax seals, signet rings, intaglio gems, and even cameos—whose black-and-white depiction were often the result of well-known intaglio gems reproduced via plaster cast. The presence of these reproductive technologies made visual claims about the accuracy and correctness of the printed word.

In chapter 3 I consider the work of German expatriate Erhard Ratdolt, focusing on his mathematical and astronomical publications, a category which consistently received exceptional legal protection. I consider how Ratdolt utilized the precise registration of the printing press to align mathematical and astronomical diagrams on either side of a single folio, which I have described as “transfoliate” diagrams. In the course of turning the page, transmitted light passing through the translucent folio causes both diagrams to become visible simultaneously, allowing for comparison. I trace Ratdolt's attention to the interaction between printed book and light source in the printed astronomical instruments of his *Kalendarium* (1476), as well as his incorporation of “transfoliate” diagrams through Euclid's *Elementa geometriae* (1482) and the compilation known as *Sphaera Mundi* (1482, 1485). Then, I consider how this mobilization of light fit within the “complex adaptive system” of broader Venetian visual culture, which was highly attentive to properties of luminosity, opacity, and transparency. Evidence from Albrecht Dürer's drawings of human proportion and his posthumously published *Four Books on Human Proportion* suggest that, after his visit to Venice in 1494, he may have adopted Ratdolt's

approach of aligning diagrams on either side of the translucent folio. Beyond book production, translucency and unexpected shifts in opacity were also characteristic of other emerging technologies at the time, including the production of clear (*cristallo*) glass and oil paints.

Chapter 4 explores technical innovation within works created in the collaboration between Florentine “expatriate” Lucantonio Giunta and the German printer Johann Emerich containing printed musical notation. The Gradual published in 1499/1501 under Giunta’s aegis was the largest incunable ever created and the first to contain woodblock illustration in addition to printed musical notation. While this topic has been addressed in terms of attribution of the woodblocks on connoisseurial grounds, I consider the unique challenges of printing musical notation at such a large scale in relation to the varying needs and preferences of individual parishes. In considering the reuse of this corpus of woodblocks for more than 30 years in a variety of devotional texts, I push beyond previous, strictly economic readings, in which reuse has been seen only as a means to defray initial costs. I suggest that reuse, particularly within the Venetian visual domain, may have metaphorically recalled the spolia that adorned important civic and religious edifices. I also consider how reuse within newly developed print technologies may reference *achieropoieta* (images thought to be miraculously made without human hands). Finally, I consider contemporary music theorist Franchino Gaffurio’s analysis of the mathematical proportions of musical scales in relation to geometric proportions. I connect this musical theory of scale and proportion to argue for the possibility that Johann Emerich, the most prolific music printer in Italy and one of the most significant in Europe at this time, may have conceived of woodblocks that would function on the proportional scale of the folded folio.

The epilogue extends the chronological and geographical scope of this study to consider the enduring influence of the innovative visual aspects of Venetian print. Of particular interest is

the expansion of the multi-national Giunti publishing firm from Italy, throughout Europe, to Spain, and eventually into the New World. Secondly, I contextualize this historical analysis in a contemporary moment in which manuscripts and early printed books are undergoing mass digitization. While scholars have begun to analyze the success and limitations of digital facsimiles and their approximations of touch, the accuracy of those analyses is contingent upon a deep historical understanding of the visual culture of the printed book and its images.⁷⁸

⁷⁸ Heather Bamford and Emily C. Francomano, “On Digital-Medieval Manuscript Culture: A Tentative Manifesto” *Digital Philology: A Journal of Medieval Cultures* 7, No. 1 (Spring, 2018). See also: Bridget Whearty and Michael Hanranhan, eds. *Digital Medieval Manuscript Cultures* (Fall 2018): <http://www.archivejournal.net/essays/digital-medieval-manuscript-cultures/>.

Chapter 2 Torn Parchment and Illuminated Gems: Nicolas Jenson and Claims to Accuracy in Print

In 1477, the French émigré to Venice, Nicolas Jenson, published an edition of Justinian's *Digestum novum*.⁷⁹ Printed on folio-sized parchment, the copy produced for Jenson's business partner, Peter Ugelheimer, is uncommonly lavish (Figure 16, hereafter referred to as Ugelheimer's Justinian). Through careful modeling, the illuminator Benedetto Bordon transformed the printed legal text and its commentary into an illusionistic piece of torn parchment. The edges of this fictive parchment appear to curl over printed word; as the viewer is enticed to peer beneath the cockled edge, image challenges imprinted word for primacy. At its most ambitious, the fictive torn parchment threatens the integrity of the printed document altogether: lines of text separated from one another by deep lacerations in the "parchment" are held together by an illusionistic thread. Both "behind" and beyond the printed folio-within-a-folio, putti secure ligatures from which ancient cameos and intaglio gems descend. This illusionistic torn parchment, like other borders framing Jenson's printed pages, appears on the first folio of printed text: it thus functions as frame and portal, simultaneously distinguishing and connecting the world of the text and the world of the reader.

While previous scholarship has tended to view illuminated printed texts like this within the framework of late manuscript production, this chapter analyzes them from the perspective of innovative print technologies. At stake is an understanding of these intricate, but often-

⁷⁹ Justinian, *Digestum novum (with the Glossa ordinaria of Accursius)*, Venice: Nicolas Jenson, 1477. Copy now held in Gotha, Forschungs Bibliothek, Mon. Typ. 1477 2° 13.

dismissed, “hybrid” texts as a site for visual experimentation in a reciprocal relationship with Venetian visual and material culture. This innovation is demonstrated in two distinct, yet interrelated, visual strategies. First, I argue that the frequent adoption of the pre-existing motif of illusionistic torn parchment to frame the printed text—the yield of the new technology of movable type—participated in a visual culture of complex thresholds. These thresholds included those being explored by the illusionistic frames and intricate foreground-background relationships in contemporary paintings by Giovanni Bellini and Antonello da Messina, as well as the manifold visual connections already established in Venice by architectural thresholds including choir screens, interior thresholds, and innovative façade designs.

In a second conceptual maneuver, this chapter considers why this illuminated motif and other richly ornamented first-folio (or frontispiece) designs came to signify differently in relation to print rather than manuscript. The conspicuous presence of illuminated motifs including intaglio gems, seals, and medals, as well as wax casts of ancient Roman coins embedded into the covers of Jenson’s presentation copies situate the innovative printed texts within ancient technologies of reproduction (i.e. sealing, casting). By exploring the emerging category of the *studiolo*, a site where these antique objects were stored and studied alongside printed books, I argue that the conspicuous presence of reproductive objects in books printed with movable type made subtle claims about the accuracy and correctness of the printed word. These claims were particularly important within the categories of classical and legal texts which provided the means of political power for the patrician class in Venice—a group whose participation in print began through investment in the honorable reproduction of ancient texts but shifted to high-powered regulation of the print industry during this period. Together, these two conceptual turns demonstrate how illuminated, printed texts informed and participated in a visual culture in

Venice that associated the illuminated devices at the threshold of the printed word with accuracy and authority. These visual assertions were a form of commercial posturing that would eventually be formalized in printed frontispieces and the rhetoric of legal print privileges.

While it may seem counterintuitive to locate a growth edge of Venetian visual culture in printed books intended for private delectation, Deborah Howard has shown how Venetian illumination—and two-dimensional art more generally—likely informed architectural space and its decoration.⁸⁰ Raised out of shallow waters, the city’s new architectural projects were constructed on larch wood pile foundations, which favored maintaining existing footprints. In the context of architecture, innovation was more likely to be drawn from experimentation first in the book arts and panel paintings and then applied to the surfaces of existing buildings than through altering their structures or foundations. Likewise, Alison Luchs has demonstrated the impact of the innovative illuminated first-folios of printed texts on sculpture and monumental tombs in and around the Veneto.⁸¹ In line with these scholars, I argue here and in the following chapters that the technology of movable type and the representation surrounding it was an active participant in a reciprocal, intermedial relationship with Venetian visual and material culture.

2.1 Nicolas Jenson, Peter Ugelheimer, and the Agostini Brothers

In order to access the highest levels of groundbreaking print and illumination, this chapter focuses on Nicolas Jenson (c. 1420–1480), one of Venice’s preeminent publishers before the arrival of Aldo Manuzio. Illuminated printed texts provide crucial visual evidence for the biography of Jenson, a historical figure Martin Lowry described as, “nothing more than a

⁸⁰ Deborah Howard, “Bellini and Architecture,” in *The Cambridge Companion to Giovanni Bellini*, ed. Peter Humfrey (Cambridge: Cambridge University Press, 2004), 143–166, particularly 143.

⁸¹ Alison Luchs, *The Mermaids of Venice: Fantastic Sea Creatures in Venetian Renaissance Art* (London: Harvey Miller Publishers, 2010), *passim*.

silhouette.”⁸² Aside from Jenson’s detailed will, frustratingly little archival evidence has come to light to reveal the events of his life. One of the few certainties is that he was born in Sommevoire, France. Included in a report of 1560 on foreign currency exchange rates, Jean Grolier and Jean Lhuillier recorded that Jenson—either the cutter of dies (*tailleur*) at the Paris mint or the master of the mint at Tours—was selected by King Charles VII in 1458 to apply his knowledge of metalwork and engraving to learn the techniques of printing with movable type recently developed in Mainz.⁸³ We do not know if this was an act of industrial espionage, apprenticeship, or indeed whether it occurred at all.

Allegedly, after completing this reconnaissance, Jenson returned to Paris in 1461. King Charles VII had died and his successor, King Louis XI, was suspicious of his father’s connections. Finding no royal support in France, Jenson sought fertile ground for his new printing skills. Even less evidence exists to inform us about the period between Jenson’s move to Mainz and his presence in Venice around 1470.⁸⁴ Lowry has challenged both the accuracy of Grolier and Lhuillier’s account as well as an autobiographical statement from Jenson himself.⁸⁵ Again, we must turn to the visual and material record of Jenson’s publications as our most trustworthy source, the earliest of which are dated to 1470 and suggest that he was in Venice by the summer of that year, if not late in 1469.⁸⁶

⁸² Martin Lowry, *Nicolas Jenson and the Rise of Venetian Publishing in Renaissance Europe* (Oxford: Basil Blackwell, 1991), viii.

⁸³ Lowry, *Nicolas Jenson*, 49.

⁸⁴ Lotte Hellinga, “Nicolas Jenson & Peter Ugelheimer – Freunde und Geschäftspartner,” in *Hinter dem Pergament: die Welt der Frankfurter Kaufmann Peter Ugelheimer und die Kunst der Buchmalerei im Venedig der Renaissance*, ed. Christoph Winterer (Frankfurt: Hirmer, 2018), 160.

⁸⁵ Lowry, *Nicolas Jenson*, 50.

⁸⁶ Lowry suggests that Jenson may have arrived in Venice in the Summer of 1470 in order to compose the edition of Cicero’s letters he dated with that year. However, Lotte Hellinga suggests that Jenson may have come to Venice in 1469 with Johannes da Spira and other German printers from the Rhine. See: Lowry, 55; Hellinga, “Nicolas Jenson & Peter Ugelheimer,” 159.

Like other printers, Jenson had originally sought to raise the large capital necessary for a print run from individual patrons interested in particular texts or limited groups of texts. By 1473, he restructured his business model to attract capital investment from wealthy merchants over longer periods of time. This allowed him to plan his publications in advance from a position of stability. Jenson's will of 1480 names this organization which he entered into with Johann Rauchfas and Peter Ugelheimer as the "*prima societas*." Rauchfas was a native of Frankfurt associated with a company called Kraft Stalburg. Peter Ugelheimer (1442/46–1487/88), also from Frankfurt, had been operating a business in the spice trade in Venice since mid-1470—not long after Jenson is thought to have arrived there.⁸⁷ Even after Jenson's death in 1480, Ugelheimer remained committed to living and working on the Italian peninsula, rescinding his Frankfurt citizenship in 1481 and residing in Milan until his death in 1487/88.

In addition to his commercial pursuits, Ugelheimer amassed a personal library of exceptionally ornate printed books. Of the fifteen books that have been identified as part of his library, all but one was executed under the imprimatur of Nicolas Jenson or by those associates still tied to Ugelheimer after Jenson's death (See Appendix A). All are printed on folio-sized parchment and most, as the one described at the outset of this chapter, contained elaborate illumination on the first folio of text, occasionally across both folios of the first opening, and, less frequently, in decorated and historiated initials throughout the text.⁸⁸ Ugelheimer seems to have begun collecting Jenson's publications after his investment in the firm in 1473. Dedicatory

⁸⁷ Although his initial commercial activity in Venice was in the spice trade, it is thought that Ugelheimer had an interest in the book trade from a young age, as he is thought to have witnessed Johannes Gutenberg presenting his unfinished Bible in 1454. See: Christoph Winterer, "Peter Ugelheimer: Verleger, Geschäftsmann und Bibliophiler," in *Hinter dem Pergament: die Welt der Frankfurter Kaufmann Peter Ugelheimer und die Kunst der Buchmalerei im Venedig der Renaissance*, ed. Christoph Winterer (Frankfurt: Hirmer, 2018), 9. See also: Michael Matthäus, "Die Familie Ugelheimer: Handel und Patriziat in Frankfurt," *ibid.*, 21.

⁸⁸ The only manuscript to be identified thus far also entered Ugelheimer's library via Jenson. See: Elizabeth Ross, "The Reception of Islamic Culture," in *The Books of Venice, Il Libro Veneziano*, ed. Lisa Pon and Craig Kallendorf (Lido di Venezia: La musa Talia, 2008), 132.

texts incorporated into the illuminations extol Ugelheimer and make reference to his support of the printing venture. This suggests that these were opulent presentation copies given to Ugelheimer by Jenson as one form of repayment for his investment.⁸⁹ For example, the illuminated folio facing the torn parchment text from Justinian’s *Digest* described above contains a gilt inscription in humanist script declaring: Peter Ugelheimer of Frankfurt, well born, desires this book for his posterity (PETRUS VGELHEMER FRANCFORDENSIS BENE NATVS – POSTERIS HVNC LIBRVM VOLVIT ESSE SVIS).⁹⁰ Books in his exceptional collection were illuminated by many known artists, including Benedetto Bordon and Girolamo da Cremona, as well as anonymous masters who have been identified by Lilian Armstrong including the Pico Master and the Master of the Seven Virtues.⁹¹ Ugelheimer’s investment in one of the largest publishing firms at the dawn of the print industry in Venice—together with the frequent, complex visual experimentation they contain—identifies his library as a key resource for understanding the visual culture of learned society in Venice at this time.

A second personal library amassed through Jenson’s network is that of the Agostini family. The Agostini were non-noble *cittadini* of Venice who invested in printing and bookselling through their banking and business dealings.⁹² The family sold paper to the Strozzi

⁸⁹ Lilian Armstrong, “The Hand-Illumination of Printed Books in Italy 1465–1515,” in *The Painted Page: Italian Renaissance Book Illumination 1450–1550* (London: Royal Academy of Arts, 1994), 192, 194, 200, 204–05; Martin Lowry, *Nicolas Jenson*, 98; Elizabeth Ross, “Reception of Islamic Culture” in *The Books of Venice*, 132–33.

⁹⁰ Additional laudatory inscriptions include: Flourishing at the beginning, Peter, you bring [things] most celebrated to fruition (PERFICE PRINCIPIO FLORENS CEL[E]B[ER]RIMA PETRE); The solution of the riddles looks to the sign. I give back to you, Peter, the gold [things] that you gave. We surpass the stars through genius (SIGNVM ASPICITO / [A]ENIGMATVM.SO/LVTIO. //AVREA REDDO TIBI QVE VGEL/HEIMER PETRE DEDISTI. //INGENIO TRANSCENDIMVS / ASTRA). For further examples, see: Elizabeth Ross, “The Reception of Islamic Culture in the Book Collection of Peter Ugelheimer,” in *The Books of Venice*, 132–133.

⁹¹ For the Pico Master, see: Lilian Armstrong, “The Pico Master: a Venetian Miniaturist of the late Quattrocento,” in *Studies of Renaissance Miniaturists in Venice* (London: Pindar Press, 2003), 1:233–338. For the Master of the Seven Virtues, see: Lilian Armstrong, “The Hand-Illumination of Printed Books in Italy 1465–1515” in *Studies of Renaissance Miniaturists in Venice* (London: Pindar Press, 2003), 2:501–504.

⁹² Martin Lowry, *The World of Aldus Manutius* (Ithaca, New York: Cornell University Press, 1979), 98, 129. Lilian Armstrong, “The Agostini Plutarch: An Illuminated Venetian Incunable,” in *Treasures of the Library, Trinity College Dublin*, ed. P. Fox (Dublin: Royal Irish Academy, 1986), 86–96.

and Ridolfi merchants of Florence who commissioned Jenson's 1476 edition of Pliny the Elder's *Natural History* in the Italian vernacular.⁹³ Furthermore, Jenson named Pietro and Alvisè Agostini as executors of his will shortly before his death in 1480. The two are described as brothers from the papermaking town of Fabriano living in Venice.⁹⁴ Of the thirteen printed books owned by the Agostini, ten were published by Jenson (See Appendix B).⁹⁵ In contrast with Ugelheimer, who only collected Jenson editions, the Agostini brothers had wide dealings with printers—due to their sale of paper—and attracted presentation copies from a broader range of firms.⁹⁶ Books not published by Jenson in the Agostini's collection were produced by other significant publishers of the period including Christoph Valdarfer and the partnership of Johannes de Colonia and Johannes Manthen. The latter represented a major Venetian rival to Jenson's press until the two firms merged in 1480.⁹⁷ Together, the Ugelheimer and Agostini libraries comprise the richest collections from which to explore the visual strategies employed by Nicolas Jenson and the illuminators commissioned by his firm, and to come to know the interests of the major early investors in the new technology.

Within these libraries, two categories of knowledge emerge as sites of visual exploration and illumination: Classical works by authors including Aristotle, Cicero, Pliny the Elder, Plutarch, Suetonius, and Vergil; as well as legal texts, with commentaries, on civil and canon

⁹³ F. Edler de Roover, "Come furono stampati a Venezia tre dei primi libri in volgare," *Bibliofilia* 55 (1953): 110.

⁹⁴ Carlo Castellani, *La Stampa in Venezia dalla sua origine alla morte di Aldo Manuzio senior* (Venice: Ferdinando Ongania, 1889), 85 ff.

⁹⁵ There are some unknown factors, such as which of the individual Agostini family members actually owned the volumes, and whether they commissioned these outstanding volumes or received them as gifts from grateful publishers. While Pietro and Alvisè are named in the will, one book is signed B. Augustini which may be Bartolommeo. For further discussion see: Lilian Armstrong, "The Agostini Plutarch: An Illuminated Venetian Incunable" in *Treasures of the Library, Trinity College Dublin*, ed. P. Fox (Dublin, Royal Irish Academy, 1986), 86–96.

⁹⁶ For more on the gifting of presentation copies, see: Lilian Armstrong, *Studies of Renaissance Miniaturists in Venice* (London: Pindar Press, 2003), 503.

⁹⁷ Martin Lowry, *Nicolas Jenson*, 165 and 165n59.

law, most notably those of Justinian (d. 565) and Gratian (d. before 1159). While Jenson published a wide range of texts including highly successful runs of Bibles and Books of Hours, and investors certainly collected books in other categories of knowledge, classical and legal texts in folio volumes represent the vast majority of their holdings and the illumination they contain is frequently the most innovative and peculiar.⁹⁸ Understood as bringing honor to the city,⁹⁹ printed classical works are described in contemporary Venetian print privileges as “ornaments” to the city.¹⁰⁰ Ornament did not merely imply decoration, but rather represented intrinsic worth, serving to complete and even characterize that which it ornamented.¹⁰¹ Clare Guest defines a fifteenth- and sixteenth-century understanding of ornament as the “radiance which illuminates virtue.”¹⁰² In addition to printed books, buildings and even noblemen were described as ornamenting the city.¹⁰³ It is logical, then, that the lettered elite would not only hold printed classical and legal texts in high esteem, but also collect, embellish, and create elaborate spaces for their display.

⁹⁸ See Appendix A. Of the fifteen identified volumes, 6 are by ancient authors, 3 are medieval commentaries on Classical philosophy, 4 are legal texts, and two are sacred texts including a Bible and a Breviary.

⁹⁹ This honor is variously described as: “honore de epsa città vostra,” Archivio di Stato di Venezia, Collegio Notatorio, Registro 15, Folio 83v. (See also: Rinaldo Fulin, *Documenti per servire alla storia della tipografia veneziana*, “Archivio Veneto”, 23 (1882): 84–212; no. 115) Hereafter the citation format for print privileges will be a condensed version of the above: ASV, CN, Reg. #, Fol. # (Fulin, page, document number); “honore a questa città,” ASV, CN, Reg. 14, Fol. 181v (Fulin, 135, No. 85) and many others.

¹⁰⁰ Examples of the use of “ornament” in print privileges include: ASV, CN, Reg. 14, Fol. 70r (Fulin, 103, No. 6), 17 August 1492: an ornament of the Venetian Republic “rei publice venetae ornamentum;” ASV, CN, Reg. 14, Fol. 99r (Fulin, 111–112, 23), 27 February 1494: both in acquiring the best paper as in the correction of the work for an ornament and universal convenience (“tam in comparanda optima papiro, quam in correctione operis pro ornamento, et universali commodo”); ASV, CN, Reg. 14, Fol. 174r (Fulin, 133, No. 81), 25 May 1498, of the new inventions which are comfortable and of public ornament[...] of great ornament and maximum necessity to the Christian Religion “di nove invention qual habiano essere a commodità et ornamento publico... a la Religion Christiana de grande ornamento, et maxime necessaria.”

¹⁰¹ Alison Wright, *Frame Work: Honour and Ornament in Italian Renaissance Art* (New Haven: Yale University Press, 2019), 38.

¹⁰² Clare Lapraik Guest argues that the understanding of ornament underwent a profound shift during this period due to antiquarianism and the revival of ancient rhetoric. At an even more abstract level, ornament can be connected to the early modern concept of universal order as in the Greek *cosmos* (κόσμος) or the harmony and inherent order of the universe. See: Clare Lapraik Guest, *The Understanding of Ornament in the Italian Renaissance* (Leiden: Brill, 2015), 3, 8.

¹⁰³ Niccolò Barbo described Zaccaria Contarini as city’s greatest and foremost ornament, “...ut putaretur esse civitatis maximum atque praecipuum ornamentum.” As cited in: Margaret King, *Venetian Humanism in an age of Patrician Dominance* (Princeton: Princeton University Press, 1986), 26n129.

The publication of books in these two categories was also interlinked through the tumultuous conditions of the rise of print in Venice. Two distinct crises from 1472–73 impacted the nascent print industry in Venice and forced Jenson to quickly adapt his strategy for publication. The first was a monetary crisis resulting from forged coins. Printers’ tools for the creation of punches and matrices are similar to those used in the production of coin dies, and the metals used in print—including copper, tin, and antimony—are identical to the composition of low-value currency such as the Venetian *soldo*. Together, when debased currency was discovered in the city, these factors led to the scapegoating of foreign printers, who had recently flooded into Venice.¹⁰⁴ This xenophobic crisis implicated at least twenty-one printers and foreigners who were suspected of the crime. If the nebulous details of his biography are to be accepted, Jenson certainly had the technological knowledge to mint debased coins. Yet he managed to evade accusation, in part through his network of patricians and influential patrons.

At the same time as the monetary crisis, the frenzied expansion of the print industry had created a crisis from within. Eager to profit from the publication of highly prized classical texts, printers temporarily oversaturated the market for these works.¹⁰⁵ The glut caused prices to crash. Jenson navigated the downturn in two ways: his move to secure long-term capital through his “*prima societas*” allowed him to plan a program of publications beyond single-investor interest; secondly, he diversified his output to include lucrative legal texts. While demand for these texts was not as great, they were mandatory professional resources for students of law in the nearby universities of Padua and Bologna, for practitioners in the legal field, and for the elite who wished to defend their wealth through litigation. Legal texts, therefore, commanded much higher prices. While the average cost of an unadorned printed classical text was 1 Lira 18 Soldi, a folio-

¹⁰⁴ Lowry, *Nicolas Jenson*, 109.

¹⁰⁵ Lowry, *Nicolas Jenson*, 20.

sized legal text fetched 5 Lire, almost three times the price of the former.¹⁰⁶ The high-value copies of classical and legal texts that lined the shelves of wealthy print investors like Ugelheimer and the Agostini not only attested to their own learnedness and esteem for the textual content, but also reflected their investing acumen as Jenson's firm emerged from these crises triumphantly.

Another important factor in Jenson's success was his shrewd display of commitment to textual accuracy of the text in books published in both categories. In dedicatory letters and colophons, Jenson was praised—either by himself, or his editors—for distinguishing his work from that of printers who simply multiplied corrupt copies. The humanist scholar Giorgio Merula (c. 1430–1494) tirelessly associated Jenson with the most advanced contemporary scholarship, and, by 1500, Jenson enjoyed a reputation as one of the first *scholarly* publishers of Europe.¹⁰⁷ While this reputation was arguably owed to editors willing to author the florid dedicatory letters included in the volumes, there is no doubt he deserved credit for an undeniable innovation: the production of new styles of type.

Jenson's awareness of the authority carried by the *visual* appearance of the text led him to develop new movable type for legal works and a separate style for classical texts. In an attempt to raise profits and meet student demand, earlier manuscript copies of legal texts had become overly abbreviated, to the point of sacrificing their legibility and intelligibility. In response, Jenson adopted the authoritative cursive gothic script of law schools known as “littera Bononiensis” and fashioned highly durable steel punches to carry on the visual tradition. He also

¹⁰⁶ One Lira was the equivalent of 20 soldi, therefore the unadorned printed classical text was the equivalent cost of 38 soldi while the legal text was 100 soldi. Based on prices recorded in the bookseller Francesco de Madiis from 1481–1484. See: Lowry, *Nicolas Jenson*, 189.

¹⁰⁷ Merula's position in the humanist school of San Marco was as the “Chair of Eloquence,” which he filled in 1468. In this role he shifted the focus of Venetian humanism away from broader rhetoric toward a narrower focus on philology. See: Maragaret King, *Venetian Humanism in an age of Patrician Dominance* (Princeton: Princeton University Press, 1986), 233.

expanded abbreviations and clarified the previously muddled text in a way that was “clear cut, outspoken, and unequivocal.”¹⁰⁸ This elegant type, with learned associations, was used in the presentation copy of Ugelheimer’s Justinian analyzed at the outset of this chapter (Figure 16).

For classical works, Jenson developed the type known as *Antiqua* which would become equally authoritative. A copy of Pliny the Elder’s *Historia Naturalis* printed by Jenson in 1472 now held in the *Biblioteca del Vescovile Seminario* (BVS; Figure 17) in Padua represents an early example. While some have described the beauty of Jenson’s *Antiqua* in terms of translating the flourish of a quill into type, it is more accurate to connect his letterforms to the sculptural point of the chisel.¹⁰⁹ Lotte Hellinga has noted how Jenson’s colophons, composed entirely of capital Roman letters, echo the ancient inscriptions from which the type was derived.¹¹⁰ That Jenson used an innovative metal type to visually equate himself and his publications with the greatest ancient Roman monuments and the achievements they record suggests a kind of Janus-faced rhetoric surrounding print in Venice at this time, situating it as *both* innovative and appropriately rooted in antiquity.

The illuminator of the Pliny in Padua, the so-called Master of the Putti, echoed the forms of Jenson’s *Antiqua* type in the visual rhymes and improvisations of his *all’antica* pen-and-ink washes. The elaborate architectural frontispiece and large initials that announce each section of the Natural History demonstrate the master’s knowledge of the visual language of antiquity and his awareness of the foundational figures of earlier Quattrocento *all’antica* style including Andrea Mantegna and Francesco Squarcione (Figure 17, Figure 18).¹¹¹ *All’antica* objects

¹⁰⁸ Lowry, *Nicolas Jenson*, 144.

¹⁰⁹ For a description of the type in terms of the quill, see: Lowry, 79. For a description in sculptural terms, see: Juliet Spohn Twomey, *Whence Jenson: A Search for the Origins of Roman Type* (Oakland: Pacem Press, 1987).

¹¹⁰ Lotte Hellinga, “Nicolas Jenson & Peter Ugelheimer,” 157.

¹¹¹ Federica Toniolo, “Gli Incunaboli Miniati della Biblioteca del Seminario Vescovile,” in *Gli Incunaboli Della Biblioteca del Seminario Vescovile di Padova*, ed. Pierantonio Gios and Federica Toniolo (Padua: Istituto per la Storia Ecclesiastica Padovana, 2008), 122.

functioned as visual texts, demonstrating an artist's accurate and appropriate use of the visual "grammar, vocabulary, and phraseology" of antiquity."¹¹² Yet, these objects provided more than visual clues to the ancient past; inscriptions carved in stone and imprinted on coins gave humanist philologists direct access to authentic classical Latin as they undertook to salvage the written heritage preserved in sometimes corrupt and questionable medieval manuscripts. The Master of the Putti's reference to inscribed ancient monuments and objects of material culture reinforces the message of Jenson's *Antiqua* type in which it is printed, lending the book the authority of antiquity.

Book XIV of the natural history, "*The Natural History of Fruit Trees*," opens with a twelve-line high initial *E* drawn in pen-and-ink in the so-called "litera Mantiniana" or Mantegnesque style (Figure 18).¹¹³ The Master of the Putti gave the letter an illusionistic three-dimensionality to the letter using ink washes of ochre and blue. This depth recalls the Roman inscriptions carved with hammer and chisel from which the script derived. Behind the letter *E* a winged putto approaches a column with a common inscription on its base, an abbreviation of the Senate and People of Rome:

SENA/TVS · POP[ULUS]Q/[UE] · R· [OMANUS].

While the *E* inscribed on the plinth is echoed by the larger pen-and-ink initial, the handwritten *Q* on the monument is reproduced in the *printed* text. Visually, the manuscript *Q* is understood to be part of the stone inscription. Yet, its extended descender (also known as a "long

¹¹² Luke Syson and Dora Thornton, *Objects of Virtue: Art in Renaissance Italy* (London: The British Museum Press, 2001), 92.

¹¹³ Toniolo, 122. See also: Millard Meiss, *Andrea Mantegna as Illuminator: An Episode in Renaissance Art, Humanism and Diplomacy* (Glückstadt-Hamburg: Augustin, 1957), 52–67; Jonathan J. G. Alexander, *Initials in Renaissance Illuminated Manuscripts: The Problem of So-called 'Litera Mantiniana,'* in *Renaissance und Humanistenhandschriften* (Schriften des Historischen Kollegs Kolloquien 13), ed. Johanne Autenrieth (Munich: 1988), 145–55.

tail”) transgresses the coffered bordering frame. This rupture suggests that the letter is at once behind the ink-wash initial *E*, on the plinth, and hovering *above* that depiction—as a manuscript embellishment at the surface of the page. The inscribed Q is also echoed by a number of printed Qs in the text adjacent to the illumination. Considering that the text was first printed by Jenson before the page was elaborated by the Master of the Putti, this initial cleverly takes its cue from the nearby printed text and compiles multiple layers of representation which demonstrate not only the illuminator’s *all’antica* erudition, but also highlight the claimed classical inheritance of the printed text.

The elongated, printed Q also speaks to Jenson’s place within a network of humanists.¹¹⁴ In 1460, the humanist polymath Felice Feliciano compiled a guide to the construction of antique capital letters based on his study of classical monuments and his own geometric principles.¹¹⁵ Felice was a close friend of Mantegna whose influence can be felt not only in the Master of the Putti’s ink-washed initials but also in Jenson’s printed type. This small detail demonstrates some of the ways in which Jenson’s firm was engaging in broader material culture. Below I consider how elaborate first-folio illumination could reflexively explore the operations of visual representation in proximity to printed text.

¹¹⁴ The distinctive “long-tailed Q” described by Felice Feliciano reached Strasburg by the later part of the 1460s. Further evidence of Feliciano’s influence can be seen in marble inscription over the entrance to the Fish Market (*Pescheria*) in Verona which was erected when Domenico Zorzi was Venetian prefect of the city. See: Feliciano, *Alphabetum Romanum*, ed. Giovanni Mardersteig, trans. R.H. Boothroyd (Verona: Editiones Officinae Bodoni, 1960) 55.

¹¹⁵ Felice’s instructions for the letter Q are as follows: “La littera sopradicta si regie secondo l’ordine del .O., ingrossando dentro e di fuori la x^a. parte come tu vedi. Ma el ti bisogna a questa littera agrandire el Quadro 1/3 verso la parte del .S., et [d]ove la croce è fermata, tira el compass fina a quel’altra croce del .Q. E per quell modo viene a formare la coda inferior, a la quale anche pratica gli vole quanto rasone.” See: Felice Feliciano Veronese, *Alphabetum Romanum*, 55. See also: Lowry, *Nicolas Jenson*, 77–78.

2.2 Torn Parchment and Thresholds within Venetian Visual Culture

2.2.1 Torn Parchment First Folio Illumination

Among the printed texts held in the Agostini library was a volume of the complete works of Virgil including the *Eclogues*, *Georgics*, and *Aeneid*, with a commentary by Servius the grammarian, and illumination by the Master of the London Pliny (British Library C.6044). On the first folio, through clever shading, the printed text appears as a monumental sheet of parchment suspended with strings from a portico (Figure 19). Reading the marginal imagery from the bottom up, we see putti and a satyr occupying the frieze-like space in the bas-de-page within the shallow depth of the loggia. The satyr's left hand, most distant from the viewer, reaches up to a string of coral-colored beads—perhaps to steady himself from the onslaught of putti—pulling the suspended text taut. At the top of the folio, two crimson ligatures attach the printed page to the fore edge of the entablature. Here is the rub: the suspended folio cannot exist both closest to the viewer, in front of the columns at the top, *and* at the furthest depth of field, in the Satyr's left hand at the bottom, without showing any sign of perspectival foreshortening. This is not, however, a failed grasp of the principles of perspective as codified by Brunelleschi. If perspective is a symbolic form, then this is an intentional subversion of that form.¹¹⁶

Nor is this a singular example; many illuminated first folios in Jenson's of classical and legal texts confront perspective in complex ways. The first-folio illumination of a copy of his 1471 edition of Suetonius' *Lives of the Caesars* now in the Biblioteca Trivulziana in Milan (B.87, hereafter referred to as the Trivulziana Suetonius, Figure 20), places the text within a porphyry monument depicting sculptures of deities, heroes, and gods. Beyond the architectural

¹¹⁶ Erwin Panofsky, "Die Perspektive als 'symbolische Form,'" *Vorträge der Bibliothek Warburg 1924–25* (Leipzig and Berlin: Teubner, 1927): 258–330.

monument is a landscape inhabited by animals—hares, a peahen, and an absolutely gorgeous peacock—which fades into the blues of atmospheric perspective. Upon closer inspection, it becomes apparent that this entire illuminated scene takes place within a fictive depth. What appears to be deep blue sky at the left (gutter-side) suddenly meets the bright white orthogonal line of architecture at the right (fore-edge-side) of the folio. This suggests that while the folio may have been originally perceived as an invisible Albertian window, the scene actually takes place within a shallow architectural space. To use Wöfflin’s terminology, this introduces yet another “degree of reality” to the representation.¹¹⁷ At the *bas-de-page*, however, the architectural certainty of the upper edge dissolves. Rather than another orthogonal line to indicate the recession of the wall against the floor, there is only a horizontal line indicating the limit of the picture plane. This creates multiple uncertainties: the pool of water from which the two hares drink is either cut off by the end of the picture plane, or by a raised architectural space; and the foot of the porphyry monument appears to be both above the architectural space and beyond it. At the point closest to the pool of water, the monument almost seems to transgress the space of the frame.

Rather than a clumsy handling of perspective, this represents a fifteenth-century visual tactic identified by Sven Sandström as a “puncture,” in which, “real space trickles into the space of the picture and vice versa.”¹¹⁸ This strategy creates a productive oscillation between surface and depth, real and fictive, contemporary and ancient. In fact, this opening onto an ancient scene appears to be only one of a series of doors within the space. A carved opening in the Mantegnesque rock between the two hares is paired with a perfectly fitted stone slab “door.”

¹¹⁷ Heinrich Wöfflin, *Die Klassische Kunst: eine Einführung in die italienische Renaissance* (Munich: F. Bruckmann, 1901). See also: Sven Sandström, *Levels of Unreality: Studies in structure and construction in Italian mural painting during the Renaissance* (Uppsala: Almqvist & Wiksells Boktryckeri Ab, 1963), 10.

¹¹⁸ Sandström, 50.

Another clearly defined entryway is just visible in the oddly geometric hills of the middle distance.

This series of thresholds found in the Agostini Virgil analyzed above and in numerous other volumes in the library of Peter Ugelheimer are activated to “construct and exploit” liminal space in a manner similar to that found in Netherlandish art, as analyzed by Lynn F. Jacobs.¹¹⁹ These thresholds, whether book covers, first folios, chapter *incipits*, or illusionistically envisioned liminality, are at once frame and content (*parergon* and *ergon*).¹²⁰ They not only establish expectations and instruct the viewer how the text should be grasped, but also act as sites for the assertion and performance of authority.

While the previous examples presented the text as a pristine folio suspended from or incorporated into architectural monuments, another common motif (featured in Ugelheimer’s *Justinian*, discussed in the opening of this chapter) was for the printed text to appear as a sheet of torn parchment. Through the folio’s many “lacerations,” this illusion created manifold possibilities for complex and deceptive foreground-background relationships. On one hand, the continuity of torn parchment illumination from the Middle Ages—both in Europe and China—through to books created with movable type suggests authority and the maintenance of textual canonicity. On the other hand, I would argue that the refashioning of the torn parchment motif in connection with *printed* text also signified differently in the eyes of the elite who were intimately involved in publishing whether through capital investment, humanistic education, legal regulation, or their own collecting.¹²¹ Through visual reference to tattered medieval

¹¹⁹ See Lynn F. Jacobs’ discussion of such thresholds in Netherlandish art in: Jacobs, *Liminality in Netherlandish Art (1385–1530)* (London: Routledge, 2017).

¹²⁰ Jacques Derrida and Craig Owens, “The Perergon” *October* 9 (1979): 3–41.

¹²¹ For more on Chinese depictions of fictive torn paper see: Nancy Berliner, “Roots and Branches of Bapo,” in *The 8 Brokens: Chinese Bapo Painting* (Boston: MFA Publications, 2018), 9–37.

manuscripts—which contained versions of ancient texts perceived to be more accurate—publishers claimed a competitive advantage and reassured their investors of the quality of their texts. Furthermore, as I will demonstrate, the illuminated torn parchment referenced the materials and innovative techniques of printing with movable type.

One of the earliest analyses of the transformation of the illuminated page from two dimensional to an illusionistic conception of three dimensions comes from Otto Pächt. The *Très Riches Heures* (1412–16) of the Duc de Berry, for Pächt, represented a turning point in which the two-dimensional pictorial field became illusionistic, three-dimensional pictorial space.¹²² He made value judgments describing what he saw as an “acute crisis” of the art of the book, which left the script “marooned like an island” within a picture.¹²³ He specifically noted Venetian illumination as an “intellectual witticism” with torn parchment decoration foreshadowing the death of the illuminated book.¹²⁴ Below, I consider why the torn parchment device may have been a meaningful choice rather than a harbinger of doom and how it could have conferred the promise of accuracy on the ancient texts he published.

This section of my study is indebted to Nicholas Herman, who has excavated the category of torn parchment frontispieces and established a “typology of illusion” to better understand its origins.¹²⁵ My contribution is, in part, to consider the economic factors that motivated the popularity of the motifs and, more expansively, to understand how this motif can be seen as linked to the materials and tools required by the printing process. Herman traces a

¹²² Otto Pächt, *Book Illumination in the Middle Ages: An Introduction* (London: Harvey Miller Publishers, 1986), 196.

¹²³ *Ibid.*, 200–201.

¹²⁴ *Ibid.*, 202. I would like to note here that a bound codex of folios protected with boards or card and covered in animal skin was always a three-dimensional object—even the scrolls and wax tablets that preceded the codex were three-dimensional objects.

¹²⁵ Nicholas Herman, “Excavating the page: virtuosity and illusionism in Italian book illumination, 1460–1520” *Word & Image* 27, no. 2 (2011): 190–211.

lineage for torn parchment frontispieces from French and Flemish manuscripts and the Venetian tradition of signing paintings using *cartellini*. These illusionistic pieces of paper attached to an object within the painting or at the surface of the picture plane contained an artist's signature often with an epigraph and/or date. The connection between *cartellini* and printed title-pages was first drawn by Louisa C. Matthew, who argued that the cartellino, conspicuously placed, promoted an artist's reputation and helped to drive commercial success, especially in the Venetian context of an export market.¹²⁶ In this way, the *cartellino* connects to the printed title-page which, "gave unprecedented prominence to the author and to the printer-publisher, who used it as a form of advertising for both the author and himself."¹²⁷ While Matthew notes that the title-page was never used in manuscripts, she is vague about its introduction in printed works offering only the "late fifteenth and early sixteenth centuries" as a date for its appearance.

In fact, the development of the title-page proves to have been less than linear. While the earliest movable type in Venice followed manuscript norms such as incipit initials, it soon became common for books to be preceded not by a title page but by a blank page. This was a consequence of the mass production of the printed book, which created a need for protecting unbound copies in storage until they were sold.¹²⁸ In turn, this introduced the need to identify the masses of stored volumes, and this eventually led to short titles being printed on an otherwise blank page. Yet, it was not until 1495–1500 that it was "three times more likely that a book would have some sort of title on its first page than anything else."¹²⁹ The Malermi Bible, published by Giovanni Ragazzo for Lucantonio Giunta in 1490, served as an early model for

¹²⁶ Louisa C. Matthew, "The Painter's Presence; Signatures in Venetian Renaissance pictures," *Art Bulletin* 80 (1998): 627.

¹²⁷ *Ibid.*

¹²⁸ Margaret M. Smith, *The Title-Page: Its Early Development 1460–1510* (London: The British Library, 2000).

¹²⁹ *Ibid.*

what became known as a “Renaissance title-border” and gained significant popularity in the next two decades.¹³⁰

Nearly all of these developments came *after* the period in which the lavishly illuminated first-folios were produced for Jenson’s investors. Although the printed title-page was yet to emerge, I would argue that much of the visual rhetoric and commercial posturing eventually embedded there was already developing within the illuminated torn-parchment first-folio. Through the demonstration of illusionistic acumen, the quality of the editing, printing, and accuracy of the text could, in a different way, be proclaimed visually.

These lacerated, punctured, dangling parchment folios of text suggested accuracy and quality in a number of ways. They referenced the actual manuscripts discovered and studied by fifteenth-century humanists. In a letter to Guarino of Verona written in 1416, Poggio Bracciolini mentioned finding among the books at St. Gall in Switzerland a “Quintilian still safe and sound, though filthy with mold and dust.”¹³¹ The dusty and worn patina of manuscripts “discovered” by the intrepid humanistic explorers of monastic libraries vouched for the purity of their content, thought to be more aligned with ancient “originals.”¹³² While medieval texts, like those by Dante and Petrarch, believed to be written by the hand of the author could claim inherent accuracy, ancient texts required more elaborate authentication.¹³³

¹³⁰ Ibid., 138.

¹³¹ Herman, “Excavating the page,” 201.

¹³² Or, instead, consider the Chinese tradition of painting torn fragments in a form of illusionistic collage known as Bapo. Nancy Berliner describes how Bapo “represented a ‘yearning for antiquity’ that mourned the destruction and loss of the ancient lifestyles, culture, and values—so palpably and visibly expressed in Bapo painting—had long been a primary theme among the Chinese literati. This “yearning for antiquity” (*huaigu*) became a motif in Chinese poetry and art as early as the Han dynasty (206 BCE–220 CE). For more on Chinese depictions of fictive torn paper see: Nancy Berliner, “Roots and Branches of Bapo,” in *The 8 Broken: Chinese Bapo Painting* (Boston: MFA Publications, 2018), 29.

¹³³ A privilege issued on 26 June 1501 claimed to have discovered manuscripts by the hands of Petrarch and Dante. See: ASV, CN, Reg. 15, Fol. 42r (Fulin, 146, No. 115).

Moreover, the transition from the depiction of a crumbling artifact on the recto to the pristine, high-contrast type on the unadorned printed verso demonstrated the rehabilitative possibilities of movable type.¹³⁴ The translation of handwritten text into print offered redemptive possibilities not just due to the new technology, but also due to the acumen and commercial savvy of a particular publisher, the careful setting and visual appearance of their chosen type, and the flawless execution of the press. This quality and accuracy were communicated to investors in a given print run who received presentation copies containing the illusionistic torn parchment first-folios. The function of this decoration—to attract and maintain capital investment for expensive print runs—indicates greater financial consequences than previously understood by scholars, such as Pächt, who merely saw witticism in a low-stakes medium.

The torn parchment first-folio was also well suited to adorn printed texts on account of its visual and material connection with frisket sheets—a critical and ubiquitous tool in the technology of early book printing. Usually made from discarded parchment manuscript folios, friskets ensured that areas of the page without text or image remained ink-free.¹³⁵ This was achieved by cutting narrow strips out of the parchment to permit lines of metal type to transfer ink while masking the rest of the folio (Figure 21). Although they became much more necessary in printing with multiple colors which required masking all of one color when printing a second (e.g. masking black text when printing red-ink rubrics, seen in Ugelheimer’s Gratian, fig. 2.27b), friskets were also used in monochromatic printing to prevent ink transfer in unwanted areas.¹³⁶ Due to the durability of the animal skin, a single parchment frisket could be reused for hundreds

¹³⁴ Herman, “Excavating the page,” 201.

¹³⁵ Extant early modern frisket sheets were made of parchment, paper, or parchment and paper pasted together. See: Elizabeth Upper (Savage), “Red Frisket Sheets, ca. 1490–1700: The Earliest Artifacts of Color Printing in the West,” *Bibliographical Society of America* 108, no. 4 (2014): 479.

¹³⁶ These reused pieces of parchment are included in printers’ inventories as early as 1514, but it is widely accepted that they were commonly used for color printing from the fifteenth century. See: Upper (Savage), “Red Frisket Sheets,” 478.

of impressions of the same printed page throughout a print run. This object, once a pristine manuscript folio in its own right, became a tool which was methodically lacerated to allow certain letters or words to be printed and systematically damaged by repeated impression until covered in a thick topography of dried ink.

These parchment devices known to printers and publishers, and likely known to those financially invested in the visual aspects of the text, were strikingly similar in material and appearance to the torn-parchment frontispieces popular in early printed works. Thus, torn parchment, while referencing early medieval manuscripts and drawing from their authority, also signified in connection to the technologies and materials of the printing press. Like the Janus-faced praise of Jenson's text and type, the torn-parchment frontispiece may suggest both the authority of older texts while also visually referencing the innovative tools and technologies that lent speed and accuracy to the printing press.

Consider, for example, the gaps between lines of printed text created by the deeply gashed "torn parchment" folio of Ugelheimer's Justinian (Figure 16). Beyond the visual similarities between this illusionistic *tour de force* and the stencil-like friskets, there are logical similarities as well. While the ravages of use would alter the edges and corners of early manuscripts prized for their proximity to antiquity, it is unlikely that any amount of use or neglect would cause deterioration well *within* the parchment page, between columns of text.¹³⁷ Instead, these visual passages could reference the intentionally slivered parchment sheets required by printers to operate their presses.

Finally, in addition to a meta-visual commentary on the process of printing with movable type, the irregularly torn parchment may have served a practical pictorial purpose. While the

¹³⁷ With an exception being the circular holes formed by bookworms tunneling through the text block.

two-dimensional text block must necessarily be imprinted parallel with the surface of the picture plane, the three-dimensional architectural monuments must be illuminated at an angle to show illusionistic depth. Torn parchment, with its many tears and voids created a visual elasticity, mediating between the illusionistic depth of the depicted monuments and the flatness of the text.

2.2.2 Printing and Thresholds

As Deborah Howard and Alison Luchs have demonstrated, the visual negotiations and experimentation advanced through book arts had significant impact in other areas of Venetian visual and material culture. This included architectural decoration, monumental tombs in churches, and the framing of altarpieces. The illusionistic illuminations leading into the printed text related to experiencing physical thresholds as sites for encountering multiple shifting modalities of visual representation.

2.2.3 Altarpieces as Thresholds

Much of the complex illuminated framing of printed texts predates or is contemporary with innovative monumental Venetian altarpieces that utilize pictorial illusionism to reflect upon the nature of religious representation. In her analysis of Giovanni Bellini's *Coronation of the Virgin* (Altarpiece for San Francesco in Pesaro, 1471–74), Howard identifies many paradoxes drawn from illusionistic illumination which were woven into the complex panel and painted frame (Figure 22).¹³⁸ Bellini's frame-within-a-frame echoes the many folio-within-a-folio devices illuminated in early printed books. As in the codices, this *mise-en-scène* questions levels of representation. Debate regarding the nature of Bellini's landscape at the center of the

¹³⁸ There has been extensive debate regarding the dates of Bellini's *Coronation of the Virgin*. For this discussion see: Anchise Tempestini, *Giovanni Bellini* (Milan: Electa, 2000), 62–63. See also: Oskar Bätschmann, *Giovanni Bellini* (London: Reaktion Books, 2008), 150, for the proposed *terminus ante quem* of 1476.

altarpiece has produced various readings: that it is a mirror; a view into a distant fortified hill town perhaps associated with the Sforza family's Rocca di Gradara; or simply a painted representation. It is unlikely to be a mirror, as the figures are not reflected, but merely the landscape. Furthermore, the Venetian technology of creating clear plate glass of that size was still unknown. The argument that it is a painted representation is a delightful tautology.

In Bellini's altarpiece, as in the illuminated first folios seen thus far, perspective has been used toward intentionally obfuscating ends. While the orthogonal lines in the marble pavement offer a cohesive system of Albertian space, the smaller scale of the saints painted on the frame contradicts the suggestion of a homogenous visual plane. As Alison Wright describes, these shifts between "reality" and illusion force the viewer to move between those aspects of the panel that have "fictional status" and those that make "truth claims."¹³⁹ This tension between fiction and truth may be better understood as a symbolic union between the earthly and the heavenly in the figure of the Virgin.¹⁴⁰ Yet, in this visual metaphor, is the depicted landscape to be understood as earthly or the heavenly? If it is to be the earthly, where is the heavenly located? If it is to be heavenly, why hint toward a recognizable earthly stronghold? Perhaps, like the choir screens explored later in this chapter, the panel offers a multitude of connections and associations. Disjunctions in scale, perspective, and visual metaphor, instead point to multiple modes of engagement and levels of reality. To paradoxes such as these, illuminated first folios added the printed word.

A major interlocutor of Bellini's, if also a competitor, was Antonello da Messina (active 1456, died 1479).¹⁴¹ Antonello probably arrived in Venice around 1475. His time there

¹³⁹ Alison Wright, *Frame Work*, 114.

¹⁴⁰ Bächtmann, *Giovanni Bellini*, 156.

¹⁴¹ *Ibid.*, 163.

represented a turning point, as his knowledge of the technique of oil painting increased and he both encountered and informed the development of Venetian panel painting. One way in which Giovanni and Antonello appear to have been in competitive visual dialogue is the use of inter-referential painted architectural space and physical framing devices. Bellini's altarpiece for the Church of San Giobbe in Venice creates seamless transitions between frame and fiction.

Although frame and panel are now separated, virtual reconstructions which reunite the two allow for rich analysis (Figure 23). The frame's gold and white pilasters insist on comparison with their painted counterparts, which appear illusionistically distant due to Bellini's command of perspective, yet in real terms are nearly contiguous with the frame.

Given Giovanni's awareness of Antonello's work, a precursor to this type of illusionism could be Antonello's *St. Jerome in his Study* (Figure 24) painted in Venice around 1475. Here, the central scene is "framed" by an architectural opening. A wide arch of warm sandstone offers a threshold onto the cathedral-like interior. Antonello's depiction rewards close looking: the topography of the rough-hewn stone has been "written" with the back end of the brush in a *sgraffito* technique (Figure 25). This visual inscription frames St. Jerome's scribal act of biblical translation. At the base of this inscribed frame, a shallow step adds an additional level of "unreality." Symbolic animals and a bowl resting at the level closest to the viewer challenge a simple reading of this illusionistic threshold.¹⁴² In support of the assertion that Venetian illumination was indeed a driver of innovation in other media, recall the illusionistic framing of the Trivulziana Suetonius (Figure 20). The book was already printed in 1471 and very likely

¹⁴² The partridge was associated with truth and the peacock frequently represented immortality. See: <https://www.nationalgallery.org.uk/paintings/antonello-da-messina-saint-jerome-in-his-study> (accessed 3 November, 2021).

illuminated before either of these ground breaking panels by Giovanni Bellini or Antonello da Messina were completed.

2.2.4 Choir Screens as Thresholds

In addition to informing and visually engaging with these spatially complex altarpieces, illusionistic renderings of torn parchment “hanging” from imagined *all’antica* monuments on first folios, I suggest, bear a relation to the construction of contemporaneous choir screens. The *all’antica* choir screen in Venice’s major Franciscan church, *Santa Maria Gloriosa dei Frari* (hereafter Frari) is a case in point. While Pächt lamented its occlusion of the text, the rendering of semipermeable torn parchment may be understood not simply as dividing the page, but also as multiplying visual relationships and engendering complex ways of seeing. Similarly, since the medieval period, the construction of choir screens at once divided and united the laity and clergy through complex visual relationships that participated in the manifestation of the divine.

The *all’antica* choir screen in the Frari was constructed from 1468 to 1475 (Figure 26). With movable type arriving in Venice in 1469 and the majority of Jenson’s illuminated copies produced throughout the 1470s, the visual elaboration of the first printed texts occurred simultaneously with the erection of the ornately sculpted choir screen. Although begun by Bartolomeo Bon, known for his use of an earlier Venetian “gothic” style, it was completed in large part by Pietro Lombardo’s workshop in a style that incorporated classical vocabulary.¹⁴³

Despite these stylistic differences, the Frari screen can be understood in connection with the *iconostasis* in the Basilica San Marco, begun as early as 1094 and greatly expanded from 1386 to 1394. The late gothic structure simultaneously divided the more public space of the nave

¹⁴³ Allison Sherman, “To God alone the honour and glory’: further notes on the patronage of Pietro Lombardo’s choir screen in the Frari, Venice,” *The Burlington Magazine* 156, no. 1340, (November 2014): 724.

of the Basilica from the sacred space of the high altar, believed to contain the saint's remains (Figure 27).¹⁴⁴ It physically manifested a symbolic hierarchy in the celebration of the liturgy in which the Epistles were read from the lower level and only the Gospels were read from the upper level.¹⁴⁵ The semipermeable edifice manifested physical, spiritual, and authoritative structures in a visual culture that created associations across space and through partial barriers.

While less visually permeable, the Frari "screen" takes the form of two solid walls surmounted by an elaborate entablature and connected by a triumphal arch, which spans the central aisle of the choir. Atop the arch is a sculpted crucifixion scene with the Virgin and John the Evangelist. Walking through the arch, or simply viewing it obliquely, reveals sculpted roundels set within the width of the wall: these frame a bishop saint in the arch to the southeast and Saint Bernardino in the arch to the northwest (Figure 28). Along the top of the screen are free-standing, full-length sculpted saints on a slightly reduced scale compared to the central crucifixion. Below these, each side of the screen contains two registers of four bust-length portraits divided by Corinthian pilasters. The low relief, marble busts are arranged symmetrically with frontal bodies and turned heads, directing their gazes toward the central aisle; some glance upward, while others gaze down. The crucifixion scene above, the reliefs occupying the depth of the arch, and the busts on the exterior create a multitude of visual intersections with one another and the viewer.

Although this screen, which loosely draws upon the vocabulary of ancient Roman architectural ornament, is not composed of the balustrades or open gothic arches that typically permit the eye to penetrate and forge visual connections between foreground and background as

¹⁴⁴ Guido Tigler, "The Iconostasis of the Dalle Masegne Brothers," in *St Mark's Basilica in Venice*, ed. Ettore Vio (London: Thames and Hudson, 2000), 108.

¹⁴⁵ *Ibid.*

seen in San Marco, its open central arch dynamically frames the altar, apse, and choir depending on the viewer's physical, and perhaps social, position—a feature later utilized with marked precision in the visual alignment of Titian's high altarpiece, the *Assumption of the Virgin*, within the opening arch. In this sense, the vernacular Italian term *ponte*, or bridge, more accurately describes the visual device which at once divides and unites sacred space.¹⁴⁶ As Jacqueline Jung has observed, these structures were not perceived primarily as barriers; they were regularly traversed both visually and physically by laypeople.¹⁴⁷ Additionally, the *ponte* became a site of lay identity construction and legacy building in the form of chapels, memorials, and burials at or in front of the screen. At Santa Maria Novella and Santa Maria del Carmine in Florence, family chapels and tombs were built into the lower level of the *ponte*. In a painting by Carpaccio depicting the screen in the Venetian church of Sant'Antonio di Castello, personal appeals for divine intervention including crutches, candles and wax *ex votos* are suspended from the screen (Figure 29).

Similar to these spaces of lay identity construction, the choir screen in the Frari contains a portrait of one of its major patrons, Giacomo di Vittore Morosini, a lay procurator of that institution by 1463 (Figure 30). Morosini was also procurator at San Girolamo di Canareggio for thirty years and a member of that church's *scuola piccola*.¹⁴⁸ In this capacity, he was engaged in the decoration campaign to decorate the scuola's meeting house. This was an unusually

¹⁴⁶ It is worth noting that lagoon-dwelling Venetians, then as now, would be intimately familiar with bridges and their metaphorical meaning. Alternatively, the vernacular *tramezzo* was also commonly used to describe the device that simultaneously divides and unifies. See: Donal Cooper, "Recovering the lost rood screens of medieval and Renaissance Italy," in *The Art and Science of the Church Screen in Medieval Europe: Making, meaning, preserving* (Rochester, NY: Boydell Press, 2017), 222.

¹⁴⁷ Jacqueline E. Jung, "Beyond the Barrier: The Unifying Role of the Choir Screen in Gothic Churches," *The Art Bulletin* 82, no. 4 (Dec 2000): 627.

¹⁴⁸ Sherman, "To God alone the honour," 725.

ambitious project for a *scuola piccola* including an altarpiece by Antonio Vivarini and narrative paintings by Giovanni Bellini and Lazzaro Bastiani.

Morosini's membership in this *scuola* also placed him in the company of major foreign printers and publishers including Nicolas Jenson and John of Cologne.¹⁴⁹ In addition to the spiritual benefits, joining was likely a strategic move to connect to the social and commercial networks the *scuola* provided. Membership allowed Morosini to meet major artistic figures in Venice and to keep informed about the burgeoning print industry—an industry he had helped to secure for Venice when, as a member of the Doge's council (*consigliere ducale*), he was one of five who issued the first print privilege granting Johannes da Spira a temporary monopoly in 1469 (Figure 31).¹⁵⁰ Morosini's involvement in the print industry was ongoing, by 1476 he had been elected as head of the Council of Ten—the body then responsible for issuing all print privileges.

This milieu of confraternity members constituted some of the legal, professional, personal, and religious networks undergirding Venetian visual culture at the time. Morosini, who was tasked with seeking out prominent artists also held considerable legal power over the print industry. Through the confraternity he maintained ties with prominent publishers, and he would have brought the full extent of his experience to bear on the choir screen of the Frari. Likewise, the artists, publishers, and illuminators vying for patrons like Morosini would have been informed by previous successful commissions.

¹⁴⁹ For a wider discussion of first-generation, foreign printers in the *Scuola di San Girolamo*, including Jenson, see: Cristina Dondi, "Printers and Guilds in Fifteenth-Century Venice," *La Bibliofilia* 106, no. 3 (2004): 229–265, especially, 231. See also: Emmanuele Cicogna, *Delle iscrizioni veneziane* (Venice: Presso Giuseppe Orlandelli, 1824–53) 6:954–955; Horatio Brown, *The Venetian Printing Press: an historical study* (London: John C. Nimmo, 1891), 14–15; Martin Lowry, "The Social World of Nicolas Jenson and John of Cologne" *La Bibliofilia* 83 (1981): 193–218.

¹⁵⁰ Allison Sherman, "To God alone the honour," 725. See also: ASV, CN, Reg. 11, Fol. 55r (Fulin, 99, No. 1).

The copy of Justinian's *Digestum novum* published by Nicolas Jenson and illuminated by Benedetto Bordon for Peter Ugelheimer's library (Figure 16), created similarly complex relationships between foreground and background as those that can be seen in the choir screen, while adding further connections between text and image. Ugelheimer's Justinian contains the commentary (*Glossa ordinaria*) of Accursius of Florence. The experience of reading a gloss, which was common across legal, classical, and sacred texts, is one of moving from foreground to background, from primary source to secondary interpretation. This was achieved through a formalized system in which passages of the primary text were assigned a letter (proceeding in alphabetical order), which corresponded to commentary on that passage with the same letter. Unlike the spatial relationships engendered through choir screens, here interaction with text and gloss, as well as the touch likely employed to hold one's place in the primary source while consulting the gloss, yielded an intimate experience, heightened by the illusionistic rendering.

The first folio of Jenson's edition of Justinian contains an honorific passage indicating the author and his text printed in red ink followed by a scant 11 lines of the primary source in large black print. In the presentation copy illuminated by Benedetto Bordon, the red ink was overpainted and illuminated in gold Mantegnesque capitals against a green ground. This elevated introduction appears to occupy a torn and creased scrap of parchment suspended from the commentary by thin red ligatures (Figure 32). This short citation is framed by 68 smaller lines of commentary, occupying the vast majority of the printed page. As Lesley Smith has described, the scribal process of adding a gloss or copying a glossed manuscript was an, "extraordinary feat of graphic imagination and skill" due to the fact that the layout of each page would have to be

worked out individually.¹⁵¹ In his study of Talmudic glosses, David Stern notes that what had required visual “prophesy” in manuscript commentaries on the Talmud became much more efficient, and popular, in print as only a single “model” page had to be worked out by hand and then hundreds or thousands could be reproduced in print without any further need for estimation.¹⁵² While folios beyond the first necessarily contain more of the primary source, Jenson’s exaggerated layout, as seen in unadorned copies (Figure 33), seems to offer the experience of moving *through* levels of authority at center and periphery. Rather than clarifying, the additional illumination complicates primary and secondary sources through the addition of a tertiary, visual text.

In the illumination, the printed commentary appears to hang from a monumental arch, yet within the large opening near the top is an indeterminate space Lilian Armstrong described as both the “upper story” of the architectural monument *and* “an urban setting” in which metalworking is taking place.¹⁵³ It cannot be both. The clever illumination forces the viewer to grapple with the depiction of a street scene, complete with the suggestion of the second story of a building on the left and blue sky on the right. Yet, just four lines of text away is the illuminated entablature of the structure from which the text appears to hang.

This visual play reaches even greater levels of complexity in another work illuminated for Peter Ugelheimer: Aristotle’s *Works (Opera)* with commentary of Averroës (Ibn Rushd) bound together with Porphyrius’ *Isagoge*, published in Venice by Andreas Torresanus de Asula and Bartholomaeus de Blavis—partners who joined the firm created by the merging of Jenson’s

¹⁵¹ Lesley Smith, “Biblical Gloss and Commentary: The Scaffolding of Scripture,” in *The Visualization of Knowledge in Medieval and Early Modern Europe*, eds. Marcia Kupfer, Adam S. Cohen, J.H. Chajes, (Turnhout, Belgium: Brepols, 2020), 115–136, particularly 123.

¹⁵² David Stern, “The Topography of the Talmudic Page,” in *The Visualization of Knowledge in Medieval and Early Modern Europe*, eds. Marcia Kupfer, Adam S. Cohen, J.H. Chajes, (Turnhout, Belgium: Brepols, 2020), 148–49.

¹⁵³ Lilian Armstrong, “The Hand-Illuminated Printed Book,” in *The Painted Page*, 194.

company with that of Johannes de Colonia and Johannes Manthen after Jenson's death (Figure 34, hereafter referred to as Ugelheimer's Aristotle). The illumination of this book, now in the Pierpont Morgan Library (PML 21194, 21195), has been attributed to Girolamo da Cremona and assistants. Here, illusionistic tears and gaps in the folio of text at the beginning of volume I offer glimpses into a pastoral scene with putti, satyrs, deer, and the base of a classicizing monument. Yet, this fairly simple foreground-background relationship is complicated at the top of the folio where, in an open landscape, Aristotle debates with the Andalusian commentator pictured on a scale incongruent with the figures below.¹⁵⁴ Again, it cannot be both, and yet the torn parchment, like the choir screen, creates opportunities for simultaneous visual division and unification, for connections to emerge across a disjuncture of time and space.

In the second volume of Ugelheimer's Aristotle, on the first page of the *Metaphysics*, the text appears to hang from monumental candelabra that also serve as balusters along a balcony (Figure 35). While this space appears more unified than other "torn parchment" illuminations, there is a constant play between reading it as an interior courtyard—helping to justify the presence of candles—or an exterior space, which would help to situate the wild animals resting on lush foliage below. The metal spikes atop these gilt bronzes—intended to hold wax candles—suggest that they are not merely decorative nor are they the architectural load-bearing candelabra-columns that emerged around this time.¹⁵⁵

¹⁵⁴ This incongruity may be considered in relation to the challenging figures on the frame of Bellini's Pesaro altarpiece and the shift in scale of free-standing saints atop the Frari choir screen.

¹⁵⁵ In the first treatise, Francesco simply writes that "there are also baluster and candelabra columns, which are very ornate and made with graceful skill." Francesco di Giorgio Martini, *Trattati di Architettura ingegneria e arte militare*, ed. Corrado Maltese, two vols. (Milan: Il Polifilo, 1967), 1:62 and 2:413. As cited in: Michael J. Waters, "Candelabra-Columns and the Lombard Architecture of Sculptural Assemblage," in *The Art of Sculpture in Fifteenth-Century Italy*, eds. Amy Bloch and Daniel Zolli (Cambridge, UK: Cambridge University Press, 2020), 344–366.

However, as a visual device, the candelabra are ideal for invoking the kind of composite, intentionally indeterminate space of the illumination. As Michael J. Waters has characterized them, *all'antica* candelabra were, “the result of an elastic mode of assemblage” and “citational hybrids produced by combining representations of heterogenous objects, some of which were implicitly ancient.”¹⁵⁶ Along with the satyrs, pendants with cameos, and *all'antica* architectural citations already explored across Ugelheimer’s library, the candelabra situate the text as both a rediscovery of ancient authorship *and* the result of fifteenth-century technologies for the reproduction and recombining of antiquity. Furthering this message, the title at the top of the folio *Liber primus metaphysice* appears as a *cartellino* impaled on the fictive candlestick—serving as a stubborn reminder that the Albertian depth created through illumination is always, in fact, at the surface of the printed page.

The balcony with candelabra balusters above an arcade may have made specific architectural reference to Italian choir screens. As most screens were removed from Italian churches by 1600, visual evidence must be drawn from the few that survive and the traces left by those removed including drawings, prints, and paintings made before their destruction as well as the architectural scars left after their destruction. In her watershed 1974 article, Marcia Hall reconstructed the choir screen which once stood in the church of Santa Croce in Florence based on foundations revealed in the wake of the 1966 flood.¹⁵⁷ Her isometric reconstruction of the Florentine *tramezzo* proposes a two-story structure with an arcade below and a balustraded balcony above (Figure 36). While Hall’s recreation suggests pointed, gothic arches along the balcony of the Santa Croce *tramezzo*, candelabra may also have been a possibility as in the Counter Reformation example now in the Victoria and Albert Museum completed around 1613

¹⁵⁶ Waters, “Candelabra-Columns,” 350.

¹⁵⁷ Marcia Hall, “The ‘tramezzo’ in Santa Croce, Florence, Reconstructed,” *The Art Bulletin*, 56 (1974): 325–41.

(Figure 37). Even after candelabra became part of an *all'antica* lexicon, they most commonly illuminated and demarcated sacred space including altars, tombs, and tabernacles.¹⁵⁸ In this way, the indeterminate space created by the balcony in the *Metaphysics* may directly relate to the simultaneously uniting and dividing space of Italian choir screens.

A final connection between illuminated torn parchment first folio pages and choir screens comes from the recent suggestion that among the accretions to the structure may have been panel paintings previously thought to be reserved only for the high altar. Over time, many screens became encrusted with panel paintings and votive frescos.¹⁵⁹ This encourages a reconsideration of the function of panel paintings beyond the altar and opens myriad visual possibilities on the surface of the choir screen. For example, the undefined space created by the illuminations considered above, including the urban setting in the “upper story” of Ugelheimer’s Justinian and the pastoral scene of debate between Aristotle and Ibn Rushd in Ugelheimer’s Aristotle may have been more adequately incorporated into a cohesive whole by a visual culture accustomed to the sophisticated relationships made possible by a physically and visually permeable choir screen, which at times included panel paintings. While the illuminations were perhaps not fully intended to evoke choir screens *per se*, illuminators and book readers of late-fifteenth-century Venice would have been equipped with these visual skills to create relationships and meaning across and through the layers of encrustation, architecture, and space.

2.3 Crossing into the *Studiolo*

While the visual relationships made possible by the choir screen may have participated in the Venetian visual culture shared with illuminated printed texts, the church interior is, of course,

¹⁵⁸ Waters, “Candelabra-Columns,” 350.

¹⁵⁹ Cooper, “Recovering the lost rood screens,” 239.

not primarily where classical and legal books would have been read. To establish how the setting for reading these printed and illuminated books may have inflected understanding in the light of the visual imagery adorning them, I turn to consider the newly emergent space of the *studiolo*. In the Quattrocento, the *studiolo* may have been something as simple as a trestle table in the corner of a bedroom or a hollow beneath a staircase.¹⁶⁰ At the other end of this spectrum were sumptuously appointed, purpose-built rooms separated from bedrooms with built-in shelving and insulating wood paneling, and even supplied with specially blended potpourri to refresh the mind and deter book-hungry pests.¹⁶¹ In the *studiolo* imagined by Antonello da Messina for St. Jerome (Figure 24), the raised, wooden platform bears a striking resemblance to the real-world *studiolo* created for Lorenzo di Pierfrancesco de' Medici.¹⁶² However, compared with other depictions of these wood-clad *studioli*, Antonello has—for the sake of a better view—removed the crucial outer wooden paneling that protected the reader from enervating drafts. In doing so, the artist offers an unusual glimpse *through* the thresholds that cut off access and made the *studiolo* a place of privacy and intimacy.

Physically entering *studioli* involved crossing these multiple thresholds. Hinged doors and partitions granted or denied access to the *studiolo* and thus guaranteed exclusivity. Unlike protective exterior doors, internal doors and shutters established boundaries between two spaces: the larger space of a noble home and the entrance of a small *studiolo*, or the front of a large covered cabinet (*armario*). There is evidence to suggest that these doors were often painted.¹⁶³

¹⁶⁰ Dora Thornton, *The Scholar in his Study: Ownership and Experience in Renaissance Italy* (New Haven: Yale University Press, 1998), 53.

¹⁶¹ To make your own Quattrocento library potpourri, see: Jon Pearson Perry, “Practical and Ceremonial Uses of Plants Materials as ‘Literary Refinements’ in the Libraries of Leonello d’Este and His Courtly Literary Circle,” *La Bibliofilia* 91, no. 2 (1989): 133.

¹⁶² Thornton, *Scholar in his Study*, 53–54.

¹⁶³ Susannah Rutherglen, “Painting at the Threshold: Pictures for Doors in Renaissance Venice,” *The Art Bulletin* 98, no. 4 (2016): 438.

The paintings adorning these spaces both related to and defined the function of those rooms.¹⁶⁴

Both solid and permeable, the doors of the *studiolo* generated meaning through the connections and separations they established in space.

Susannah Rutherglen has identified a panel by Carpaccio as a painted door decorating one of these boundaries. It was divided horizontally in the nineteenth century and now exists as two panels: one in the J. Paul Getty Museum (Figure 38, Figure 39)¹⁶⁵ and the other in the Museo Correr in Venice (Figure 40).¹⁶⁶ Aligned pictorial elements and woodgrain analysis have confirmed that the Getty scene of *Hunting on the Lagoon* once served as the distant landscape behind two Venetian women depicted sitting on a balcony in the Correr panel. On the reverse of the Getty panel, Carpaccio depicted a *trompe l'oeil* letter rack that participates in the tradition of *cartellini*, an illusionism found not only in more public panel painting, but also in the illuminated volumes stored in a *studiolo* behind such a door. When closed, the panel may have hinted at the function of each space: the depicted letters referencing the written correspondence taking place in the *studiolo* on one side and, on the side of the noble home, an appropriate scene of elite Venetian leisure. Held to be the earliest surviving Venetian still life, the letter rack establishes the type of visual analysis invited by the decoration of a *studiolo*. Contrasting with the Albertian perspectival construction of the panel's lagoon scene, the flat illusionistic surface of the letter rack rewards close, critical analysis of its handling of paint and the many inscriptions which range from legible to mere suggestions of text. It is with this critical eye, and in this setting, that we may return to consideration of the illusionistic torn parchment of printed texts.

¹⁶⁴ Monika Schmitter, "The Quadro da Portego in Sixteenth-Century Venetian Art," *Renaissance Quarterly* 64, no. 3 (Fall 2011): 693–751.

¹⁶⁵ J. Paul Getty Museum accession number 79.PB.72

¹⁶⁶ Museo Correr accession number Cl. I. n.0046. See also: Peter Humfrey, Susannah Rutherglen, Deborah Howard, et al. *Vittore Carpaccio: Master Storyteller of Renaissance Venice* (New Haven: Yale University Press, 2022).

While it is unlikely that all *studioli* had painted doors, many had thresholds of some kind and, once inside, the space itself was frequently enriched with constellations of images rich in learned associations. Perhaps the most well-known decorative assemblage is the cycle of elaborate wooden intarsia panels designed by Francesco di Giorgio Martini for Federico da Montefeltro's *studioli* in his palaces at Urbino and Gubbio. The Duke's study would have been replete with visual and verbal puns and associations.¹⁶⁷ For example, the panels feature illusionistic latticework shutters that appear open, closed, or ajar, encouraging the spectator to gaze "through" their openings at the scientific and musical instruments, armor, and other curios they contain.¹⁶⁸ Although Venetian patrons and publishers may not have entered the *studioli* at Gubbio or Urbino, within the aforementioned screen in the Frari, the choir stalls contain intarsia panels completed around 1468 by Marco Cozzi and a workshop of sculptors from Strasbourg.¹⁶⁹ Seven repeated and sometimes mirrored scenes depict urban environments that emphasize a series of thresholds receding through illusionistic space (Figure 41).

In addition to these extremely opulent extant panels, many descriptions of the carpentry of armaria used to store books make mention of visual decoration, as do representations of the rooms. Ugo Rozzo, in his analysis of late-Quattrocento Italian woodcuts depicting *studioli*, points to the common feature of a desk fitted with built-in book shelves secured behind locking doors (Figure 42). "On Literary Refinements" (*De politia litteraria*), written by Angelo

¹⁶⁷ These dense and erudite puns would have been ideal for "slow and pleasurable digestion" for the well-educated Quattrocento observer. See: Robert Kirkbride, *Architecture and Memory: The Renaissance Studioli of Federico da Montefeltro* (New York: Columbia University Press, 2008), 33.

¹⁶⁸ Kirkbride, *Architecture and Memory*, 39.

¹⁶⁹ There was also important illusionistic intarsia in the sacristy of the Basilica San Marco completed in three campaigns: first by the Florentine Tommaso Astorico from 1493–96; next, the Mantuan brothers Antonio and Paolo Mola created a majority of the works from 1497–1500; and finally in 1523 the cycle was completed by Vincenzo da Verona and Pietro da Padova. The date of a majority of these works falling after the period of printed book illumination reinforces Debora Howard's idea that book illumination informed and influenced other media, rather than the opposite. See: Umberto Daniele, "The Inlaid Cabinets in the Sacristy," in *St Mark's Basilica in Venice*, ed. Ettore Vio (London: Thames and Hudson, 2000), 152.

Decembrio in 1464, describing the literary culture of Leonello d'Este's court, features a dialogue between Guarino da Verona, Leonello's literary mentor, and Feltrino Boiardo, a prominent courtier. Guarino notes that the collection of books is more accurately called a *biblioplethora*, as *plethora* (πληθος, transliterated: *plethos*) relates to a large quantity, rather than *biblioteca*, which refers to the chest (θήκη, transliterated: *theke*) in which books are stored.¹⁷⁰ Guarino also describes shutting books behind panes of glass to prevent household dust from soiling the pages.¹⁷¹

Glass-encased bookshelves might have added a semipermeable, translucent threshold between viewer and text through which to construct meaning and authority. Yet, the mention of glass-encased books by Boethius is more critical. In *The Consolation of Philosophy* (*De consolatione philosophiae*) written in 523 AD, owners who decorated cabinets (*armadio/pl. armadii*) for storing books with ivory and enclosed them with glass doors were criticized for enriching the shelves more than their own minds.¹⁷² This suggests, at least in late antiquity, an impulse to surround books with thresholds of wood, ivory, and glass—and a snide critique cautioning against it.

However, the increased practice of constructing and furnishing a *studiolo* in the fifteenth century was often seen as a parallel to the ancient Roman practice, particularly in countryside villas. This classical citation even extended to the manner in which the books were stored, with some *studioli* containing bookchests built into the walls as described by Pliny the Elder.¹⁷³ To the savvy fifteenth-century humanist, the storage of books in chests, built-in cabinets, and perhaps

¹⁷⁰ The work was penned by Angelo Decembrio (c. 1415–c.1466). See: Jon Pearson Perry, “Practical and Ceremonial Uses of Plants,” 130.

¹⁷¹ *Ibid.*, 131.

¹⁷² Salvatore Battaglia, ed. *Il Boezio e l'Arrighetto nelle versione del Trecento* (Turin: Unione Tipografico-editrice Torinese, 1929), 36.

¹⁷³ Thornton, *Scholar in his Study*, 68–69.

behind glass, not only erected additional thresholds for physical protection and the construction of symbolic meaning, but perhaps also added to the classical authority of those texts thought to be stored according to classical convention.

2.4 Claims of Reproductive Accuracy and Authority

Having crossed the many thresholds into the exclusive and resonant space of the *studiolo*, it is possible now to analyze those illuminated motifs represented on printed first folios that are associated with the space. I argue that these frequently appearing features exposed both the fears surrounding the possibilities of movable type and the reassurances made through claims of increased accuracy and ancient authority. The depiction of coins, cameos, intaglio gems, seals, and signet rings—objects frequently stored and examined in *studioli* alongside texts—situated movable type within ancient technologies for visual reproduction and authorization: objects used to impress images or which were themselves the result of impression. While already part of the repertory of illuminators of manuscripts, the frequency of these motifs in printed books produced for the wealthiest levels of Venetian society suggests the imagery took on new associations.

While the print-heavy collections of Peter Ugelheimer and the Agostini were amassed by investors with an obvious bias toward the print industry, they point to the shifting value of print in this period. Evidence that early print was devalued relative to manuscript has been provided by the widely cited Florentine bookseller Vespasiano da Bisticci who famously sneered that, “...had there been one printed volume,” in the sumptuous library of Duke Federico da Montefeltro, “it would have been ashamed in such company.”¹⁷⁴ This firsthand account by the

¹⁷⁴ Emily Waters and W. George Waters, trans. *The Vespasiano Memoirs: Lives of Illustrious Men of the XVth Century* (Toronto: University of Toronto Press, 1997), 102–105. See also: Vespasiano da Bisticci, *Vite di Uomini Illustri del Secolo XV*, trans. Paolo d’Ancona and Erhard Aeschlimann (Milan: Editore Ulrico Hoepli, 1951), 213: “In quella libreria i libri tutti sono belli in superlativo grado, tutti iscritti a penna, e non ve n’è ignuno a stampa, che se ne sarebbe vergognato; tutti miniate elegantissimamente, e non v’è ignuno che non sia iscritto in cavretto.

manuscript seller who profited handsomely from the Duke’s thirty-thousand-ducat expenditure—and who openly despised the threatening rise of print—rarely receives analysis or contextualization.

In fact, the ducal collections did contain printed books.¹⁷⁵ They were cataloged under an unusual Greek term meaning “those which have been engraved” (ἐγγραφαχθεῖσα, transliterated: *énkhaphakhtheĩsa*) and stored separately in a space known as the “other library” (*altra biblioteca*). An inventory drawn up five years after Federico’s death demonstrates that the duke owned at least fifty printed books.¹⁷⁶ The vast majority of these texts were printed in Latin and were then used as exemplars to be copied *into* manuscript. In contrast, the heavily ornamented manuscripts of which Vespasiano boasted were faulted in his lifetime for being more beautiful than reliable. As investigated further below, many of the texts in the library were criticized in a letter from Agnolo Ambrogini (called Poliziano) to Piero di Lorenzo di Medici for being “new and corrupt” (*nuovi e corrotti*) transcriptions, which ultimately reflected badly on their owner.¹⁷⁷

Indeed, this shift in opinion was occurring in the few short decades since 1469 when print had arrived in Venice. By 1489, Baptista da Guarino—the youngest son of Guarino da Verona—wrote to Pico della Mirandola expressing his preference for buying printed books over manuscripts, since they offered a more reliable text.¹⁷⁸ While the earliest printed books may have

¹⁷⁵ Luigi Michelini Tocci, “La formazione della biblioteca di Federico da Montefeltro: Codici contemporanei e libri a stampa,” in *Federico di Montefeltro: lo stato, le arti, la cultura*, ed. Giorgio Cerboni Baiardi, Giorgio Chittolini, Piero Floriani (Roma: Bulzoni Editore, 1986), 9–18.

¹⁷⁶ *Ibid.*, 17.

¹⁷⁷ Alison Wright, *Frame Work*, 273. See also: Cecil H. Clough, “The Library of the Dukes of Urbino,” *Librarium: Revue de la Société des bibliophiles suisses* 9, no. 2 (1966): 102. Gino Franceschini, *Figure del Rinascimento Urbinate* (Urbino: S.T.E.U., 1959), 141.

¹⁷⁸ By this time Pico della Mirandola’s library consisted mostly of printed books as well. See: Nicolas Barker, “The Invention of Printing: Revolution within Evolution,” *The Quarterly Journal of the Library of Congress* 35, no. 2 (1978): 73.

shared in transmitting corrupt texts, the benefit of faster, more affordable reproduction meant that comparison could be made among scholars as a precursor to emendation.

2.5 Antique Objects in the Service of Print

In a dedicatory letter published in 1471 printed by Jenson's press, Ognibene da Lonigo described Jenson as a "new Daedalus," by whose inventive powers the book was not written with a pen, but rather impressed like "setting gems in wax."¹⁷⁹ In fact, Jenson's was not the only editor eager to connect the new technology with ancient media. Nicolas Gupalatinus described Clement of Padua's text as, "letters being set like signet rings to print their images in wax."¹⁸⁰ Previous scholarship has understood these letters—written within four days of each other—as a race by the publishers to claim to be the first to introduce print in Italy.¹⁸¹ This seems unlikely as Konrad Sweynheim and Arnold Pannartz had already established their press at the Benedictine abbey of Subaico, near Rome, in 1464—at least five years before movable type entered Venice. Instead, this group of letters can be read within the desire to situate print within earlier technologies of reproduction in a way that conferred the authority of antiquity to their publication.

Visual analyses of the illuminated first pages of presentation copies produced by Jenson for his investors often describe the Roman architecture, festoons, bucrania, and putti, as signals of material wealth and antiquity.¹⁸² The pendants of pearls and gems have been associated with

¹⁷⁹Catalogue of Printed Books now in the British Museum 5: 168–9, "Accedebāt iustæ preces magistri Nicolai Ienson Gallici alterius (ut uere dicā) Dædali: qui librariæ artis mirabilis inventor: non ut scribantur calamo libri: sed ueluti gēma imprimantur: ac prope figillo primus omnium ingeniose mōstrauit."

¹⁸⁰ Lowry, *Nicolas Jenson*, 58.

¹⁸¹ *Ibid.*, Lowry states: "It is certainly clear from the allusions to 'Daedalus' or to 'impressing gems in wax', that a common rhetoric was emerging and that priority—being first in Italy, first in quality, or quite simply 'first' was an important part of it."

¹⁸² Lowry, *Nicolas Jenson*, 84; Elizabeth Ross, "The Reception of Islamic Culture," 139–40; Nicholas Herman, "Excavating the page," 205.

the accessories of affluent book ownership including luxury paperweights or bookmarks.¹⁸³ In a more metaphorical sense, the concentration of gems and cameos may be understood to represent the “virtues” to be gleaned from disciplined engagement with the text.¹⁸⁴ While these arguments work well when interpreting the illuminated first folios in printed books as an extension of the manuscript tradition, I propose a reading of these illuminated elements rooted in the new print technology.

Although some of these *all’antica* objects may simply set the scene for classical, humanistic, and late antique texts, the presence of what I am calling “reproductive objects” is conspicuous. This category includes objects that are the product of a reproductive technology (reliefs) and those that make the reproduction possible (matrices). For the illuminators who worked closely with Jenson, including Benedetto Bordon, Girolamo da Cremona, the Master of the Seven Virtues, and the Master of the Pico Pliny, this resulted in the frequent depiction of intaglio gems, coins, medals, and wax impressions.

To these more obvious forms of reproduction, I add what appear to be illuminated representations of cameos. Desirable or well-known ancient intaglio gems were often cast and copied in bronze, wax, or plaster for dissemination to artists and humanist antiquarians. While the overall iconographical features of intaglio gems could be communicated through the opaque wax or bronze, the colors and refractive qualities of the engraved gems were often lost in the new medium.¹⁸⁵ The appearance of the precious stones was then “recovered” through their depiction as high-contrast, black-and-white cameos in illuminated first folios and initials. Evidence for this practice is explored in greater detail below; well-known ancient gems owned by the Medici and

¹⁸³ Herman notes that this is closely linked to humanist material culture. See Herman, 205.

¹⁸⁴ Herman, 204.

¹⁸⁵ Toby Yuen, “Glyptic Sources of Renaissance Art,” in *Engraved Gems: Survivals and Revivals*, ed. Clifford Malcom Brown, National Gallery of Art, Washington (Hanover: University Press of New England, 1997), 138.

the Venetian numismatist Pope Paul II were copied, distributed, and reborn as cameos alongside printed texts.¹⁸⁶ As another addition to this visual lexicon of reproduction, I propose considering a more broadly defined style of decoration including monochromatic or grisaille illumination which imitates the appearance of a matrix impressed on a monochromatic support such as wax, clay, or metal; and gold ink figures on solid grounds, which seek to reproduce the refractive qualities of light interacting with intaglio gems.

Admittedly, this list risks the reading of reproduction into any monochromatic element. Yet, the reproduction of certain architectural forms was known and practiced in the ancient world.¹⁸⁷ It was also widely utilized in reproductive terracotta sculpture of the fifteenth and sixteenth centuries, such as the workshop of the della Robbia.¹⁸⁸ Whether or not the illuminators of Jenson's printed texts were aware of ancient Roman stucco molds or the innovative Florentine family, they were likely familiar with the monochromatic impressions of wax seals and minted coins with which they conducted commerce or the business of the Church.

Having defined this category, I turn to the prodigious visual evidence within the illuminations of Ugelheimer's library. Consider the illumination attributed to Girolamo da Cremona and the so-called Master of the Seven Virtues for the first folio of Gratian's *Decretum* (Gotha Forschungs Bibliothek, Mon. Typ. 1477, 2° 12) published by Jenson in 1477 and presented to Ugelheimer (Figure 44, hereafter, Ugelheimer's Gratian). Set in golden scrollwork,

¹⁸⁶ Cameos themselves may have been understood as a reproductive technology as Albertus Magnus mistakenly understood ancient cameos to be stones which were naturally "impressed" with the images they contained by way of the influence of celestial bodies. See: Katharine Park, "Impressed Images: Reproducing Wonders," in *Picturing Science, Producing Art*, ed. Caroline A. Jones and Peter Galison (London: Routledge, 1998), 254–271, particularly 258.

¹⁸⁷ Over one hundred examples of matrices and positives were recovered from the Italian excavations at Sabratha in present-day Libya. See: Giuseppina Barone, et al. *I Gessi di Sabratha: Anticipazioni e Problemi* (Rome: L'Erma di Bretschneider, 1994).

¹⁸⁸ Maria Grazia Vaccari, "Le Robbiano: Appunti sulla tecnica e sugli aspetti commerciali," in *I Della Robbia: Il dialogo tra le Arti nel Rinascimento*, ed. Giancarlo Gentili (Milan: Skira, 2009), 85.

seventeen black-and-white illuminated cameos frame the beginning of the text and an additional six frame the architectural monument on the facing folio (Figure 43). Within Ugelheimer's Justinian, there are three cameos illuminated by Benedetto Bordon: one above the text, one possibly set in a ring "behind" the right column of torn parchment, and one suspended to the right of the text (Figure 16). An intaglio gem with a silhouetted figure is tucked neatly in the initial h (Figure 45). This male figure with one raised arm likely references the second-century B.C. bronze known as the Terme Ruler or Hellenistic Prince (Figure 46),¹⁸⁹ a similar figure can be seen in a first-century B.C. engraved cornelian ring stone long held in the Marlborough collection (Figure 47).¹⁹⁰ This illumination of an intaglio gem, which reproduces the ancient bronze, relates directly to a printed text which has been reproduced through impression.

Perhaps most relevant to this reading of reproductive objects is the red object set within scrolling metalwork suspended from the right side of the entablature (Figure 16). This could be understood as gem set within a ring for use as a signet. Yet, the seated, winged figure appears in relief, eliminating the reproductive function of the gem as a matrix. Another possibility is that it represents a positive wax impression produced by an engraved gem. While other illuminated devices depict matrices from which impressions may be created, this would indicate, instead, the *product* of such reproductive technologies.

These reproductive objects were certainly not limited to presentation copies for those in close contact with Jenson. The Trivulziana Suetonius opens with a full-page illuminated portrait medal of Julius Caesar facing the *all'antica* monument. After this oversized depiction of Julius

¹⁸⁹ Paul Zanker, *The Power of Images in the Age of Augustus* (Ann Arbor: The University of Michigan Press, 1988), 4–5.

¹⁹⁰ A description of the gem can be found in Claudia Wagner and John Boardman, *Masterpieces in Miniature: Engraved Gems from Prehistory to the Present* (London: Philip Wilson Publishers, 2018), cat. 179. The gem sold as Lot 32 in an auction at Christie's on 14 April 2022 for \$126,000 to an undisclosed buyer.

Caesar, the other eleven illuminated profiles are located at the *bas-de-page* of the beginning of each *Life*. They are on a scale commensurate not with the ancient coins they depict but with the *all'antica* portrait medals popularized by Pisanello in the 1430s and widely collected by elite patrons and stored in specialized chests in *studioli*. The hand illumination of these reproductive objects not only framed the printed text within similar ancient technologies, numismatics were understood as a primary source for the detailed recovery of the ancient world.¹⁹¹ Their illuminated presence next to print offered humanist readers the opportunity to examine the profile, physiognomy, and perceived virtue of each leader.

This move, to classicize the innovative process of movable type via the depiction of ancient reproductive technologies, coincides with the larger Venetian need to invent an ancient civic past. The history of Venice is often characterized by a desire to invent a classical history that would confirm its tenuous connection with the Roman imperial past rather than its true foundations in late antiquity and Byzantium.¹⁹² Venetian collectors addressed this lacuna via multiple avenues. In the first half of the fifteenth century in particular, collectors focused on small-scale artifacts including coins, seals, and gems. Portable and still fairly available, by the 1430s, antique coins and gems were an important component of Venetian collections.¹⁹³ This was also evidenced by the interest paid to Cyriacus of Ancona (Ciriaco di Pizzicolti) who brought with him ancient gold and silver coins as well as seals during his visit to Venice in 1432–33. One of the most renowned of these collections was brought together by Venetian

¹⁹¹ Luke Syson and Dora Thornton, *Objects of Virtue*, 2001.

¹⁹² Patricia Fortini Brown, *Venice and Antiquity: The Venetian Sense of the Past* (New Haven: Yale University Press, 1996), 9.

¹⁹³ Fortini Brown, 104.

Cardinal Pietro Barbo (later Pope Paul II).¹⁹⁴ Although the Florentine Lorenzo de' Medici is frequently lauded for his exemplary collection of numismatics, this was due in large part to his acquisition of Pope Paul II's unparalleled collection of ancient coins and gems after the Pope's death.

Ancient technologies for the reproduction of images and texts existed long before the introduction of movable type in the west. The semiotic authority carried by seals derived from their primary function of impression, by which the negative intaglio is transformed into a positive image in wax or clay.¹⁹⁵ Andreas Grüner expands upon this to explain that an imprint from a sealing stone or signet is extremely reliable because the print bypasses a “mediating individual” which would be required to reproduce other media such as drawings or paintings.¹⁹⁶ Instead, the mechanically reproduced image protects against forgery and bears the “aura” of the individual who impressed the image. Yet, the technology and resulting authority ascribed to the seal embodies a paradox. The elimination of the mediating individual suggests mechanical accuracy. Yet, the seal must be handmade by exactly such a “mediating individual.”¹⁹⁷ While each mechanically reproduced impression bore high fidelity to the matrix, the image itself was handmade, the depth and handling of which was of utmost importance in verifying signet and seal.

¹⁹⁴ Beyond having the means to amass this collection, Barbo was renowned by his contemporaries Enea Silvio Piccolomini, Gaspare da Verona, and Michele Canensi for his numismatic knowledge. Handwritten notes in an inventory of the collection created in 1457 demonstrates his awareness of genuine or forged coins. See: Roberto Weiss, *The Renaissance Discovery of Classical Antiquity* (Oxford: Basil Blackwell, 1969), 168–69.

¹⁹⁵ Verity Platt, “Making an Impression: Replication and the Ontology of the Graeco-Roman Seal Stone,” *Art History* 29, no. 2, April (2006): 238.

¹⁹⁶ Andreas Grüner, “Antike Reproduktionsmedien: Siegel und Münze zwischen Serialität und Authentizität,” in *Multiples in Pre-Modern Art*, ed. Walter Cupperi (Zürich-Berlin: diaphanes, 2014), 73.

¹⁹⁷ Grüner, “Antike Reproduktionsmedien,” 74–75.

Returning to the fifteenth century, the illuminated intaglio gems and coins surrounding a printed text were also achieved by hand, through illumination, rather than mechanically, through impression. In connecting the perceived authority of these illuminated devices to the mechanically reproduced text, we should consider that the movable type also represents this paradox, having originated from human editors, typesetters, and metalworkers. Just as the presence of a seal *exposed* fears of forgery, these visual claims of mechanical accuracy illuminated alongside the text belie anxieties of errors introduced—and all too easily reproduced—by the new technology.

While an elite Quattrocento society may not have been aware of all nuances embodied in the ancient seal, biblical references to seals in the Revelation of St. John and the ongoing bureaucratic use of signets and wax seals—often stored and employed in *studioli*—would have informed viewers of the authority of these illuminated devices. It is particularly compelling that these authoritative reproductions often appear at the *opening* of the text or the beginning of individual chapters. While these seals are not literally broken to access the text, they are physically and visually confronted at the threshold. We see a representation of the formal use of seals in the presentation copy of Ugelheimer's Justinian. In a ten-line high illumination at the beginning of Book VI, a minister unfurls a long scroll toward the figure of a seated Ulpian (Figure 48). Hanging from the scroll by two red cords is a relatively large red wax seal trimmed with gold. This scene of opening an authorized document falls deep within the text block, but recalls the seals and intaglio gems at the opening of the book itself.

Not only did these ancient objects reproduce an image via impression, they themselves were frequently copied through the use of glass paste or by recreating a matrix from a wax or clay impression. This reproduction continued during the fifteenth and sixteenth centuries when

the collecting and studying of ancient gems gained popularity and prestige among humanists in Venice and beyond. Many of the cameos and gems illuminated in texts referenced ancient examples that were only known through intermediary sources.¹⁹⁸

In addition to the illuminated depiction of the Terme Ruler in Ugelheimer's Justinian, Ugelheimer's Gratian likely also replicates a well-known ancient gem. An illuminated initial O on folio 4v contains the figures of a seated Apollo and restrained Marsyas (Figure 49). Angela Nuovo argues that this is an inexact replica of the so-called "Seal of Nero," a late-first century BCE carnelian carved by Dioskourides (Figure 50).¹⁹⁹ Now often associated with the Medici as one of the most valuable gems in Lorenzo de' Medici's collection, the desirable intaglio only came to Lorenzo via the collection of Venetian Pope Paul II.²⁰⁰ Evidencing the high esteem with which he held the gem, Paul II commissioned a bronze portrait medal from Cristoforo di Geremia in 1464 depicting the patron on the obverse, and a cast of the "seal of Nero" on the reverse (Figure 51). Here, rather than an exact copy of the intaglio matrix, the medal represents the subject in relief—as if it had actually been impressed into the bronze.

The figures of the gem were also reworked in the reliefs in the courtyard of *Palazzo Medici*. The frieze labeled *Quies*, or rest/repose, reverses the position of Apollo and Marsyas (Figure 52). Apollo's lyre has been replaced with a smaller *lira da braccio* and Marsyas is no longer bound but reaches toward the musician.²⁰¹ Although some of these intermedial translations may represent unintentional mirroring or accidental adaptation of the ancient gem,

¹⁹⁸ This phenomenon is confirmed by manuscripts of Ptolemy's *Geography* and Didymus' *De spiritu sancto*, which depict known Medici gems as cameos. See: Yuen, "Glyptic Sources of Renaissance Art," 138.

¹⁹⁹ Angela Nuovo, "Bücher für Italien: das Handelsnetzwerk der venezianischen Compagnia," in *Hinter dem Pergament: Die Welt der Frankfurter Kaufmann Peter Ugelheimer und die Kunst der Buchmalerei im Venedig der Renaissance*, ed. Christoph Winterer (Frankfurt: Hirmer, 2018), 170.

²⁰⁰ For an extended provenance of the gem, including the Venetian cleric Lodovico Trevisan, see: Tim Shephard et al., eds. *Music in the Art of Renaissance Italy: 1420–1540* (London: Harvey Miller, 2020), 193.

²⁰¹ James David Draper, *Bertoldo di Giovanni: Sculptor of the Medici Household* (Columbia: University of Missouri Press, 1992), 241–42.

the liberties taken in the Medici courtyard by Bertoldo di Giovanni suggest an openness to interpretation and transformation.

The flexibility and acceptance of physical differences among replicas proposes that the reproduction of these motifs may not have been operating within western notions of “aura” at all, but something closer to what Hsueh-man Shen has discerned as “authentic replicas” in her investigation of the ontological efficacy of reproduced objects within Medieval Buddhist China. Rather than bearers of aura, sacred Buddhist texts and images—which were being reproduced via woodblock, xylograph, and movable type long before European print reached such sophistication—were understood as extensions of the source. Because they are the result of reproductive technologies (e.g. printing, rubbing, casting), all examples are understood to be equally true. The temporal dimension is removed, physical differences are ignored, and ontologies of copy and original are merged.²⁰²

Copying gems and cameos via reproductive technologies not only satisfied humanist collectors, it provided a material record of transient stones which frequently circulated on short term loan, as collateral, or as debt repayment.²⁰³ These value-dense objects were endowed with antiquity while also absorbing the clout of contemporary collectors as they passed from one cabinet or *studiolo* to the next. Although their copying across media may have altered their appearance, their presence in illumination provided an opportunity to fix these transient objects within the space of the codex, impressing both ancient authorization and the personalities of powerful contemporary owners alongside the authoritative text. Within the space of a single first

²⁰² Hsueh-man Shen, *Authentic Replicas: Buddhist Art in Medieval China* (Honolulu: University of Hawai’I Press, 2019), 234.

²⁰³ Leah R. Clark, “Transient Possessions: Circulation, Replication, and Transmission of Gems and Jewels in Quattrocento Italy,” *Journal of Early Modern History* 15 (2011): 188.

folio, the trajectories of semiprecious stones and classical texts momentarily intersected and mutually legitimized one another.

Coins and their connections to ancient reproduction are present not only within illuminated first folios but also occasionally on the leather covers of particularly lavish presentation copies. Anthony Hobson's seminal work has yielded a corpus of these bindings, known as humanistic or plaquette bindings.²⁰⁴ In particular, I wish to consider a subsection of Ugelheimer's library containing some of the most elaborate bindings known in Europe at the time. Of Ugelheimer's fifteen printed books, eight have bindings utilizing ornamental forms and types of metalwork originating in the Islamic world.²⁰⁵ While Hobson assigned these to three different Paduan workshops, Andrea Lermer has argued that they were all produced by a single Venetian workshop between 1475 to 1485, working closely with both Ugelheimer and Jenson.²⁰⁶ Lermer has explained the appearance of elements of Mamluk and West Persian design in the bindings to the presence of ambassadors sent by the Aq Qoyunlu ruler Uzun Hasan (r. 1453–1478).²⁰⁷ Reference to such objects embody important global exchange at a time when Venice was otherwise excluded from trade with the Ottoman Empire (1453–1479). Particularly relevant to this discussion are the two West-Persian-informed bindings which also contain wax impressions of ancient Roman coins: Ugelheimer's Gratian (Figure 53, Figure 54), and Ugelheimer Justinian (Figure 55, Figure 56), both printed by Jenson in Venice in 1477. The translation of coins into wax reliefs embedded on the cover speaks to Jenson's expertise in the

²⁰⁴ Anthony Hobson, *Humanists and Bookbinders: The Origins and Diffusion of the Humanist Bookbinding 1459–1559 with a census of historiated plaquette and medallion bindings of the Renaissance* (Cambridge: Cambridge University Press, 1989), see especially, 52–55 and 91–127.

²⁰⁵ See: Andrea Lermer, "Die Renaissance-Einbände für Peter Ugelheimers Bücher und ihre Islamischen Vorbilder," in *Hinter dem Pergament: Die Welt der Frankfurter Kaufmann Peter Ugelheimer und die Kunst der Buchmalerei im Venedig der Renaissance*, ed. Christoph Winterer (Frankfurt: Hirmer, 2018), 203–223, particularly 222.

²⁰⁶ Lermer, 203.

²⁰⁷ Lermer, 218.

mint and reinforces Andrea Lerner's notion that the bindings were made by a single workshop in "mediating contact" with Jenson.

These covers contain undulating calligraphic lines in hand-cut and gilt leather pieces affixed over blue, white, and green textile. At the center of the kaleidoscopic container for Ugelheimer's Justinian are six roundels containing wax casts of ancient coins—one impression is now missing from the lower cover and two are now missing from the upper cover.²⁰⁸ Although Elizabeth Ross categorized these as "faux" Roman coins, Lerner identified each figure: one portrait of Diva Faustina I, six impressions of the Emperor Nero, and four impressions of Antoninus Pius.²⁰⁹ While the spousal relationship between Antoninus Pius and Faustina the Elder suggests a logical grouping, the presence of the oft-maligned emperor Nero must be addressed. Nero's infamous biography was known in the fifteenth century through Suetonius' *Twelve Caesars (De Vita Caesarum)*, an edition of which was published by Jenson himself, as seen in the Trivulziana copy. Nevertheless, objects depicting and associated with Nero continued to draw humanist attention and command some of the highest prices for coins on the fifteenth-century antiquarian market.²¹⁰ The aforementioned portrait medal of Pope Paul II borrowed classical imagery from the so-called "Seal of Nero" and the inventory created after the pope's death records an additional six engraved gems ("*intailles*") of Nero.²¹¹ While on one hand this

²⁰⁸ While scholars agree that the binding is original to the printed text, my firsthand visual analysis suggests evidence of an early conservation campaign for both Ugelheimer's Justinian and Gratian. In particular, the Gratian [Mon Typ. 1477, 2° (12)] has been unbound, the folios have been trimmed, and the leather on the spine replaced. Most significantly, when rebound, the cover was replaced upside-down in relation to the direction in which the wax figures face (i.e. the heads face down when the text is upright).

²⁰⁹ Note that Ross uses "faux" and "*all'antica*" seemingly interchangeably. See: Elizabeth Ross, "The Reception of Islamic Culture in the Book," 131. For Lerner's identifications, see Lerner, "Die Renaissance-Einbände für Peter Ugelheimers Bücher," 216.

²¹⁰ Luke Syson and Dora Thornton have also observed that coins depicting Nero were in high demand in humanist circles and were often subjected to "informed restoration" to heighten their desirability for fifteenth century collectors. See: Luke Syson and Dora Thornton, *Objects of Virtue*, 106–107.

²¹¹ Eugène Münz, *Les Arts à la Cour des Papes Pendant le XVe et le XVIe siècle* (Hildesheim: Olms, 1983), 2:141.

may suggest a literal papal seal of approval, on the other hand, Nero represented the ever-present threat that humanistic study would not necessarily result in good government.²¹² Perhaps the repeated presence of Nero the cover of Ugelheimer's Justinian, illuminated in the Trivulziana Suetonius, the Papal portrait medal, and coins fetching high prices, suggests a highly complex reputation that served as a historical warning against poor government, anti-Christian sentiment, and overindulgence—or simply an infamous malefactor of the ancient world who fascinated and whose significance was not taken literally.

The illumination of the coin of Nero in Jenson's edition of the *Twelve Caesars* (Figure 57) and the coin impressions on the cover of Ugelheimer's Justinian bear a striking resemblance. Yet, the legend on the illuminated coin is rotated roughly 90 degrees. Whether the matrices for the cover were made directly from an ancient coin or approximated in an *all'antica* style, the similarity to the images in the illuminated Suetonius suggests the presence of an ancient exemplar—perhaps owned by Jenson—and lent, or more likely reproduced and distributed, as a model for illuminators, binders, goldsmiths, or metalworkers to endow their objects with the authority of antiquity and conjure up the complex presence of Nero.

Most significantly, the translation from an ancient coin to wax relief cast on Ugelheimer's Justinian and Gratian bindings carried material significance. Translating identifiable coins into wax relief, particularly when ancient wax seals were also well known, indicates that it was not only the sealing or impression that was meaningful but also the act of translation itself. This intermedial translation was central to the new technology of movable type which mobilized the skills of the goldsmith, the technology of screw presses, and knowledge of

²¹² This was further evidenced by the inclusion of Nero in Ambrogio Lorenzetti's allegory of Bad Government below the figure of Tyranny. Peter Stacey "The Image of Nero in Renaissance Political Thought," in *The Cambridge Companion to the Age of Nero*, ed. Shadi Bartsch *et al.* (Cambridge: Cambridge University Press, 2017), 298.

the construction of codices to translate manuscript into print. The early modern invention of printing—in western Europe—not only developed new media practices but also initiated intense theoretical reflection on intermedial practices, syntheses, and differentiations, which Jörg Robert has connected to the rising popularity of the early modern debate of *paragone*.²¹³ The translation of coins from ancient objects, to illumination, to wax relief/seals exemplifies the debates and possibilities surrounding print in the fifteenth century.

This complex intermediality required matrices that translated ancient coins into wax inlays, a technological and material feat which referenced Jenson's expertise in the production of dies and matrices due to his experience in the French mint. This *technē* developed in the mint also translated into the creation of more durable punches, cast in steel. These punches could create greater numbers of brass matrices from which the relatively soft lead type was cast. This innovation meant that the punches could be used longer than most early typefaces. It also allowed Jenson to create more, longer-lasting punches than he needed and to sell the surplus to other printers.²¹⁴ Jenson's will of 1480 stipulated that these valuable steel punches—the *means of the means of production*—would pass to Peter Ugelheimer personally rather than becoming property of the publishing firm. The impression of ancient coins on the cover of Ugelheimer's presentation copy reified and materialized the business partnership while likely referencing Jenson's extraordinary command of print media, which had been gained in the context of minting coins.

²¹³ Jörg Robert, *Intermedialität in der frühen Neuzeit: Formen, Funktionen, Konzepte* (Berlin: Walter De Gruyter, 2017), 3–4.

²¹⁴ Hellinga, "Nicolas Jenson & Peter Ugelheimer," 163.

2.6 Anxieties over Reproduction in Paint and Print Regulation

While publishers were eager to defend the accuracy of their classical and legal texts via illusionistic illumination and ostentatious claims in dedicatory letters, the promise of print also brought with it fears of unbridled multiplication of low-quality works. The earliest call for control over the printing press came in 1470 from Niccolò Perotti, Bishop of Siponto in southern Italy.²¹⁵ Perotti warned that printing placed the Latin language in danger of perishing amid a flood of corrupt texts.²¹⁶ To avoid these ills, Perotti suggested implementing a number of universally accepted editorial practices and to have someone “charged by papal authority” to oversee the work of printing. Instead, publishers like Jenson relied on identifying authoritative versions of the ancient texts, proofreading to catch errors in the typesetting, strategizing the visual appearance of type, and ornamenting the printed volumes to ensure wealthy patrons of the accuracy of the printed text they had invested in and were welcoming into their collections.

Publishers sought to quell this anxiety over the accuracy of printed books as they claimed print privileges. Nearly one in five print privileges issued before 1517 makes reference to the text in question as being “correct” or to the process of “correction.” Since privileges were awarded to unique titles, casting doubt upon the accuracy of previously printed texts was a rhetorical maneuver that worked in favor of the granting of a new privilege for an already claimed title. For example, in 1494, Lazzaro Soardi successfully persuaded the Council of Ten to award him a privilege to produce a new edition of Cicero’s *Opera* by arguing that the current editions were most incorrect (*incorrectissimi*).²¹⁷ Eventually, rather than denigrating previous editions, the privileges reflect an attempt to outdo earlier emendations with claims like “new corrections”

²¹⁵ John Monfasani, “The First Call for Press Censorship: Niccolò Perotti, Giovanni Andrea Bussi, Antonio Moreto, and the Editing of Pliny’s Natural History” *Renaissance Quarterly* 41, no. 1 (Spring, 1988), 3.

²¹⁶ *Ibid.*, 8.

²¹⁷ ASV, CN, Reg. 14, Fol. 103v (Fulin, 112–113, 25).

(*nova correctione*), “very correct” (*molto correcto*), “generously corrected” (*bontà correcte*), and the “most correct” (*correctissimi*).²¹⁸ This rhetoric of correctness became so common that a publisher’s “correction” was almost synonymous with what would now describe an edition.

The currency of these terms is reflected in Poliziano’s critique of Federico da Montefeltro’s manuscripts as “new and corrupt” (*nuovi e corrotti*), which he contrasts with the most ancient and most correct (*antiquissimi e corretissimi*) manuscripts in the Medici library at San Marco.²¹⁹ In contrast, print privileges frequently claim their text to be “new and correct” (*nuovi e correcte*). While publishers mobilized “correctness” as a currency to secure print privileges beginning in the 1490s, from the years from 1469 to 1492 only two privileges were successfully garnered. I suggest that during this time presentation copies *visually* represented these claims of correctness and antiquarian knowledge that would become codified, rhetorical gestures in the text of the privileges in the following decade. As we have seen, this language was also echoed in the dedicatory letters written by editors and scholars on Jenson’s behalf.²²⁰

This consideration of the rhetoric of correctness incorporated into Venetian print privileges sheds light on the role of Venetian patricians in the publication of classical texts. Previous scholarship has understood a gradual decline in the active role played by Venetian patricians with print, particularly regarding the publication of classical works.²²¹ The argument establishes that patricians had invested in the publication of classical texts due to their interest in

²¹⁸ In addition to variations of the word correct, humanists also employed versions of emend (*emendo*) and collation (*collazione*). See: Silvia Rizzo. *Il Lessico Filologico degli Umanisti* (Roma: Edizioni di storia e letteratura, 1973), 245–249. For uses of “Nova,” see: ASV, CN, Reg. 14, Fol. 148r (Fulin, 125, No. 55); “Molto” ASV, CN, Reg. 15, Fol. 18r (Fulin, 139–140, No. 99); “Bontà”: ASV, CN, Reg. 14, Fol. 150v, (Fulin, 126, No. 58); “Correctissimi”: ASV, CN, Reg. 15, Fol. 42r (Fulin, 146, No. 115).

²¹⁹ Angelo Ambrogini, *Le Più Belle Pagine di Angelo Poliziano*, ed. A. S. Novaro (Milano: Fratelli Treves, Editori, 1925), 198–99. See also: Gino Franceschini, “Per La Storia Della Biblioteca di Federico da Montefeltro Duca d’Urbino,” in *Figure del Rinascimento Urbinate* (Urbino: S.T.E.U, 1959), 109–147, particularly 141.

²²⁰ Martin Lowry, *Nicolas Jenson*, 88–89.

²²¹ Margaret King, *Venetian Humanism*, 25.

rhetoric and humanist study for the sake of good governance. This echelon of patronage was replaced after 1490 when foreign humanists were attracted to Venice by the need for specialists to engage in practical and technical philological labor of emending texts.²²² Many patricians, it is posited, became satisfied with the passive role of prompting print runs and receiving recognition in dedicatory letters.²²³ It is further suggested that patricians focused instead on comfortable mainland investments and abandoned the shaping of humanist study through the risky capital venture of printing, leaving it instead to non-noble, often foreign, entrepreneurs.

This narrative of the rise of the printing industry eroding patrician participation in the production of classical texts in Venice fails to consider the legal structures created by those very patricians. Print privileges were issued by the Venetian Council of Ten until 1517 and thereafter by the Venetian Senate.²²⁴ The Council consisted of ten patrician magistrates elected to one-year terms with no more than one member of the same family serving at a time and no one elected to a successive term.²²⁵ This system ensured wide participation on the Council among patrician men and, in turn, broad patrician oversight of the print industry. While patricians may have moved away from directly editing or funding the publication of humanist texts, they remained active collectors of humanist texts in both print and manuscript and retained the exclusive right to determine which publishers received legal protections, for which texts, and to what degree.²²⁶

²²² Ibid., 240.

²²³ Ibid., 234.

²²⁴ Although created as a temporary measure in 1310, by 1455 the legal powers of the Council of Ten were made permanent. See: Edward Muir, *Civic Ritual in Renaissance Venice* (Princeton: Princeton University Press, 1981), 20.

²²⁵ David Chambers, Brian Pullan, and Jennifer Fletcher, eds. *Venice: A Documentary History, 1450–1630* (Toronto: University of Toronto Press, 2001), 55.

²²⁶ For Pietro Barbo see Roberto Weiss, *Un Umanista Veneziano: Papa Paolo II* (Venice: Istituto per la collaborazione culturale, 1958); for Giovanni Marcanova's library, Lino Sighinolfi, *La Biblioteca di Giovanni Marcanova* (Munich: Monaco, n.p., 1921); For Giorgio Valla's, J.L. Heiberg, *Beiträge zur Geschichte Georg Vallas und seiner Bibliothek* (Nendeln: Kraus Repr., 1968), 109–29, and Paul Lawrence Rose, "Humanist Culture and Renaissance Mathematics," *Studies in the Renaissance* 20 (1973): 65–104, especially 94ff.

2.7 Conclusions

Given the stark contrast between the mass reproduction of printed text and the uniquely hand-painted illumination that frames the first folios of presentation copies, it may be tempting to understand the painted decoration as the site of significant intellectual labor, rich with classical allusions able to attract investors in the new technology, while the text was a mere reproduction. Yet, as Martin Davies demonstrated through his analysis of printed editions of Pliny the Elder, the text was also a site of intellectual performance and learned posturing. The limitations of the earliest printed editions of Pliny's *Natural History* (*Naturalis Historia*), in particular the lack of Greek type resulting in blank spaces for the Greek to be handwritten, left obvious errors and omissions in the text. Exceptionally poor early printed editions, by Konrad Sweynheym and Arnold Pannartz and shortly later in Venice by Johannes da Spira, piqued interest in early quality control and made clear to humanists that Pliny's text was a blank canvas on which to demonstrate their talents of emendation and "correction."²²⁷ Historians of the book including D.F. McKenzie and Rogier Chartier have shown that facture—including format, *mise-en-page*, punctuation, type, and ink quality—can generate or obscure meaning in ways that differentiates one edition and even one copy from another.²²⁸ Thus, we must factor in the publisher—the term itself a synecdoche for the diverse labor of editors, typesetters, correctors, press operators, and others—when considering the cultural labor involved in the production of the book.

²²⁷ Martin Davies, "Making Sense of Pliny in the Quattrocento" *Renaissance Studies*, 9, no. 2 (1995): 247.

²²⁸ See: D.F. McKenzie, "The book as an expressive form," in *Bibliography and the Sociology of Texts* (Cambridge: Cambridge University Press, 1999). See also: Roger Chartier, *The Author's Hand and the Printer's Mind*, trans. Lydia G. Cochrane (Cambridge: Polity Press, 2014).

Rather than parsing the labor of paint or print, it may be more appropriate to read these works through what Lorenzo Pericolo describes as the “manifoldness of Venetian history.”²²⁹ In his analysis of Gentile Bellini’s architectural syntax, Pericolo demonstrates that the act of “refashioning” can be both historicizing *and* modernizing. Similarly, Peter Burke suggests that it is appropriate to speak of “awareness of innovation,” rather than simply reflecting on earlier periods, or what has been described previously as historical perspective, antiquarian feeling, archaeologizing spirit, historicism (*Historismus*), or historical awareness (*Geschichtsbewusstsein*),²³⁰ This notion is evidenced by the repeated fifteenth-century efforts to praise Jenson for his ingenuity while also situating his works as steeped in classical authority.

Both text and illuminated image can be understood as sites of authorial performance; one does not simply ornament or frame the other, but rather they are in a mutually enriching dialogue. This is demonstrated in the interplay between Jenson’s *Antiqua* type and the illuminated *all’antica* monuments; in the “letter Bononiensis” of his legal texts and the frequency of authorizing “reproductive objects” including gems, cameos and wax seals; and the opportunity for careful antiquarian observation of the “virtues” of Caesars in their illuminated portraits alongside their printed biographies by Suetonius.

For elite collectors like Ugelheimer, the Agostini, and the Venetian patricians regulating print, opulent presentation copies were often held in some form of *studiolo*, whether that was a desk with storage space, or a purpose-built room. By entering into these spaces, Quattrocento humanists reenacted the scholarly activities of ancient authors including Cicero and Pliny the

²²⁹ Lorenzo Pericolo, “Incorporating the Middle Ages: Lazzaro Bastiani, the Bellini, and the ‘Greek’ and ‘German’ Architecture of Medieval Venice,” in *Remembering the Middle Ages in Early Modern Italy*, eds. Lorenzo Pericolo and Jessica N. Richardson (Turnhout: Brepols, 2015), 163.

²³⁰ Burke cites art historians Aby Warburg, Fritz Saxl, Erwin Panofsky, and Hans Baron. See: Peter Burke, “The Renaissance Sense of Anachronism,” in *Die Renaissance und ihr Bild in der Geschichte: Die Renaissance als erste Aufklärung III*, ed. Enno Rudolph (Tübingen: Mohr Siebeck, 1998), 16–35.

Elder, writers whose texts they had helped to revive through legal privileging, funding, and collecting of the new technology of print. Furthermore, the thresholds crossed—including ever-smaller architectural spaces, painted doors, and decorated cabinets—informed their reading of printed books which themselves contained illuminated thresholds at the first folio.

These thresholds, as spaces of manifold visual association and manifestations of authority, informed and were likely informed by the associative spaces of the *studioli* and the choir screen. This accretion of meaning surrounding *printed* text allowed the illuminated motifs to signify differently than they had when in conjunction with manuscripts. Innovative technology required historical framing in order to persuade investors and elite collectors of the accuracy and integrity of print which, otherwise, was feared for its rapid reproduction of errors. Yet, to the eye accustomed to the “manifoldness of Venetian history,” this framing was also a re-framing that established print’s unique claims over manuscript.

Chapter 3 Erhard Ratdolt and the Manipulation of Light in Fifteenth-Century Geometric and Astronomical Texts

Print privileges issued by the Venetian Council of Ten (*Capi del Consiglio dei Dieci*) typically extended greater legal protections to mathematical and astronomical texts than any other category of print. These protections included higher fines imposed against the production of counterfeits and longer periods of time for publishers to exercise the exclusive right to print their texts. These branches of knowledge were traditionally united as part of the medieval *quadrivium* (arithmetic, geometry, music, and astronomy).²³¹ The two fields also presented similar technological challenges to the printer, that of finding means to reproduce complex diagrams, which had previously only existed in manuscript, and to embed these at proper points in the text in question. The production of these printed works positioned their publishers as the inheritors of an intellectual genealogy stretching from Ptolemy (100–170 A.D) to Abū al-Wafā’ (328–386 A.H./ 940–998 A.D.) to Johannes de Sacrobosco (1196–1256) to Johannes Müller von Königsberg (latinized as Regiomontanus, 1436–1476). Finally, texts in this category held immense cultural value for providing innovative tools for measuring time as well as convenient means to determine the moving date of Easter by ascertaining the “golden number.”

While geometrically derived forms may appear to be objective conveyances of information, their re-creation in print required the manipulation of physical media and therefore necessarily involved design and stylistic decisions on behalf of the author, printer, and/or

²³¹ Klaus Arnold “Bildung im Bild: Darstellungen der *septem artes liberales* in der Kunst des Mittelalters und der Renaissance,” in Ursula Schaefer, ed. *Artes im Mittelalter* (Berlin: Akademie Verlag, 1999), 361–375.

publisher.²³² This chapter considers how luminosity, opacity, and transparency may have been incorporated into the reading, viewing, and performance of geometric and astronomical books printed in Venice between 1478 and 1515. Finally, the chapter expands to consider broader artistic production to suggest a Venetian visual culture aware of and delighted by the possibilities of light moderated by diverse media.

3.1 Erhard Ratdolt

Born in the Free Imperial City of Augsburg, Erhard Ratdolt (1447–1528) spent a decade in Venice (1476–1486).²³³ There he printed texts across a wide variety of intellectual traditions including astronomy and geometry, humanities and poetry, canon and civil law, medicine, and theology, as seen in broadsheets advertising titles available from his Venetian press in 1484.²³⁴ Throughout his time in Venice, however, Ratdolt invested the greater part of his intellectual and innovative efforts in the category of astronomical and mathematical texts.

Here I focus on three texts that Ratdolt printed in Venice: first, a calendar containing tables predicting eclipses as well as a printed instrument for finding the time; next, printed geometric diagrams elucidating the concepts in Euclid's *Elements*; and finally, astronomical diagrams developed by Regiomontanus and printed by Ratdolt.²³⁵ At stake in this chapter is an

²³² Irene J. Winter describes this as “the necessity of style in the materialization of content.” See: Irene J. Winter, “The Affective Properties of Styles: An Inquiry into Analytical Process and the Inscription of Meaning in Art History,” in *Picturing Science Producing Art*, eds. Caroline A. Jones and Peter Galison (New York: Routledge, 1998), 55–77.

²³³ Gilbert R. Redgrave, *Erhard Ratdolt and his Work at Venice* (London: Chiswick Press, 1894), 3.

²³⁴ *Libri venales Venetiis impressi* [Bücheranzeige/book advertisement] (Venice: Erhard Ratdolt, 1484). Copy now in Deutsches Buch- und Schriftmuseum Leipzig, Bö-V. Ink. 132.

²³⁵ There is a rich and lively scholarly debate as to the most appropriate terminology for visualized information which I have often referred to as diagrams for ease of reading. James Elkins chose to call them “informational images” in order to bring them under the rubric of the history of art, arguing that “that they engage the central issues of art history such as periods styles, meanings, the history of ideas, concepts of criticism, changes in society; [and] that they can present [...] complex questions of representation, convention, medium, production, interpretation, and reception. See: James Elkins, *Domain of Images* (Ithaca: Cornell University Press, 1999), 4–5; Christoph Lüthy and Alexis Smets used the term “epistemic images” in order to emphasize the need to grasp them within the context of

understanding of Ratdolt’s innovative deployment of the printing press, premised on the physical manipulation and dynamic use of books containing printed tables, diagrams, and instruments. It will be shown that Ratdolt’s use of the press factored in page-turning when moving between text and image—or between sequential images—and incorporated the notion of transporting the book to new settings when using instruments to observe celestial bodies such as the sun or stars. Inherent in these dynamic operations was a manipulation of the printed book to take advantage of direct, indirect, and transmitted light.

As indicated in the introduction, rather than understanding these complex printed texts as a sudden revolution, as described by Elizabeth Eisenstein,²³⁶ or as the slower evolution envisioned by Adrian Johns,²³⁷ I engage with Jay David Bolter and Richard Grusin’s concept of remediation, which argues that new media must always justify their own existence by promising to reform and improve upon earlier works.²³⁸ These “remediations” call attention to the labor of their re-conception either through *hypermediacy* in which the medium is explicitly visible, or *immediacy* in which the medium disappears, providing seemingly unmediated access to content. As the use of the printing press expanded at the end of the fifteenth century, visual and textual acts of remediation not only justified print’s intermedial translation of manuscripts, but also

the epistemological, metaphysical, and social assumptions within which they are embedded. See: Christoph Lüthy and Alexis Smets, “Words, Lines, Diagrams, Images: Toward a History of Scientific Imagery,” *Early Science and Medicine: A Journal for the Study of Science, Technology and Medicine in the Pre-Modern Period*, ed. Christoph Lüthy, 14, no. 1–3 (2009): 398.; Horst Bredekamp and his collaborators have chosen “*das technische Bild*,” (the technical image), to emphasize layers of *technē* embedded in images which are often instrument-based. See: Horst Bredekamp, Vera Dünkel, Birgit Schneider, eds., *The Technical Image: A History of Styles in Scientific Imagery* (Chicago: University of Chicago Press, 2015). Others have suggested the term “cognitive instruments” or “tools of reason” emphasizing their dynamic ability to allow users to think with them and in doing so to generate knowledge and understanding. See: Greg Priest, Silvia de Toffoli, and Paula Findlen, “Tools of Reason: The Practice of Scientific Diagramming from Antiquity to the Present” *Endeavour* 42 (2018) 49–59.

²³⁶ Elizabeth Eisenstein, *The Printing Press as an Agent of Change*. 2 vols. (Cambridge: Cambridge University Press, 1979).

²³⁷ Adrian Johns, *The Nature of the Book: Print and Knowledge in the Making* (Chicago: University of Chicago Press, 1998).

²³⁸ Jay David Bolter and Richard Grusin, *Remediation: Understanding New Media* (Cambridge: Massachusetts Institute of Technology Press, 1999).

supported the act of reprinting earlier *printed* works in new formats and with new relationships to the materials of their making. As I will demonstrate, Ratdolt's remediations occur both in acts of *hypermediacy*—for example, a dedicatory letter printed in gold—and acts of *immediacy*—in the case of astronomical diagrams aligned on each side of a single folio, in which the medium dissolves to suggest direct access to information.

The second maneuver of this chapter is to consider examples of translucency and opacity produced and appreciated in Venice in order to describe a Venetian visual culture which was highly attentive to the interaction of objects and light, not just in printed books but also in and through glass, painting, and architecture. Ultimately, I argue that this aspect of Venetian visual culture informed Ratdolt's innovative publishing campaigns and alerted readers of these texts to the material possibilities of the printed page.

3.2 Kalendarium

A calendar produced by Ratdolt and his partners Bernhard Maler and Peter Löslein in Venice in 1476 can be seen as a remediation of an earlier publication by Regiomontanus in Nuremberg in 1474. Scholarly characterizations of Ratdolt's edition have ranged from the insidious act of piracy to a benign reprinting.²³⁹ Visual analysis focused through the lens of remediation, however, better understands Ratdolt's edition as a self-aware interpretation.

Unlike the Nuremberg calendar which opens immediately upon a table of dates, Ratdolt's re-framing is achieved literally, though an innovative woodblock printed border, and conceptually through a poem. The decorated border, often hailed as the first of its kind, contains

²³⁹ On piracy, see: Suzanne Karr Schmidt, "Printed Scientific Objects," in *Altered and Adorned: Using Renaissance Prints in Daily Life* (New Haven: Yale University Press, 2011), 75; in contrast, see: Michael H. Shank, "Regiomontanus and Astronomical Controversy in the Background of Copernicus," in *Before Copernicus: The Cultures and Contexts of Scientific Learning in the Fifteenth Century* (Montreal: McGill-Queen's University Press, 2017), 100.

classicizing urns from which sprout abstracted acanthus, budding pomegranates, and climbing roses all arranged symmetrically on a vertical axis (Figure 58). The curving natural forms of leaves above echo the handcrafted volutes below. An open escutcheon at the top declares this work worthy of ownership and personalization at the highest levels of society. In addition to the visual framing of the calendar, the theoretical framing is established through the encomiastic poem organized into rhyming couplets [translation mine]:

<p>Questa op[er]a da ogni parte e un libro doro Non fu piu preciosa gemma mai Dil kalendaril : che tratta cose asai Con gran facilita : ma gran lavoro Qui numero aureo : e tutti I segni fuoro Descripti dil gran polo da ogni lai : Quando ti sole : e luna eclipse fai : Quante terre se reçe a [que]sto thexoro. In un instant tu sai qual hora sia : Qual sara l'anno : giorno : tempo : e mexe : Che tutti ponti son d'astrologia. Ioanne de monte regio questo fexe: Coglier tal frutto acio non grave sia In breve tempo : e con pochi penexe. Scampa vertu. I nomi di impressori Son qui da basso di rossi colori. Venetijs. 1476.</p>	<p>This work in every part is a book of gold There was never a more precious gem Than the calendar : that treats such things With great facility : but [also] great labor Here the golden number : and all other outward signs Described from the great pole to each latitude When you sun : and moon, make an eclipse How many lands benefit from this treasury [thesaurus] In an instant you know what hour it is Which will be the year : day : time : and month That everyone may bridge [i.e. master] astrology Johannes of Monteregio [Regiomontanus] made this Therefore grasping this fruit should not be difficult in a short time: and with little suffering May virtue be saved [escape danger]. The names of the printers are here below in red colors Venice. 1476.</p>
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The decorated frontispiece of the calendar performs the dual function of remediation: it references the previous calendar while at the same time calling attention to the improved format and design of the new version. The poem opens by praising *this work*—that is, the publication printed by Ratdolt—as a book of gold. This is distinguished it from the original calendar, and allows it to be lauded as a precious gem (*preciosa gemma*). While both gems and gold were valuable, gold was commonly the material in which precious gems were set. Each could have existed on its own but lustrous metallic foils and golden bezels framed and amplified precious

stones.²⁴⁰ These remediations claim more immediate access to information yet, in doing so, inevitably call attention to the medium itself.

The acknowledgement and praise of the original work produced by Regiomontanus on the very first page of the Venetian calendar could be construed as a poor attempt at piracy.²⁴¹ In fact, the term piracy was not in use until the seventeenth century in England and only entered other European languages in the later seventeenth and early eighteenth centuries.²⁴² At the time Ratdolt published this calendar, the conception of intellectual property was still in an inchoate phase in Venice. Moreover, Venetian privileges had no legal jurisdiction over other territories such as Nuremberg where Regiomontanus originally published the calendar. As Adrian Johns succinctly states, “Piracy was a property not of objects alone, but of objects in space.”²⁴³ Instead, the printers acknowledged the ethically ambiguous nature of their publication of Regiomontanus’ work in the year of his death but hoped to salvage virtue through a worthy publication.

Their virtuous desire is also acknowledged by the line “Grasping this fruit should not be difficult [*Coglièr tal frutto acio non grave sia*]” in the poem, which draws on multiple meanings of *grave*. Like its English equivalent, definitions denote qualities of weight, and slowness as a

²⁴⁰ Benvenuto Cellini describes methods for setting precious stones in gold bezels. He also describes the process for making metal foils used to enhance gems. He indicates that the foils from Venice were well known—if less durable than those of his master. “[...] la foglia per tutte le sorte di gioie; e se bene e’ ce ne veniva di Francia e di Vinezia, [...] qual foglie mostravano essere molto belle, ei si vedeva per esperienza le non eran durabili per l’un dieci come quelle di Salvestro.” See: Carlo Milanese, ed. *I trattati dell’oreficeria e della scultura di Benvenuto Cellini Novamente messi alle stampe secondo la originale dettatura del codice Marciano* (Firenze: Felice Le Monnier, 1857), 46–47. This improvement was clear to nineteenth-century connoisseur Gilbert R. Redgrave who praised the new calendar as “an extremely elegant work, and in every way a marvelous improvement upon the rude prototype.” See: Gilbert R. Redgrave, *Erhard Ratdolt and his Work at Venice: A paper read before the Bibliographical Society*, November 20, 1893 (London: Chiswick Press, 1894, repr. 1899), 14.

²⁴¹ In the German-language translation published only by the two Augsburgers, Bernhard Maler and Erhard Ratdolt, the words of the poem are necessarily different in order to maintain rhyming couplets. Yet, it is still acknowledged as a work of Regiomontanus: “Das hat gemacht maister hans von königsperg genant.” See: Johannes Regiomontanus (Johann Müller of Königsberg), *Kalendarium* [German] (Venice: Bernhard Maler (Pictor) and Erhard Ratdolt, 1478). ISTC No. ir00100500. <https://data.cerl.org/istc/ir00100500>

²⁴² Adrian Johns, *Piracy: The Intellectual Property Wars from Gutenberg to Gates* (Chicago: University of Chicago Press, 2009), 24.

²⁴³ Johns, *Ibid.*.

consequence of weight, but also as damaging, threatening, causing pain, harm or danger.²⁴⁴ So it may be understood not only that the printers hoped for the acquisition of this knowledge to be quick due to print, but also that the very (re)printing of it should not be seen as harmful or threatening. This second notion is reflected in the language of print privileges where, beginning in 1492 (1491 *m.v.*), impositions against “stealing the fruit” of a printer’s labor occur frequently with only slight variation in phrasing.²⁴⁵

Finally, the printers placed their address after the praise of Regiomontanus’ intellectual labor, at the lowest point of the page. It reads: Bernardus Pictor de Augusta (Bernhard Maler of Augsburg), Petrus Loslein de Langencen (Peter Löslein of Langenzenn), and Erhardus Ratdolt de Augusta (Erhard Ratdolt of Augsburg). The unusual surname Pictor, translated as *Maler* in German (“painter” in English), has led some scholars to suggest that rather than a family name it describes his role in the production of the visual elements including the decorated border of this frontispiece while Löslein acted as a copy editor and Ratdolt was responsible for the physical operation of the press.²⁴⁶ If indeed the latter was the case, this expertise would be a crucial advancement, offering a building block for later works requiring highly sophisticated alignments across multiple impressions.

While their acknowledgment of Regiomontanus’ intellectual labor may indicate humility, the publishers break from the previous rhyme scheme to call attention to their names printed in red ink, “the names of the printers are here below in red colors [*i nomi di impressori/ son qui da*

²⁴⁴ Salvatore Battaglia, ed. *Grande Dizionario della Lingua Italiano*, Vol. VII *Grav-Ing* (Turin: Unione Tipografico, Editrice Torinese), 3–6.

²⁴⁵ These phrases occur on 3 January 1492 Archivio di Stato di Venezia (ASV) Collegio Notatorio (CN) Registro (Reg.) 14 Fol. 53r (Fulin, 102, No. 4); 18 January 1493 ASV, CN Reg. 14 Fol. 79r (Fulin, 106–107, No. 12); 2 May 1494, ASV, CN Reg. 14 Fol. 103v (Fulin, 112–113, No. 25); 25 February, 1496 ASV, CN Reg. 14 Fol. 137v (Fulin, 120, No. 25); 15 July 1498, ASV, CN Reg. 14 Fol. 178v (Fulin, 133–134, No. 82); 20 November, 1505, ASV, CN Reg. 15 Fol. 155r (Fulin, 158, No. 151); 26 September, 1513, ASV, CN Reg. 17 Fol. 80r (Fulin, 178, No. 189).

²⁴⁶ R.T. Risk, *Erhard Ratdolt: Master Printer* (Francetown: n.p., 1982), 21–22.

basso di rossi colori].” As Bolter and Grusin explain, although each medium promises to reform its predecessors by offering a more “immediate or authentic experience,” the remediation inevitably leads us to become aware of the new medium as a medium.²⁴⁷ Printing their names in red was not only visually striking, it required a complex and costly second run through the printing press fitted with different type, more precious ink, and parchment masks (or friskets, as analyzed in Chapter 2) to execute the high contrast “signature.”

The calendars Ratdolt printed in Venice contain a table giving locations of the lands of the [western European] world, followed by tables predicting solar and lunar eclipses and the locations in which they may be viewed, until the year 1530. These celestial phenomena are represented by circular diagrams containing crescent shapes representing partial eclipses and by solid printed circles indicating a full eclipse. The crescent shapes in the 1478 Ratdolt publication are colored with a hand painted yellow wash (Figure 59). Often derided as hastily executed or as “swiftly painted,”²⁴⁸ the hand coloring of these diagrams varies greatly from one volume to the next. While haste may have been a factor, I would argue that audience—or speculated audience—also played a role. In the elaborate edition held in the BSB (2 Inc.c.a.777) as well as BL, IB.20497, the coloring rarely exceeds the margins and frequently demonstrates a delicate modeling built up through multiple, time-consuming washes of a single color or through the application of deeper ochres over bright yellow grounds. Rather than the byproduct of haste, this

²⁴⁷ Bolter and Grusin, *Remediation*, 19.

²⁴⁸ Thomas Primeau, Deborah Carton, and Susan Dackerman, *Painted Prints: The Revelation of Color in Northern Renaissance and Baroque Engravings, Etchings, and Woodcuts* (University Park, Pa: Pennsylvania State University Press, 2002), 9.

modeling in more luxurious copies may record a nuanced observation of celestial bodies and their interactions in a period before the telescope.²⁴⁹

By 1482, Ratdolt—having lost his partners to plague—developed a technique for *printing* both crescents of the eclipse diagrams in the calendar in different colors. The irregularity of these diagrams, including points of overlap or gaps between the two shapes, suggests that they were produced from multiple matrices—each printed in a separate run (Figure 60).²⁵⁰ Although Hans Burgkmair is often credited with the advancements that led to chiaroscuro woodblock printing in Augsburg circa 1508, the technology—if not the fully developed technique—seems to be present in Venice seventeen years earlier.²⁵¹ While still imperfect at this stage, Ratdolt’s ability to mobilize the technique of multiple impressions through precise registration, I would argue, played an increasing role throughout his production of mathematical and astronomical print in Venice.

This shift from paint to print can also be understood as the hypermediacy of hand-painted washes being replaced by the immediacy of fully-integrated, printed diagrams. Yet, these large expanses of printed ink make visible any imperfections in the matrix; the direction in which the

²⁴⁹ Volcanic activity can cloud the Earth’s atmosphere, which causes the surface of the moon to appear redder during eclipses. There was a cluster of volcanic activity preceding the publication of this calendar: Kuwae, in the South Pacific, in 1452–53, and the Veidivötn-Barðarbunga volcano on Iceland in 1477. The Kuwae eruption is considered to be one of the largest volcanic eruptions in the last 10,000 years. This would help to explain the red moon in the eclipse diagrams and argue for further nuanced observation. On Kuwae, see: Hoffman, A. et al. “Looking to Epi: Further Consequences of the Kuwae eruption, central Vanuatu, AD 1452,” *Indo-pacific Prehistory Association* (2006): 62–71. See also: J.B. Witter, “The Kuwae (Vanatu) eruption of AD 1452: potential magnitude and volatile release,” *Bulletin of Volcanology* 69, no. 3 (2007): 301–318. For the Veidivötn-Barðarbunga eruption, see: P.M. Abbot, et al. “Cryptotephra from the Icelandic Veidivötn 1477 CE eruption in a Greenland ice core: confirming the dating of volcanic events in the 1450sCE and assessing the eruption’s climactic impact,” *Climate of the Past* 17 (2021): 565–585.

²⁵⁰ From the early 1480s, images were printed in register. One impression each of several matrices, each inked in a different color, are superimposed on a support. The impressions can overlap partly, completely, or not at all, and the inks can be transparent (and thus combine to form new color gradations) or opaque. See: Ad Stijnman and Elizabeth Savage, eds., “Introduction” In *Printing Colour: 1400–1700 History, Techniques, Functions and Receptions* (Leiden: Brill, 2015), 5.

²⁵¹ *Ibid.* It has been suggested that Burgkmair developed these techniques while working with Ratdolt in the 1490s after Ratdolt’s return to Augsburg from Venice; however, it may be that Ratdolt developed the foundational aspects of registration while still in Venice.

ink was applied to the wood matrix using a leather pounce; inclusions of fiber or folds in the paper at the moment of the impression; and imperfections of the paper support itself. One example of this can be seen in the German language version of the 1478 calendar now held in the BL (IB 20497). The diagram for the predicted total lunar eclipse (*Finster des Mondes*) of 1479—a printed solid black circle—coincides with the position of a bull’s head and staff watermark in the paper folio. The result is an eerie negative image of the bull staring out through the darkness of the eclipse (Figure 61). As with any remediation, the printed diagrams which claim greater immediacy over their hand painted predecessors ultimately result in a new hypermediacy.

Turning the page on the tables of solar and lunar eclipses, the calendars also contain four printed instruments. Each instrument is pasted to a second folio within the codex to offer rigidity and opacity during operation.²⁵² The last printed instrument, known as the Universal Horary or Regiomontanus Dial, was informed by an earlier tool known as the navicular, a portable sundial that could be used at any northern latitude to tell the time.²⁵³ The resulting printed instrument employs a copper-alloy indicator (*brachiolus*).²⁵⁴ The indicator has two pivot points and, at the

²⁵² As given in the 1476 Italian edition, these titles are (respectively): *Lo Instrumento de le Hore Inequale* (Instrument of unequal hours); *Lo Instrumento del Vero Moto de la Luna* (Instrument of the true movement of the moon); *El Quadrante del Horologio Horizontale* (Quadrant of the horizontal clock/horary); *El Quadrato Generale de le Hore* (General quadrant of the hours, or universal horary).

²⁵³ Catherine Eagleton has traced the transmissions of knowledge that led to this variation. The printed device was based on a much earlier instrument known as the navicular, a portable sundial that can be used at any latitude to tell the time. Manuscript descriptions and depictions of this instrument circulated in Vienna during the fifteenth century and ultimately lead to an altered form known as the *Organum Ptolomei*. See: Catherine Eagleton, “Medieval Sundials and Manuscript Sources: The Transmission of Information about the Navicula and the Organum Ptolomei in Fifteenth-Century Europe,” in *Transmitting Knowledge: Words, Images, and Instruments in Early Modern Europe* (Oxford: Oxford University Press, 2006), 41–71. See Also: Frederick A. Stebbins “A Medieval Portable Sundial,” *Journal of the Royal Astronomical Society of Canada* 2 (1961): 49–56; and David A. King, *World-Maps for Finding the Direction and Distance to Mecca: Innovation and Tradition in Islamic Science* (Leiden: Brill, 1999). Finally, for many of the sources cited by Stebbins and King, see: Ernst Zinner, *Astronomische Instrumente des 11.–18. Jahrhunderts* (Munich: Beck, 1956).

²⁵⁴ Because of the accuracy required of the *brachiolus*, it is unlikely that individual calendar owners could fashion their own, but rather that they were supplied by the publisher. They appear to have been available at differing price points. A *brachiolus* from Ratdolt’s 1483 publication now at the Huntington Library (42653) may represent the lower end of production quality: the constituent elements appear to have been crudely snipped from a copper-alloy sheet and held together with ferrous rivets of varying sizes. At the other end of production appears to be highly

end of the indicator, a string is attached with an adjustable bead to cast a shadow (Figure 14). When positioned correctly, this shadow indicates the time of day on the printed instrument.

Reconstructing the physical act of using these tools informs our understanding of Venetian visual and proto-scientific culture which must have, in turn, been informed by that culture. In the Italian language edition of the calendar, instructions are given for using the instrument: “place the arch of the semicircle on your chest in such a way that the line for twelve o’clock is projected toward you.”²⁵⁵ This means that the dial is printed to fit on the paper folio but must be repositioned ninety degrees clockwise when operated.²⁵⁶ Employing the instruments required the viewer to manipulate the book in ways that reading did not.

Additionally, the calculated movements of the *brachiolus* and plumb line required an informed and informing sense of touch. While vision is afforded preeminence in reading, these instruments are physically interactive, demanding not only mental concentration but also physical manipulation.²⁵⁷ Operating these prints requires observation and participation, that is, intellectual knowledge *plus* sensory perception.²⁵⁸ Furthermore, touch is not only a personal epistemology, but the act of touching is gestural and externally visible, informing other viewers beyond a purely linguistic framework.²⁵⁹ The social nature of gesture is reinforced when one considers that, rather than engaging with a horizontal book in the privileged and private space of

finished indicators stamped or cast with ribbed lines for greater strength as in the BSB codex. Here the rivets match the material of the *brachiolus* and the pins which allow the tool to pivot are stamped with a floral motif.

²⁵⁵ [...] *oppone larcho del semicirculo al tuo petto: in tal modo che la linea de lhora duodecima sia sporta verso di te*

²⁵⁶ Suzanne Karr Schmidt, “Johannes Stabius,” in *Prints and the Pursuit of Knowledge in Early Modern Europe*, ed. Susan Dackerman (New Haven: Yale University Press, 2011), 75.

²⁵⁷ Suzanne Karr Schmidt, *Interactive and Sculptural Printmaking in the Renaissance* (Leiden: Brill, 2018).

²⁵⁸ J.S. Ackerman, “Interpretation, Response: Suggestions for a Theory of Art Criticism,” in *Theories of Criticism: Essays in Literature and Art* [Occasional papers of the Council of Scholars of the Library of Congress, no. 2] (Washington D.C., 1984), 33–53.

²⁵⁹ Adrian W.B. Randolph, “Hands: Gesture in Renaissance Portraiture,” in *Touching Objects: Intimate Experiences of Italian Fifteenth-Century Art* (New Haven: Yale University Press, 2014), 20.

the *studiolo*, the printed instruments of the calendar must be positioned and made to interact with natural light—outdoors.

There is visual evidence of the performative use of these instruments within astronomical manuscripts and printed books themselves. A thirteenth-century manuscript containing the Latin translation of Ptolemy’s astrological text, the *Almagest*, begins with an initial Q containing two figures engaged in astronomical study (Figure 62). While the text was transcribed in France in 1279, this manuscript is interesting for also being used in fifteenth-century Italy.²⁶⁰ The format of the historiated initial appears to be a consistent type within copies of the *Almagest*: a crowned figure holds an armillary sphere and engages in discussion with a tonsured cleric. The figures’ elongated forefingers imply speech and instruction and emphasize the role of gesture in, and the performative nature of, interacting with astronomical models and texts. Taking this interpretation further, the bright white hands with wide black outlines participate in the tradition of manicules, marginal sketches of pointing fingers intended to direct the reader’s eye to important passages. Not only does this establish a visual register alongside the text from the first moment of interaction with the book, but it also evidences the embodied, physical nature of reading and manipulating astronomical books at the time.²⁶¹

²⁶⁰ This manuscript later belonged to the physician of Lorenzo de’ Medici, Pier Leoni (d. 1492), in fifteenth-century Italy. For more on Pier Leoni and his collection see: José Ruyschaert, “Nouvelles recherches au sujet de la bibliothèque de Pier Leoni, médecin de Laurent le Magnifique,” *Académie royal de Belgique. Bulletin de la Classe des lettres et des sciences morales et politiques* 5, no. 46 (1960): 37–65. Pier Leoni’s lauded library contained both manuscript and print as described by the Dominican Fra Giambattista Braccieschi in 1582/3: “La compera consiste in questo : di comperare circa duegento pezzi di libri scritti a mano e circa trenta altri pezzi stampati de’ quali circa un dieci o dodici pezzi sono tra hebrei e greci, e tutto il restante sono latini de’ quali circa un centinaio sono di cose medicinali e tutto il restante di varii sogetti o di cose astrologice o filosofice o teologice o curiose et alchimiche.” Vatic. lat. 6411, fol. 276 as cited in: León Dorez, “Recherches sur la bibliothèque de Pier Leoni, médecin de Laurent de Médicis,” in *Revue des Bibliothèques* 4 (1894): 77–78.

²⁶¹ As William Sherman describes, “Both literally and metaphorically, however, reading used to be considered as much the province of the hand as of the other faculties (sight, intellect, and emotion) and activities (cogitation, meditation, and digestion) associated with the taking in of texts... readers picked up their books with an acute awareness of the symbolic and instrumental power of the hand.” See: William H. Sherman, *Used Books: Marking Readers in Renaissance England* (Philadelphia: University of Pennsylvania Press, 2008), 48.

In the first printed edition of the *Almagest*, again we see a version of this image type. This *Almagest* was published by Petrus Liechtenstein in 1515 in Venice using an innovative composite woodblock system to insert the two astronomers within an initial B (Figure 63). The figure on the left, who I identify as Ptolemy, reads his own text—the precursor to this edition of the *Almagest*—and an armillary sphere rests against his lectern. The figure on the right, who I believe to be Regiomontanus, raises an astronomical instrument to the heavens.²⁶²

The two protruding rectangles depicted at the top of the instrument represent the sights used to align a universal horary with the sun in order to determine the time of day.²⁶³ While this could represent an instrument crafted from metal, I would contend that Regiomontanus holds a *printed* instrument. Given that Regiomontanus established the first printing press devoted primarily to mathematical and astrological texts, published a calendar and two other astronomical texts in 1474, and planned to produce an additional forty-five astronomical editions (cut short by his untimely death in 1476), a printed astronomical instrument seems a more appropriate attribute.²⁶⁴ An example of this type of printed instrument with sights can be seen in the *Horoscope* for Johannes Stabius, printed in Nuremberg in 1512 (Figure 64).²⁶⁵ Within the woodcut initial *B* depicting the two astronomers, the gesture and pose of the Regiomontanus figure can be seen as a necessary component in performing a particular astronomical process

²⁶² Earlier representations of Ptolemy, as in the 1297 illumination, show the figure wearing a crown based on Isidore of Seville's misidentification of the astronomer Ptolemy as a Ptolemaic king of Egypt. This attribute remained with Ptolemy throughout the Middle Ages and into the fifteenth century. Petrus Liechtenstein attempted to correct this error by replacing Ptolemy's crown with a turban. It is likely that Ptolemy's companion has been updated as well. While traditionally Ptolemy was in conversation with Gerard of Cremona, the monk who translated the *Almagest* from Arabic into Latin, he now converses with Regiomontanus. This configuration was printed in Regiomontanus' own commentary on the *Almagest* published in Venice in 1496, see: Regiomontanus, *Epitoma in Almagestum Ptolemaei*, ed. Johannes Baptista Abiosus (Venice: Johannes Hamman for Kaspar Grossch and Stephan Roemer, 31 August, 1496), fol. 3v. ISTC No. ir00111000. <https://data.cerl.org/istc/ir00111000>

²⁶³ For instructions on operating the instrument, see: Suzanne Karr Schmidt, "Johannes Stabius," in *Prints and the Pursuit of Knowledge in Early Modern Europe*, 280–82n1.

²⁶⁴ Michael Shank, "Regiomontanus and Astronomical Controversy in the Background of Copernicus," in *Before Copernicus*, ed. Rivka Feldhay and F. Jamil Ragep (Montreal: McGill-Queen's University Press, 2017), 100.

²⁶⁵ Dackerman, *Prints and the Pursuit of Knowledge*, 285.

aided by a printed instrument. To employ the instrument, theory alone would have been insufficient, and an astronomer would have had to physically manipulate the printed page in a visible, out-of-door performance of knowledge which dynamically interacted with natural light.²⁶⁶

3.3 Euclid's Elements

Having established the possibility of physically manipulating printed texts in alignment with cosmological bodies, I now turn to the first printed edition of Euclid's Elements to consider how the printing of geometric diagrams prompted new interactions with the printed page. Euclid's writings and drawings served for almost two thousand years as the standard introduction to geometry.²⁶⁷ The work was transmitted in manuscript form and, by the eighth century, had reached parts of the Arabic-speaking world through the Caliph al-Mansūr (754–775 CE/ 136–158 AH). It is known to have been translated into Latin from Arabic by Adelard of Bath in 1120 and, later that century, by Gerard of Cremona in Toledo. In manuscript form, the text consists of a series of geometric "propositions" which correspond to diagrams demonstrating those ideas in the margins. Ratdolt's 1482 edition was the first to address the technological challenges of reproducing the complex geometric diagrams in print.

²⁶⁶ Formal posturing of the body was a calculated and codified social code on the Italian peninsula already in the fourteenth century. The elegantly extended fingers and fixed gazes of Ptolemy and Gerard of Cremona in HM 65 present further evidence for the currency of this visual language. Likewise, Regiomontanus' stance—carefully recorded in strict profile—in Petrus Liechtenstein's 1515 *Almagest* demonstrates the continued currency of posture in early sixteenth-century Venice. This may also be understood as what Craig Owen describes as the apotropaic politics of pose in which "to strike a pose" is to "pose a threat." While necessary for the correct operation of their instruments, the elegance of the poses may have also performed a secondary role of discouraging competition from outsiders who wished to challenge the authority of the astronomer in order to gain favorable positions at court or in universities. See: Michael Camille, "The Pose of the Queer," in *Queering the Middle Ages*, ed. Glenn Burger and Steven F. Kruger (Minneapolis: University of Minnesota Press, 2001), 68.

²⁶⁷ Hubert L.L. Busard, *The Latin Translation of the Arabic Version of Euclid's Elements Commonly Ascribed to Gerard of Cremona: Introduction, Edition, and Critical Apparatus* (Leiden: Brill, 1984), ix. In fact, Euclid's geometric proofs were the only approved materials for teaching and testing geometry at Cambridge University until 1887. See: H.M. Taylor, *Euclid's Elements of Geometry: Edited for the Syndics of the Press* (Cambridge: Cambridge University Press 1893), iv.

Proud of his new technology, the German-expatriate Ratdolt dedicated the first edition of the text to the Venetian Doge, Giovanni Mocenigo (in office 1478–1485), with a dedicatory letter printed entirely in gold (Figure 65).²⁶⁸ This extraordinary feature was executed through a process by which gold leaf was applied directly to the matrix and impressed on parchment treated with a rosin or powdered egg white binder.²⁶⁹ The physical form of the letter, held to be the first dedicatory letter in print, emerges as a remarkable example of Bolter and Grusin’s concept of hypermediacy. Before analyzing the printed geometric diagrams, I will pause to consider the letter, accepted as the first dedicatory letter in print.²⁷⁰ To an even higher degree than the calendar frontispiece, this dedicatory letter delights in Bolter and Grusin’s concept of *hypermediacy*. By printing in gold, Ratdolt drew attention to the medium and technology of the text’s production.

Reading the printed gold is difficult: direct light reflects from the precious metal with such intensity that the letters are obscured. Instead, areas of indirect light or shadow allow the greatest visual contrast between text and support. Readers were forced to manipulate the folio in dynamic relation with a light source in order to read this spectacle of print from top to bottom. This movement may be said to echo the self-conscious gestures and poses of astronomers operating printed tools and anticipates the accommodation of light *through* the folio.

In contrast to the glittering hypermediacy of the dedicatory letter, the unframed printed geometric diagrams claim immediacy. Neither the text nor diagram alone could fully explain the

²⁶⁸ Seven extant copies contain a dedicatory letter printed in gold: two are in the Bibliothèque nationale de France, two are at the Bayerische Staatsbibliothek in Munich, one is in the University Library in Budapest, one is in the Stadtbibliothek in Augsburg, and one is in the British Library. See: Victor Carter, Lotte Hellinga, and Tony Parker, “Printing with Gold in the Fifteenth Century,” *The British Library Journal* 9, no. 1 (Spring 1983): 1.

²⁶⁹ Non-invasive scientific analysis conducted at the British Library concluded that the process for printing with movable type and gold leaf was likely similar to the process used to create gold tooled bindings. *Ibid.*

²⁷⁰ Renzo Baldasso, “La stampa dell’editio princeps degli Elementi di Euclide (Venezia, Erhard Ratdolt, 1482),” in *The Books of Venice*, ed. Lisa Pon and Craig Kallendorf (Venice: La Musa Talia, 2007), 63.

geometric propositions in Euclid but rather the two exist in mutual dependence.²⁷¹ The text describes the proposition and the diagram provides the illustration, while the reader must constantly shift between the two epistemologies to derive full meaning. The shifting placement of the geometric diagrams in early iterations of the *Elements* suggests that Euclid provided Ratdolt with fertile ground to explore the relationship between text and diagram and the experience of moving between the two. This was facilitated by the process of printing with movable type and spacers known as “furniture” that allowed for exact alignment.²⁷² I would argue that this intentional alignment created an intellectually productive space for comparison and mental manipulation of images.

It is clear that Ratdolt invested a great deal of care and attention into the placement of these diagrams as they were in constant flux in the printing of the first edition. Although they are all dated to 25 May 1482, comparison of the shifting placement of diagrams in extant copies of the earliest edition makes it possible to propose the order in which these books were executed—and, by extension, how Ratdolt may have considered text-image relationships and an embodied reading of the text.

First, an advertisement for the *Elements* published in 1481–82 consists of only the initial folio of text accompanied by printed diagrams—a kind of proof of concept (Figure 66). Missing from this early iteration is the simplest diagram labeled “point” which is the first element mentioned in the text: “[A] point is that which has no parts [*Punctus est cuius p[ar]s nō[n] est*].”

²⁷¹ Eunsoo Lee, “Let the Diagram Speak: Compass Arcs and Visual Auxiliaries in Printed Diagrams of Euclid’s *Elements*,” *Endeavour* 42 (2018): 81.

²⁷² While Hellinga Carter has argued that Ratdolt was able to print the diagrams at the same time as the text, Renzo Baldasso demonstrates that disparity between the depth of impression into the paper folio of the diagrams relative to the text indicates separate print runs. See: Hellinga Carter, 3; and Renzo Baldasso, “La Stampa dell’Editio Princeps Degli Elementi di Euclide,” 75.

This would not only be the most logical visual aid to include first, but also called for a large decorated initial *P* to begin “*Punctus*,” in the manuscript tradition as well as in Ratdolt’s prints.

Next, a copy in the British Library (G7837) appears to be a proof for the placement of the dedicatory letter (Figure 67). Here the text is printed in black ink on a separate folio that has been pasted over the first folio. Rubricated lines show the carefully calculated proportions that structure the page—taking the height of a single line of printed text as the basic unit of measure. This proof logically follows the advertisement, as preparation for the copies with black ink and gold-embossed dedicatory letters. The British Library’s G7837 copy adds the “*Punctus*” diagram but still places it out of order relative to the text. Next, were copies with the black-ink dedicatory letter, which repeat the order of diagrams in G7837. The seven extant gold-printed editions may be placed after this. Not only do they elaborate upon the black-printed letter, but these contain the correct order of the diagrams, placing the “*Punctus*” diagram first. The gold-letter variants also include the most diagrams of any variant, specifically the curved and straight lines that follow the initial point and line.

Within the seven extant gold-letter variants it may be possible to argue that those on paper were executed before those on vellum. This is supported by Curt Bühler’s analysis of the text in which a typographical error—present in some paper volumes with black-ink dedicatory letters on signature 8 recto—has been corrected for the printing of the gold-letter volumes on vellum as well as later copies on paper.²⁷³ This shifting organization reflects Ratdolt’s attention not only to the content of the text but also to the visual appearance of the printed work. Diagrams such as the concentric circles and parallel lines follow the placement of the text which appears on

²⁷³ Bühler argues that although printing paper copies before the vellum may have dulled the type, the error is unlikely to have entered the text after being correctly printed on vellum. See: Curt Ferdinand Bühler, “A Typographical Error in the Editio Princeps of Euclid,” *Gutenberg-Jahrbuch* (1966): 104.

the recto of the folio of the advertisement but migrates to the verso after the decorative border was introduced. These changes suggest that reader-experience and the timing of turning the folio was a factor in design of great consideration.

In copies of Ratdolt's Euclid published after the experimental stages described above, I have identified three pairs of diagrams which I believe represent manipulations of the alignment of the printed images to exploit the properties of transmitted light through the folio.²⁷⁴ The benefits to physically aligning these diagrams in relation to one another on either side of a single folio are manifold. To place diagrams in conversation through the folio, in some cases, allows mental manipulation or rotation of a three-dimensional object, while in others, it enables comparisons to be drawn between shapes of different sizes; in still other cases it creates continuous illusionistic space through the plane of the folio.

Perhaps the most striking example is a pair of diagrams illustrating Book I: propositions 43 (recto) and 45 (verso). Both propositions describe parallelograms rendered as squares of different sizes on either side of the folio (Figure 68, Figure 69). The diagonal line in proposition 43 is visible through the folio where it aligns with the square in proposition 45 (Figure 70). In the text of proposition 45, an earlier proposition, 33, is invoked as proof that the top and bottom lines, *ab* and *cd*, of the parallelogram are indeed parallel and equal.²⁷⁵ Proposition 33, referenced in the text but no longer visible, requires a diagonal line for its proof. So, in Proposition 45 (verso), the diagonal line which is visible through the folio from Proposition 43 (recto) provides the required additional information. Of the many ways the folios could have been arranged

²⁷⁴ They are: Book I, Propositions 43 and 45; Book IV, Propositions 5 and 8; Book IV, Propositions 13 and 14; Book XI, Propositions 34 and 36; Book XII, Proposition 3 and 4; and Book XIII, Propositions 5 and 7. These six are the most visually striking, which have logical reasons for their overlap. There are other instances of overlapping diagrams throughout the text; some which may be intentional and others which serve as examples that some overlap may be inevitable and inconsequential.

²⁷⁵ *lineam.c.d.eritq[ue] ipsa equalis et equidistans lineae.a.b.per.33*

visually, this suggests an intentional and information-dense layering of diagrams to aid the viewer's perception and spatial reasoning.

In a similar but more direct example, Propositions 13 and 14 of Book III both demonstrate the relationships between regular pentagons and circles. Proposition 13 explains how to circumscribe a pentagon with a circle and proposition 14 explains how to do the opposite (Figure 71). The alignment of the two diagrams on either side of the folio allows viewers to visually explore relationships of circles both inside and outside pentagons.

Ratdolt's innovations in aligning diagrams on recto and verso to draw out additional information falls in line with attempts, both before and after his publication, to evoke three-dimensionality and to assist students of Euclid's proofs.²⁷⁶ A French manuscript of the Elements from the first half of the fourteenth century, Harley MS 5405, generally disregards any alignment of penned diagrams. Many of these appear to be added as an afterthought, as evidenced by circles that overlap the text (Figure 72). Yet, there are discrete examples that suggest an awareness of the possibilities presented by utilizing both sides of the folio. In the margin of folio 33 recto, a triangle is circumscribed by a circle. On the verso of this folio, a square perfectly circumscribes the previously described pair and is, in turn, circumscribed by another circle creating multiple relationships between circumscribed shapes, similar to what we have seen in Ratdolt's edition (Figure 73).

Similarly, Burney MS 275—a fourteenth-century French miscellany containing excerpts of Euclid—contains scores of diagrams with complete disregard for their relation to diagrams on

²⁷⁶ For attempts to clarify diagrams after Ratdolt's publication, see: Eunsoo Lee, "Let the Diagram Speak: Compass Arcs and Visual Auxiliaries in Printed Diagrams of Euclid's Elements" *Endeavour* 42 (2018): 93–94. *Endeavour* 42 (2018): 93–94.

the opposite side of the folio.²⁷⁷ Yet, two sets of circular diagrams share the exact location on opposite sides of the folio (Figure 74).²⁷⁸ Such a drastic shift in the positioning of diagrams may relate to the tools used. The circles on either side of the folio share a center, which was pierced by a compass through the parchment folio, marking the exact location on both recto and verso.²⁷⁹ Just as the compass offered a technology to overcome the difficulty of aligning diagrams on either side of the folio, so the innovative constituent technologies of print—including diagrams spaced at regular intervals locked into *formes*, and the exact alignment of the folio over multiple print runs due to metal pins securing the paper folio in place—allowed both circular and non-circular diagrams to benefit from exact alignment.

In Book XII, alignment is mobilized to illusionistic ends in Propositions 3 and 4. On the recto of this folio is a complex pyramidal diagram corresponding to proposition 3. According to the text, this diagram demonstrates that a pyramid with a triangular base may be divided into two equal prisms and two equal pyramids (Figure 75). The graphic, two-dimensional nature of this diagram creates a challenging visual environment for three-dimensional mental manipulation. The pyramidal diagram on the verso is just visible through the folio when lying flat, and clearly visible in the transmitted light of a page-turn. Here, rather than perfect overlap in their alignment, an intentional—yet relational—offset provides an opportunity for comparison. Viewing the diagram first on the recto, then in a mirror image through to the verso does not create the

²⁷⁷ Burney MS 275 is a scholastic miscellany produced in Paris between 1309–16 containing, among many other things, excerpts of Euclid from Adelard of Bath’s translation.

²⁷⁸ These diagrams can be found on ff. 328r and 328v; as well as ff. 333r and 333v which correspond to sections IX–XV.2 of Version III of the Adelard of Bath translation. See: H.L.L. Busard, *The First Latin Translation of Euclid’s Elements Commonly Ascribed to Adelard of Bath* (Toronto: Pontifical Institute of Mediaeval Studies, 1983), 25.

²⁷⁹ There are also other recto/verso circular diagrams that *do not* take advantage of alignment. Michael Camille argued for sophisticated viewers and producers who knew when to engage with additional visual information or not. See: Michael Camille, “The Trivial Arts in British Library, Burney MS 275,” in: *New Offerings, Ancient Treasures: Studies in Medieval Art for George Henderson*, ed. Paul Binski and William Noel (Thrupp: Sutton Publishing Limited, 2001), 343–366.

illusionistic three-dimensionality of Brunelleschi. Instead, the comparison aids the viewer in the mental manipulation of a complex shape as if simultaneously analyzing the object from the pyramid's uppermost point (recto) and base (verso). While this could be understood simply as a repetition of the image so that it is visible *after* a page turn, seeing both in transmitted light provides an additional view of each diagram for considering the positions of the constituent shapes into which the larger pyramid has been divided.

While the text itself never explicitly calls the reader's attention to multiple diagrams at once, students of geometry—particularly as we shall see below within the geometry of the cosmos—would have been required to mentally manipulate and set diagrams into motion. Kathleen M. Crowther and Peter Barker's reconstruction of how astronomers "saw" astronomical diagrams suggests that the texts trained the reader to understand flat, circular diagrams as three-dimensional, concentric, and dynamic structures of the cosmos.²⁸⁰ In fact, precisely because there could be no naturalistic depiction of cosmic events—which were beyond the reach of the human eye—readers necessarily must have developed powers of mental manipulation.

The first image in *Sphaera Mundi*, a text explored at greater length below, illustrates the expectation of a reader's capacity for mental manipulation. The Euclidian definition of a sphere is given as a semi-circle rotated around its diameter (Figure 76). This demonstrates not only that students of astronomy were required to develop powers of visualization, but also that a firm grasp of Euclidean geometry was prerequisite in contemplating the cosmos. Crowther and Barker explain that it was not enough to imagine an object in three-dimensions, the students also had to

²⁸⁰ Kathleen M. Crowther and Peter Barker, "Training the Intelligent Eye: Understanding Illustrations in Early Modern Astronomy Texts," *Isis* 104, no. 3 (September 2013): 430.

set this shape in motion in their minds.²⁸¹ Viewing and employing multiple diagrams at once would have required not only the physical vision of the eye, but also an intellectual capacity to manipulate images against one another.

At this point, I have argued, in the case of the calendars with printed instruments, for the possibility of the viewer mentally and physically manipulating printed books in collaboration with natural light in order to produce information. In Ratdolt's landmark publication of Euclid's *Elements*, I then suggested, an innovative interaction with light through the rich materiality of the gold-printed dedicatory letter and through diagrams aligned on either side of the folio. With the latter example, we may glimpse the inchoate stages of what I am calling "transfoliate" diagrams, that is, diagrams aligned on either side of a folio to offer additional information when viewed simultaneously. I now come to the argument for fully developed transfoliate diagrams printed in Ratdolt's editions of *Sphaera Mundi*.

3.4 Sphaera Mundi

Just as Euclid's *Elements* represented the standard text for geometric instruction, the text known as *Sphaera Mundi* became the standard for astronomical learning in the Middle Ages. The first section, the Treatise on Spheres (*Tractatus de Sphaera*) written by Johannes de Sacrobosco (c. 1195–c. 1256), offered a general introduction to the cosmic spheres—concentric orbs (in) which were thought to move heavenly bodies and a final orb holding the "fixed stars."²⁸² The second section was titled Planetary Theory (*Theorica Planetarum*) and was once

²⁸¹ According to the authors, this type of envisioning is based in the tripartite division of vision offered by St. Augustine: corporeal vision includes what is seen with the physical organ of the eye; spiritual vision describes dreams and fantasies that take place in the mind; and intellectual vision—independent of corporeal vision—grasps higher truths. See: Crowther and Barker, 433.

²⁸² Although little is known about his life including his place of birth, Johannes de Sacrobosco (also Ioannis de Sacro Bosco or John of Hollywood) studied at Oxford University and, by 5 June 1221, is recorded as an instructor at the university in Paris. See: Jürgen Hamel, *Studien zur "Sphaera" des Johannes de Sacrobosco* (Leipzig: AVA, Akad. Verlag, 2014), 9.

attributed to Gerard of Cremona, but is now ascribed to an anonymous author. For over two hundred years, from the 1250s through most of the fifteenth century, astronomical curricula in European universities relied on these two complementary texts, traveling together.²⁸³

In Ratdolt's publication of *Sphaera Mundi*, the second text, Planetary Theory, was replaced by Georg von Peurbach's New Planetary Theory (*Theoricae Novae Planetarum*).²⁸⁴ Thus, in Ratdolt's publications of 1482 and 1485, the work generally known as *Sphaera Mundi* contains (in order): Johannes Sacrobosco's *Tractatus de Sphaera*; Georg von Peurbach's *Theorica Nova Planetarum*; and Regiomontanus' *Disputationes contra Cremonensia deliramenta*.

The selection and compilation of these texts was highly charged. Astronomy in the late-fifteenth century was extremely productive: Georg von Peurbach (1423–1461) and his pupil Regiomontanus were at the center of bitter controversies challenging previous astronomical understanding.²⁸⁵ Although they continued to labor under a geo-centric model, leading astronomers were becoming aware that their observations did not align with existing models of the cosmos. Peurbach's solution was to complicate the ancient, two-dimensional model of concentric spheres with three-dimensional orbs. Within this three-dimensional model, his addition of "partial orbs," above and below celestial bodies, attempted to explain their

²⁸³ Peter Barker, "Albert of Brudzewo's Little Commentary on George Peurbach's *Theoricae Novae Planetarum*," *Journal for the History of Astronomy* 44, no. 155 (May 2013): 126. See Also: E.J. Aiton, "Peurbach's *Theoricae Novae Planetarum*: A Translation with Commentary," *Osiris* 3 (1987): 6.

²⁸⁴ The *Theoricae Novae Planetarum* originated as a series of lectures given by Peurbach in 1454 in the Collegio Civicum (Bürgerschule) in Vienna. Sometimes described as a "gothic humanist," Peurbach (1423–1461) stands as a traditional figure who made astronomical advancements of his own but whose work is largely known only through the publications of his lectures by his protégé, Regiomontanus. See: E.J. Aiton, "Peurbach's *Theoricae Novae Planetarum*: A Translation with Commentary," *Osiris* 3 (1987): 5–44.

²⁸⁵ Michael Shank, "Regiomontanus and Astronomical Controversy in the Background of Copernicus," in *Before Copernicus: the cultures and contexts of scientific learning in the fifteenth century*, ed. Rivka Feldhay and F.J. Ragep (Montreal: McGill-Queen's University Press, 2017), 80.

“irregular” motion (i.e. physical observations that diverged from existing theoretical models).²⁸⁶

These debates and commentaries first published in Nuremberg and Venice had wide reverberations across scholarly and intellectual networks spanning a wide geography.²⁸⁷

The discussion of these models within the history of science has been framed by the debate surrounding the “reality” of the orbs. That is, whether they were understood to be a physical material in which planets were “set” and forced to move—like a gem set in a ring—or whether they represented only a mathematical metaphor that allowed for mental visualization.²⁸⁸ Regardless of their perceived “reality,” new theoretical models required updated visual representations that were innovative both in content and technique.

In Ratdolt’s 1485 edition of the *Sphaera Mundi*, I have identified further examples of “transfoliate” diagrams: three pairs of diagrams that take advantage of precise alignment to offer additional information when viewed with transmitted light.²⁸⁹ Perhaps the most straightforward and explicitly useful pairing was that of the Theory of Aspects diagram with the Theories of Conjunction and Opposition diagram. The Theory of Aspects diagram depicts the twelve signs of the zodiac around its circumference (Figure 77). Lines between the constellations describe their spatial relationship to one another, or aspect. Next, the Theories of Conjunction and Opposition

²⁸⁶ These orbs were thought to have rotated in place or to be carried by other partial orbs, reconfiguring and rectifying technical problems in the flat circular models of Ptolemy’s *Almagest* and Georg of Cremona’s earlier work. See: Peter Barker, “Albert of Brudzewo’s Little Commentary on George Peurbach’s *Theoricae Novae Planetarum*,” *Journal for the History of Astronomy* 44, no. 155 (May 2013): 126. See Also: E.J. Aiton, “Peurbach’s *Theoricae Novae Planetarum*: A Translation with Commentary,” *Osiris* 3 (1987): 6.

²⁸⁷ As Y. Tzvi Langermann has noted, Peurbach’s work was translated and commented on in Hebrew by leaders of Jewish communities in Cracow and Salonika (Thessaloniki). See: Y. Tzvi Langermann, “Peurbach in the Hebrew Tradition,” *Journal for the History of Astronomy* 29, Part 2, no. 95 (1998): 138. The texts of Sacrobosco and Peurbach also traveled together in manuscript form in Hebrew-speaking communities where they were overlaid with verses from the Torah. See: Langermann, *Ibid.*, 140.

²⁸⁸ Peter Barker, “The Reality of Peurbach’s Orbs: Cosmology Continuity in Fifteenth and Sixteenth Century Astronomy,” in *Change and Continuity in Early Modern Cosmology*, ed. Patrick J. Boner (Dordrecht: Springer, 2011), 7–33.

²⁸⁹ They are: *Theorica minvtorvm pro-portionalivm lvnae (recto)* and *Theorica Draconis Lvnae (verso)*; *Theorica axium et polorum (recto)* and *Theorica Motvum (verso)*; *Theorica aspetvum et radiatorvm (recto)* and *Theorica Conivnctionis et oppositionis lvminarivm (verso)*.

diagram describes the position of planets within the zodiac (Figure 78). It demonstrates the position of a planet when it is in “conjunction” with a zodiacal sign and distinguishes between “true,” “mean,” and “visible” conjunctions.²⁹⁰ Although each page is opaque when lying flat, when the folio is held up to the light in the process of turning the page it becomes translucent (Figure 79). The visual imposition of these two diagrams in transmitted light allows viewers to understand the position of the planets within the space of the zodiac and to visualize their spatial relationships with one another as they orbit. These diagrams required highly complex manipulations of the printing press, blocks, and the folio.

A more complex example comes from the second section of Ratdolt’s edition: the *New Theory of Planets*. Here, in a section describing the motion of the moon, the alignment of two diagrams allows viewers to understand the distance between the moon and the earth as it travels through the zodiac, as well as the orientation of the moon respective to the sun. In the first diagram, the theory of proportional parts describes how the orbit of the moon changes as it moves through the space of the zodiac in relation to the center of the earth (Figure 80).²⁹¹ As the moon moves through the twelve divisions of the circular diagram (and thus the twelve signs of the zodiac) an imagined line from the center of the earth to the point when the moon is furthest away (apogee) and an imagined line from the center of the earth to the point when the moon is closest (perigee) fluctuate in proportion to one another.²⁹² When divided by sixty, which can be seen in the concentric circles labeled by tens, the proportion of apogee measurement to perigee

²⁹⁰ Ibid.

²⁹¹ The twelve constellations of the zodiac are used as a tool for measuring the movement of planets observed in comparison to the fixed location of each constellation. In a geo-centric model, the sun appears to rise and set in different constellations throughout the year, thus the zodiac is also known as the “ecliptic” as the sun “eclipses” each constellation as it passes between the earth and the “fixed stars” throughout the year.

²⁹² Aiton, “Peurbach’s *Theoricae Novae Planetarum*: A Translation with Commentary,” 16–17.

measurement is visualized as the printed ochre section on the diagram as the moon moves through the zodiac.

Aligned on the opposite side of the folio from this proportional understanding of the distance between the earth and moon is the *Theorica Draconis Lunae* diagram, which refers to the orientation of the moon as it moves through the zodiac (or ecliptic).²⁹³ As the moon orbits the earth, it traces an imagined circular plane. Similarly, as the sun was perceived to pass through the signs of the zodiac its “movement” traced a separate plane. Because the angle of the moon’s orbit around the earth and the angle of the sun’s “movement” through the zodiac are not identical, the two planes intersect (Figure 81). This means that as the moon orbits the earth, half of its orbit will be north of the plane created by sun, and half will be south of the sun’s plane. The northern part of the moon’s plane is known as the head of the dragon and the southern plane is known as the tail of the dragon. So, in the first diagram the proportional distance of the apogee and perigee of the moon to the earth is visible as it travels through the ecliptic, and in the transfoliate diagram, it may be observed whether the moon is in orbit above or below the sun’s perceived orbit (Figure 82). Such information would have been important as the period of time in which the moon was in the “head of the dragon” was considered to be auspicious, while the “tail of the dragon” was inauspicious. While each of these diagrams function independently, a more granular, information-dense reading is possible when the diagrams are aligned and read together.

It is important to note that Ratdolt was not the first to introduce the precise registration that allowed for diagrams to be read with transmitted light. The earliest example I have found appears in the *Sphaera Mundi* (with texts by Sacrobosco and those attributed to Gerard of Cremona) published by Franciscus Renner de Heilbronn in 1478 (Figure 83). Heilbronn began

²⁹³ The ecliptic describes the apparent position of the sun as it rises and sets throughout the year, this was observed in relation to the twelve signs of the zodiac or constellations.

printing in Venice in 1471, just two years after the introduction of print to the city in 1469. He reprinted two texts printed first by Ratdolt, the *Cosmographia* by Dionysius Perigetes in 1481, and *Cosmographia* by Pomponius Mela in 1482.²⁹⁴ These publication dates may help to contextualize the relationship between the two printers. While Ratdolt's inspiration for transfoliate diagrams may have developed from Heilbronn's 1478 example, it appears influence between the two printers flowed in two directions at various moments of their careers in Venice. The atmosphere of fierce competition described in the print privileges likely spurred a combination of innovation, collaborative borrowing, imitation, and/or theft.

While I have argued for geometric and astronomical evidence that the visual combination of diagrams is logical and produces new information, there are arguments to be made against this intentional mobilization of printing techniques. Given the rectangular wooden *formes* in which text and images were held and swapped out as necessary, two diagrams necessarily align when preceded by the same number of lines of text. Yet, this is not the case in the transfoliate diagrams produced by Ratdolt I have investigated. In each instance I have identified, the two diagrams are preceded by a *different* number of lines of text, creating an obstacle for the printer to overcome through the addition of "furniture" or spacers to hold the diagram in place in the absence of text in the immediate vicinity.

Another argument is that the diagrams were aligned intentionally, but only so that the lines visible through the folio would not compete with one another. This was common practice with the printing of text to maintain aligned rows of printed words on either side of the folio. However, in other instances throughout the book, Ratdolt did leave unrelated diagrams to fall in after the text and lines visible through the folio compete visually. A final argument is that it

²⁹⁴ R.T. Risk, Ratdolt, 1982, 25. Franciscus (Franz) Renner de Heilbronn, who attracted the support of Nicolaus of Frankfurt, reprinted two versions of *Cosmographia* printed by Ratdolt, first in 1477 and again in 1478.

required a great command of the subject matter in addition to printing experience. While I argue that the printer was capable of such a feat, given his specialization in geometric and astronomical texts, I expand my scope below to consider Venetian visual culture more broadly, in search of the production and appreciation of translucency and opacity.

3.5 Venetian Production and Reception of Translucency

In asking whether broader visual and material culture may have informed the way geometric and astronomical texts were produced and interacted with, I build upon scholarship which argues that the dichotomy between art and science is false.²⁹⁵ In attempting to define a subject area of “scientific illustrations” scholars have ignored much of their visual significance.²⁹⁶ Yet, neither can there be a simple elision as diagrams are neither purely linguistic nor completely pictorial.²⁹⁷ The histories are complementary and often overlap. To understand how these diagrams were viewed and, moreover, to push for the idea that printers sought to activate the translucency of the folio, it is important to demonstrate that properties of translucency were deeply appreciated in Venetian visual culture, as seen in artistic production: a keen awareness and reception of these qualities is in evidence, leading to their mobilization for metaphorical and theological meaning.

Around 1400 Cennino Cennini, in his *Libro dell'arte* spoke of the production of transparent materials for the manipulation and translation of images.²⁹⁸ In chapter 23 he

²⁹⁵ Brian Baigrie, *Picturing Knowledge: Historical and Philosophical Problems Concerning the Use of Art in Science* (Toronto: Toronto University Press, 1996), 29.

²⁹⁶ Caroline A. Jones and Peter Galison, *Picturing Science, Producing Art* (Hoboken: Taylor and Francis, 1998), 2.

²⁹⁷ Alan F. Blackwell, *Thinking with Diagrams* (Dordrecht: Kluwer Academic Publishers, 2001), 1.

²⁹⁸ While Cennini is traditionally associated with the Tuscan hill town Colle di Val d'Elsa, Laura Broecke argues that much of his writing may have occurred during a period in which he lived in the Veneto, likely Padua, due to the inclusion of that region's dialect and his description of uniquely Venetian techniques for working gold. See: Laura Broecke, *Cennino Cennini's Il libro dell'arte: A new English translation and commentary with Italian transcription* (London: Archetype Publications, 2015), 5–9.

described the way, “in which way you can trace drawings with tracing paper.”²⁹⁹ The English translation “tracing paper” lacks the connotations of light and transparency imbedded in the original Italian term *carta lucida*.³⁰⁰ Cennini describes three ways of producing *carta lucida*: first, by scraping goat-skin extremely thin and applying linseed oil if necessary; second, a process in which animal glue or fish glue is allowed to dry in a thin layer on smooth marble and then peeled off; and a third approach is to apply linseed oil to soft, white rag paper. Cennini then describes placing the *carta lucida* over a drawing and securing it with wax. Because of its transparency, the figure beneath will suddenly shine through, clearly visible.

There is evidence of this type of transfer present in copies of Hyginus’ *Poeticon Astronomicum* which contains Ratdolt’s woodcuts of constellations and planets.³⁰¹ A copy in the Huntington Library (717870) published by Thomas de Blavis de Alexandria retains evidence of a substance applied to the folio surrounding the figure of Virgo (Figure 84). This is likely oil, transferred onto the image from *carta lucida* as it was pressed against the printed image to be traced. This is further evidenced by the remains of a darker substance in each of the corners, likely wax, used to secure the tracing paper as described by Cennini. This use of *carta lucida* speaks to the production of transparent tools for the manipulation and translation of images, as well as readers’ appreciation of the material possibilities of translucency.

²⁹⁹ *In che modo puoi [ritrarre] la sustanza d’una buona figura, o disegni con la carta lucida*. See: Cennino Cennini, *Il Libro dell’Arte della Pittura: il manoscritto della Biblioteca Nazionale Centrale di Firenze, con integrazioni dal Codice Riccardiano*, eds. Franco Cardini, Antonio P. Torresi and Galeazzo Viganò (Ferrara: Liberty House, 2004), 72.

³⁰⁰ While in English the verb used to signify reproduction with this technique is “to trace,” in Italian, the verb used is “to light” or *lucidare*. The transitive verb *lucidare* in the first definition means to copy by means of light, using a transparent piece of paper and a writing instrument. Only in the third definition does it indicate polishing or luster. See: Grande Dizionario della Lingua Italiana, “Lucidare,” 252.

³⁰¹ This text was frequently bound together with Ratdolt’s editions of *Sphaera Mundi*, for example, Biblioteca Marciana Inc. V. 812–0815 contains 812 Pomponius Mela, *Cosmographia* (Ratdolt, Venice, 1482); 813 Johannes Sacrobosco, *Sphaera Mundi* (Franciscus Renner de Heilbronn, Venice, 1478); 0814 Hyginus *Poeticon Astronomicum* (Ratdolt, Venice, 1485); 815 Marsilio Ficino, *De Vita Libri Tres* (Bartolomeo Pelusio, Venice, 1498).

Although Cennini's book reads as something of a manual, scholars have noted frequent impracticalities, errors, and omissions in the text. Instead, it may have been intended as a presentation book with the aim of elevating the status of the artist at court and to associate artists with the learned and lettered rather than court entertainers.³⁰² If artists were indeed looking to this text to further their craft, the description of *carta lucida* is instructive on the production of transparent tools for the manipulation of images. If, on the other hand, the text was aimed at a courtly audience, it could have informed viewers of the material possibilities of translucency.

In searching for visual evidence of the activation and manipulation of translucency in Venice, one must include glass; however, before the technological development of clear glass by glassmaker Angelo Barovier around 1450, naturally occurring rock crystal was crafted as a transparent medium.³⁰³ Reliquaries, in particular, began employing the optical properties of rock crystal during the late Middle Ages to offer mediated visual access to the miraculous relics they contained.³⁰⁴ One particularly instructive example is the reliquary arm of St. George held in the treasury of San Marco.³⁰⁵ The conical, silver-gilt and enameled reliquary is an amalgam of materials and objects first brought together in Constantinople (before 1204). It was then

³⁰² Broecke, 7–9.

³⁰³ For more on the development of clear or *cristallo* glass, see: Rosa Barovier Mentasti "La nascita del cristallo," in *Trasparenze e riflessi: Il vetro Italiano nella pittura*, ed. Rosa Barovier Mentasti (Verona: Editoriale Bortolazzi Stei, 2006), 35–56. Rock crystal is an alternative name for transparent coarsely crystalline quartz (SiO₂). See: William Nesse, *Introduction to Mineralogy* (New York: Oxford University Press, 2000), 205.

³⁰⁴ Michael Camille noted a shift in the production of reliquaries in the late Middle Ages from an earlier emphasis on mystical illumination achieved through layers of luminous gold to transparent layers of rock crystal. He attributed this to a gradual demystification and increasingly mathematical understanding of light by considering the combination of Euclidian geometry, Arabic optical theory, and Aristotelian materialism in this period. See: Michael Camille, "Before the Gaze: The internal senses and late medieval practices of seeing," in *Visuality Before and Beyond the Renaissance: Seeing as Others Saw*, ed. Robert S. Nelson (Cambridge: Cambridge University Press, 2000), 197–223. See also: John Gage "Lumen, Alluminar, Riant: Three Related Concepts in Gothic Aesthetics," *Europäische Kunst um 1300*, ed. G. Schmitt (Wien: Akten des XXXV. Internationalen Kongresses für Kunstgeschichte, 1986) 31–37.

³⁰⁵ There are over a dozen examples of rock crystal or clear glass in the treasury of San Marco, including many which explicitly mediate light such as oil lamps. See: David Buckton, ed., *The Treasury of San Marco Venice* (Milan: Olivetti, 1984).

transported to Venice after the fourth crusade and further embellished in the fourteenth and sixteenth centuries (Figure 85). At the top, a convex lens allows light and the gaze to pass through to the bone relic below. Although the current lens is made of clear glass, it replaced an earlier piece of rock crystal. The curved opening of the reliquary together with the protrusion of bone would have required that the earlier rock crystal be convex in a manner similar to the current glass. These convex lenses not only allowed for protected visual access to the relic, they also acted as optical lenses to modify the light passing through and to increase the apparent size of the relic.³⁰⁶ While the relic would have been of primary significance, no less was the translucent medium that magnified and modulated its visibility.

Once clear (*cristallo*) glass was developed by the Barovier family, a range of new techniques became possible. While there was, at this time, an almost obsessive desire for acquiring the most transparent glass possible, free of any imperfections, there was also an interest in objects possessing a new dynamic range between transparency and opacity. A beaker, dated to around 1500 and now in the Corning Museum of Glass (61.3.1) is an example of illusionism in Venetian glass that intentionally played with the effects of translucency (Figure 86). Fashioned from chalcedony glass (*vetri calcedonii*), a trompe-l'oeil imitation of the semiprecious family of stones which includes agate, carnelian, onyx, and others, it was produced by combining gathers of molten glass of different hues and opacities together with the highly-prized *cristallo* glass.³⁰⁷ The mixture was then blown and shaped into the desired form. In the

³⁰⁶ In contemporaneous reliquaries, artists exploited rock crystal's magnifying properties to modify the appearance of imagery incised into the crystal or to alter the apparent size of bones and blood below. An example of this can be seen in the Ninian Reliquary (c. 1200) now in the British Museum (1946,0407.1a) See: Stefania Gerevini, "Christus crystallus: Rock Crystal, Theology and Materiality in the Medieval West," in *Matter of Faith: An Interdisciplinary Study of Relics and Relic Veneration in the Medieval Period*, ed. James Robinson and Lloyd de Beer with Anna Harnden, 92–99 (London: British Museum Press, 2014), 93.

³⁰⁷ "Chalcedony glass was one of the most complicated and demanding glasses that Venetian workshops produced at this time. Glass recipes described how a mixture of several ingredients including silver, mercury, cobalt, manganese,

final result, milky blue glass eddies and flows through a translucent red. As the eye moves across the surface of this beaker, the glass rapidly alternates between opaque and translucent strata in an irregular rhythm that echoes the almost iridescent quality of the striated natural stone.

This interplay of light is not guaranteed in objects made of chalcedony glass. A similar goblet in the Wallace Collection (C513) seems almost obstinately opaque in contrast (Figure 87). While the outside of the goblet is formed by glass saturated with blues, greens, and earthy reds, a completely opaque jade-colored slip blown inside the vessel prevents nearly all transmitted light from illuminating these colors. Instead, the viewer or user must rotate the goblet to view a small section of rich hues before the light is swallowed again (Figure 88).³⁰⁸ This goblet suggests a more complex range of dynamic effects achieved by Venetian glassmakers. As Paul Hills writes, “The glassblowers of the fifteenth century diversified their products to create a varied range that sharpened discrimination of the absolutely transparent, the translucent, and the opaque.”³⁰⁹ Rather than a visual culture that valued transparency alone, creators and viewers alike explored the ways that light interacted with certain materials and they delighted in unexpected outcomes.³¹⁰ For the viewer familiar with chalcedony glass, the Wallace goblet may have come as something of a surprise. This interplay of opacity and transparency suggests a viewership

copper oxide, iron oxide, and red lead were dissolved in nitric acid. A brownish precipitate formed that was carefully added to the waiting *crystallo* glass melt.” “[...] The addition of such a disparate mixture of coloring and opacifying produced a whole host of physical effects in the glass resulting in calcedonio’s swirled, sometimes opaque, sometimes transparent, multicolored visual appearance.” See: W. Patrick McCray, *Glassmaking in Renaissance Venice: The Fragile Craft* (Aldershot: Ashgate, 1999), 100, 122. For technical studies on chalcedony glass, see: W. Patrick McCray, Zoe Osborne, and W. David Kingery, “The culture and technology of Renaissance Venetian chalcedony glass,” *Rivista della Stazione Sperimentale del Vetro*, no. 5/6 (1995): 259–78.

³⁰⁸ This characteristic is erased by contemporary studio lighting that evenly illuminates the glass. Instead, viewing it from a single light source, which more closely replicates fifteenth- and sixteenth-century indoor conditions reveals its stubborn display of color.

³⁰⁹ Hills, 114.

³¹⁰ Suzanne Higgot notes, that if—like similar chalcedony glass objects—the Wallace goblet originally had a cover, the delight of discovering the remarkable contrast of hue between the inside and outside of the bowl would have been all the greater. Suzanne Higgot, *The Wallace Collection: Catalogue of Glass and Limoges Painted Enamels*, (London: Trustees of the Wallace Collection, 2011), 46.

aware of light-reactive properties of various materials—always on their mettle for unexpected interactions with light.³¹¹

An exceptional glass goblet and bottle in the British Museum (ca. 1500) coyly embody the heightened attentiveness to variations on opacity and transparency in Venetian visual culture (Figure 89). These glass objects are decorated with *millefiori*, a motif in which colored glass rosettes are applied to the exterior of glass object before it is finished.³¹² When these objects are vertical, the glass between the rosettes appears gray and metallic; but pouring from the bottle or drinking from the goblet caused the glass between the rosettes to become transparent, revealing the liquid contents within (Figure 90). Like the opaque paper of Euclid's *Elementa* or the *Sphaera Mundi* compilation, which became transparent as the reader turned the page, here the viewer (or drinker) would have been rewarded by manipulating the vessel as it oscillated between opacity and transparency.³¹³

There is evidence that these elegant visual commentaries on the properties of light and material existed beyond drinking games and were perhaps closer to the contemplation of printed books. In his *Praise of the City of Venice*, Marcantonio Sabellicus mentioned spheres of millefiori glass either used as paperweights, or pierced and set in silver mounts to hang from shelves as decorative objects in the *studiolo*.³¹⁴ As mentioned in Chapter 2, particularly lavish

³¹¹ I am suggesting an expanded notion of Baxandall's "Period Eye" to include material properties of transparency and/or opacity. See: Michael Baxandall, *Painting and Experience in Fifteenth-Century Italy* (Oxford: Oxford University Press, 1972), 34: "The fifteenth-century man looking at a picture was curiously on his mettle. He was aware that the picture embodied skill and he was frequently assured that it was the part of the cultivated beholder to make discriminations about that skill, and sometimes even to do so verbally."

³¹² The millefiori technique involves pulling various colors of molten glass into long, thin canes. The canes were then nested together and sliced into cross-sections, revealing brightly colored rosettes. These rosettes are applied to the molten glass, which is reheated and blown into a mold. See: Jutta-Annette Bruhn, *Designs in Miniature: The Story of Mosaic Glass* (Corning, New York: Corning Museum of Glass, 1995), 5.

³¹³ Bruhn, *Designs in Miniature*, 18.

³¹⁴ Anne-Elizabeth Theuerkauff-Liederwald, *Venezianisches Glas der veste Coburg: Die sammlung Herzog Alfreds von Sachsen-Coburg und Gotha (1844-1900)* (Lingen: Kunstsammlungen der Veste Coburg, 1994), 62-7.

studioli may have had bookshelves (*armadi*) covered with glass panes to protect books from dust and damage. Already rich with information, the *studiolo* may now be conceived of as a space in which the play of light in and through objects inspired new comparisons and generated complex meaning.

A painting attributed to Jacopo de' Barbari, which depicts Luca Pacioli and possibly Guidobaldo da Montefeltro in study, delights in recording the reflection and refraction of light through a clear glass object (Figure 91). In addition to the desk populated with geometry books and diagrams, a depicted glass curio, known as a rhombicuboctahedron, hanging to the left of the figures rewards close looking.³¹⁵ The clear glass object is partially filled with water and the view from a nearby window reflects multiple times across the various planes of this complex object.³¹⁶ As the eye adjusts to the darkness of the painting's background, more subtle detail emerges reflected in the glass: the green table cloth, the friar's gray habit, and his hand holding a pointer. Finally, just visible on the triangular face of the *crystallo* glass parallel to the picture plane is a possible self-portrait of the artist and easel (Figure 92). Regardless of this object's actual existence, this depiction is the product of a visual culture which eagerly engaged with qualities of transparency, unexpected opacity, reflection and refraction—especially as they related to newly available technologies and learning.³¹⁷

If this glass object existed outside of the artist's imagination, it is quite possible that it would have been produced in the glassworks on the nearby island of Murano, drawing on the

³¹⁵ A rhombicuboctahedron is an Archimedean solid or three-dimensional shape comprised of eight triangular, six square, and twelve rectangular faces.

³¹⁶ In support of the identification of the pupil as Guidobaldo da Montefeltro, the structure reflected in the glass object has been identified as the *Palazzo Ducale* of Urbino. See: Sergio Marinelli, "Trasparenze e riflessi di un dio minore," in *Trasparenze e riflessi: Il vetro Italiano nella pittura*, ed. Rosa Barovier Mentasti (Verona: Editoriale Bortolazzi Stei, 2006), 3–10, especially 6.

³¹⁷ Renzo Baldasso and John Logan, "Between the Golden Ratio and a Semiperfect Solid: Fra Luca Pacioli and the Portrayal of Mathematical Humanism," 136.

technical knowledge of Angelo Barovier and his glassblowing family.³¹⁸ More than an awe-inducing curio, the complex piece of colorless glass offers a geometric proof in three dimensions. It is a reflective tool in the pursuit and instruction of geometrical knowledge alongside printed books and manuscripts. The mathematician-friar Luca Pacioli points with his left hand to the 1482 edition of Euclid's *Elementa* translated by Adelard of Bath, edited by Johannes Campanus, and published by Erhard Ratdolt in Venice.³¹⁹ Reasonable arguments against the physical existence of the glass object—due to its dubious ability to support the weight of the water it has been filled with given its large size and glass hook—nonetheless distract from the significance of the newly developed material in this period and its perceived utility in the pursuit of knowledge. If the discussion of geometric concepts, such as the platonic solids from which the glass object is formed, in Euclid could be expressed through the plasticity and transparency of glass, perhaps the translucent properties of glass might have previously informed the visual appearance and organization of information in Ratdolt's edition of Euclid.

This visual cultural moment of fascination with the properties of light and its interaction across media extended beyond mathematical and astronomical investigations and into theological metaphor. A cycle of paintings by Vittore Carpaccio in the *Scuola di San Giorgio degli Schiavoni* (or *Scuola Dalmatia dei SS. Giorgio e Trifone*) in Venice records a wide range of lighting effects (Figure 93). One painting (c.1501–09) depicts St. Augustine in his studio at a moment when he is said to have received a vision of St. Jerome. The vision takes the form of a

³¹⁸ Angelo Barovier's name is the one most frequently associated with the introduction and innovation of several new and sophisticated luxury vessel glass compositions including *crystallo*, *calcedonio*, and *lattimo*. Historical records indicate that the Barovier family, especially Angelo as well as his brother Taddeo, was directly involved with the introduction of all three glasses. See: McCray, 100. See also: Archivio di Stato di Venezia (ASV), Podestà di Murano, b. 26, fasc. 2. For the original contract between Taddeo Barovier and Bartolomeo Visentin, in which Visentin would learn the techniques of luxury glass.

³¹⁹ Sergio Marinelli, "Trasparenze e riflessi di un dio minore," in *Trasparenze e riflessi: Il vetro Italiano nella pittura*, ed. Rosa Barovier Mentasti, 3–10 (Verona: Editoriale Bortolazzi Stei, 2006), 6.

supernatural light entering through the window at the evening hour of compline.³²⁰ Because the light closest to St. Augustine represents the saintly presence of Jerome, the light entering the window in a small room opposite Augustine must be sunlight.³²¹ This is significant as the rich catalogue of lighting effects in the *studiolo* is not the result of natural causes, but rather the effect of mundane objects suffused with sacred illumination.

According to saintly legends published in fifteenth-century Venice, Jerome posed a series of mystical questions to Augustine during his visitation:

Augustine, Augustine, what are you seeking? Do you think that you can put the whole sea in a little vase? [...] Make fast the heavens so that they may not keep going in their accustomed motion? [...] Your ear [to] hear what is received by no ear through sound?³²²

While previous scholarship has understood the luminous objects depicted throughout the scene in purely pictorial terms, I argue that many of them refer to Jerome's existential questions posed to Augustine. The luxurious, imported blue-and-white porcelain vase perched on a cornice—its profile in sharp relief against Jerome's glow—represents the little vessel attempting to contain the whole sea. The geo-centric armillary sphere illuminated not by the “moving” sun but by saintly fluorescence struggles to “make fast the heavens.” Lastly, the enticing open codices displaying musical notation at Augustine's feet endeavor to make heard what is received by no ear through sound.

³²⁰ The painting was previously thought to be a depiction of St. Jerome in his Studio until 1959, when Helen Roberts used apocryphal legends published in Venice in the late fifteenth century to argue that the scene depicts St. Augustine. See: Helen I. Roberts, “St. Augustine in ‘St. Jerome’s Study’: Carpaccio’s Painting and Its Legendary Sources,” *The Art Bulletin* 41, no. 4 (Dec., 1959): 283–297, particularly 286.

³²¹ Sunlight cannot be entering from opposite sides of the building at once. See: Hugo Chapman, Marzia Faietti eds. *Fra Angelico to Leonardo: Italian Renaissance Drawings* (London: British Museum, 2010), 267, Cat. No. 81.

³²² Instead of “pure forms” as suggested by Terisio Pignatti or a “consistent density of objects drawing the eye backward” as proposed by Caroline Brooke, see: Terisio Pignatti, trans. James Emmons, *Carpaccio* (Lausanne: Skira, 1958) 58, as well as Caroline Brooke, “Vittore Carpaccio’s Method of Composition in his Drawings for the Scuola di S. Giorgio Teleri,” *Master Drawings* 42, no. 2 (2004): 304.

Of the many painterly entanglements with light across this canvas, the six open codices are of greatest interest to the present consideration of luminosity and learning. Most visible is the volume resting against the podium and open to the viewer's perusal (Figure 94).³²³ The upper corners of the book are described in strong raking light. Brushstrokes indicating bright warm light slash across the rectangular folio. The thickness of this pigment, read as brilliant light, occludes the manuscript text and part of the rubricated initial R. The effect of saintly illumination—to obscure, rather than to elucidate the tools of mortal learning—likely came as an unexpected interaction between rays of light and parchment, much like the difficulty with which one would interact with the gold-printed dedicatory letter in Ratdolt's *Euclid* or the obstinately opaque chalcedony glass, while still appealing to a visual culture delighted by such surprises.

The internal logic of light within Carpaccio's painting is somewhat diminished by the even glow of artificial, electric light in its contemporary setting. Until recently it was accepted that the painting cycle was originally located in the upper room of the *Scuola* and that it was moved to the lower level after the 1551 completion of building renovations.³²⁴ If so, this would suggest that the lighting conditions would have been similar to those downstairs where the painting now hangs.³²⁵ The appearance of the exterior of the *scuola* before construction of the façade is thought to be recorded in two other paintings by Carpaccio still in the *scuola*: a frontal view in "St. Jerome and the Lion in the Convent" (1509) and a lateral view in the "Funeral of St.

³²³ The books and manuscripts have become transparent over time due to the thinning of the paint layers and, consequently, the carpeted edge of the podium is visible through most of the codex. Ibid., Brooke, 304n11.

³²⁴ An inventory dated 1 December 1557 records, "a painting of Saint Augustine," (*Uno Quadro de S. Agostino*). However, it does not give the specific location. See: Guido Perocco, *Carpaccio nella Scuola di S. Giorgio Degli Schiavoni* (Venice: Ferdinando Ongania, 1964), 225.

³²⁵ Gustavo Ludwig and Pompeo Molmenti have argued that the paintings were "located on the upper hall of the *Sala dell'Albergo*, illuminated by two façade windows and another two over the canal." See: Gustavo Ludwig and Pompeo Molmenti, *Vittore Carpaccio: La vita e le opera* (Milan: Ulrico Hoepli, 1906).

Jerome” (1502) (Figure 95, Figure 96).³²⁶ From these depictions, it may be concluded that light entered the upper story through an oculus on the southern side and possibly through two pointed-arch windows flanking the central oculus.

Yet the conservation of the cycle of paintings in 2022 has prompted a reconsideration of the location of the painting, based not only on material evidence but also on additional archival sources brought to bear. Valentina Piovan and her collaborators draw attention to an extended controversy between the Scuola degli Schiavoni and the Priory of the Order of Saint John of Jerusalem, with whom the Scuola shared walls and rooms.³²⁷ This controversy, which began in 1502 and ultimately required legal action to settle, revolved around which institution had use of the upper hall. Piovan argues that it is implausible that Carpaccio would conceive of placing his monumental cycle in a contested space.³²⁸ Instead, she suggests, because the theme of light is so important in the painting of St. Augustine, the installation would have utilized the window opening above the ground-floor door that is still present today as a source of natural light. Significantly, before the 1551 renovation, the ceiling was between 190–180 cm lower, aligning the natural source of light even more closely with the source of light in the painting coming from the miraculous vision of St. Jerome. Finally, the poor state of conservation of *St. Augustine* compared to the other paintings in the cycle supports the notion that it was exposed to the light, humidity, and air of an open window and door.³²⁹ In its current location at a right angle to the main entrance—when devoid of artificial light—soft, steady sunlight light enters through the south-facing transom window and enhances the otherworldly presence of St. Jerome throughout

³²⁶ Variations between these two depictions of the façade may represent changes carried out between 1502–1509, or may simply represent creative alterations by the artist. See: Perocco, 46–47.

³²⁷ Valentina Piovan, Stefania Randazzo, and Melissa Conn, “Carpaccio’s Original Painting Installation in the Scuola Dalmata: Where and Why” *Confraternitas*, 32 (2021 [2022]): 6–25.

³²⁸ *Ibid.*, Piovan, 13.

³²⁹ *Ibid.*, Piovan, 16.

the canvas (Figure 97). Whether this is the original location or, as previously argued, it was upstairs, Carpaccio's notion that the light source of the painting be enhanced by participation with natural light remains unchanged.

While the divine light depicted in Carpaccio's canvas obscures some of the manuscripts appearing on the table, the illumination in the *Virgin Annunciate* by Antonello da Saliba's took a different, likely materially-informed approach. The painting, now in the *Gallerie dell'Accademia* in Venice (Cat. 590) is a copy after the earlier panel created by da Saliba's uncle, the better-known Antonello da Messina in 1476 (Figure 98). While the two panels are similar in terms of composition, they diverge precisely at the level of light interacting with various materials. At the moment of the annunciation to Mary, the Virgin raises her hand from her book in a gesture of surprise and humility.³³⁰ As the book's internal binding structure pulls the folios back to a resting position, they are caught in what may be understood as divine light, each with a different optical response. The largest visible folio reflects light much like the depiction by Carpaccio, rendering the rubricated initial and iron gall script visible in high contrast. However, an interesting transformation takes place in the folio nearest the viewer. The raised corner is penetrated by light and the support appears translucent.

The painting was created by the Sicilian artist during a sojourn to Venice in the 1480s, where he entered the workshop of his uncle. Antonello Da Saliba's position in this workshop likely placed the artist in the ambit of a number of printers. This was due to the fact that his first cousin, Paola (i.e. Antonello da Messina's daughter), was married to Venice's first printer Johannes da Spira, and to two printers after Johannes' death: John of Cologne and Rinaldus of

³³⁰ For the Virgin's reply, see: The Gospel of St. Luke (1:46–47).

Nijmegen (Figure 99).³³¹ Working within this context of painters and printers it is likely that Antonello was exposed to the material possibilities of parchment and paper as it was being explored and exploited by the nascent print industry in Venice.

As in Antonello da Saliba's rendering of the book in his depiction of the Virgin Annunciate, the depiction of light transmitted through a transparent or translucent substance was frequently employed in the fifteenth century to symbolize the mystery of the incarnation. Theologians and poets often explained the perpetual virginity of Mary through the comparison of the passage of sunlight through a glass window.³³² St. Bernard wrote:

Just as the brilliance of the sun fills and penetrates a glass window without damaging it, and pierces its solid form with imperceptible subtlety, neither hurting it when entering nor destroying it when emerging: thus, the word of God, the splendor of the Father, entered the virgin chamber and then came forth from the closed womb.³³³

This metaphor assumed physical form in the mosaics and window of the so-called Mascoli Chapel (known as the *Cappella Nova* until the seventeenth century) of the Basilica San Marco in Venice (Figure 100). There a window composed of concentric circles of bottle-glass disks was placed in the center of a mosaic depicting the Annunciation designed by Michele Giambono. Paul Hills described these lenses, as “condensing the light passing through [...] into gleams of silver” fittingly calling to mind the Virgin's immaculate conception.³³⁴ I contend that Antonello da Saliba's depiction of light transmitted through parchment, rather than glass, participated in

³³¹ Deborah Parker, “Women in the Book Trade in Italy, 1475–1620,” *Renaissance Quarterly* 49, No. 3 (Autumn 1996): 516.

³³² Millard Meiss, “Light as Form and Symbol in Some Fifteenth-Century Paintings,” *The Art Bulletin* 27, no. 3 (Sept., 1945): 176.

³³³ Anselm Salzer, *Die Sinnbilder und Beiworte Mariens in der deutschen Literatur und lateinischen Hymnenpoesie des Mittelalters* (Linz: K.K. Ober-Gymnasium der Benedictiner im Selbstverlag, 1893), 74.

³³⁴ Paul Hills, *Venetian Colour: Marble, Painting, Mosaic and Glass* (New Haven: Yale University Press, 2000), 111.

contemporary theological understandings of translucency in connection with the Annunciation, while exploring the material possibilities of the codex.

3.6 Attuned to Translucency

I have traced the play of light in and through early printed calendars, geometrical texts, and astronomical diagrams in fifteenth-century Venice. Printed instruments encouraged interaction, touch, and pose which informed the operator as well as informing those who witnessed the astronomer's process while manipulating printed tables and instruments. Evidence of early transfoliate diagrams is visible in Erhard Ratdolt's landmark publication of Euclid's *Elements*. Finally, I argue that the technique was refined and employed in Ratdolt's second publication of *Sphaera Mundi* as well.

Evidence of both production and informed reception demonstrates a Venetian visual and proto-scientific culture that delighted not only in translucency, but in unexpected manipulations of light between transparency and opacity. Producers of Venetian material culture were particularly skilled in the creation of these objects and savvy Venetian viewers—informed by a variety of paintings, glass objects, prints, and mosaics—were on their mettle to seek out the physical interaction of light within and through familiar objects. Applying this sensitivity to the effects of light within mathematic and astronomical texts allowed viewers to set diagrams in motion against one another in the production of new experiential knowledge.

3.7 Epilogue

In 1486, Erhard Ratdolt returned to his native Augsburg. As evidenced by the woodblock illustrations in the copy of Hyginus' *Poeticon Astronomicum* published in Venice by Thomas de Blavis de Alexandria in 1488 (Figure 84), Ratdolt sold some elements of his printing operation in

Venice before he left. Other woodblocks, however, were deemed worthy of transport from Venice back to Augsburg.³³⁵ The choice indicates a shift in Ratdolt's innovative efforts upon his return. He continued to print calendars and some astronomical treatises, but moved beyond the diagrammatic mode toward elaborate illustration with multiple colors. This required technical expertise in registration similar to that which he had already developed through the production of transfoliate diagrams in Venice. One of his first successes depicted Friedrich II von Hohenzollern, Bishop of Augsburg, in full regalia with four colors: black, yellow, red, and olive green (Figure 101). This full-page illustration was included at the opening of the *Obsequiale augustanum*, published in February 1487. Ratdolt's assistant, Hans Burgkmair, would go on to produce complex chiaroscuro woodblock prints long before Vasari assigned credit for the invention to the Italian Ugo da Carpi.³³⁶

While chiaroscuro woodblock printing may be understood as one aspect of the legacy of Ratdolt's Venetian experiments with complex registration, there is evidence for the dissemination of transfoliate diagrams and images beyond Venice after Ratdolt's departure. This lineage may be traced through another German printer's interactions with Venice—Albrecht Dürer. After his first Venetian sojourn in 1494–95, Dürer employed a compass and ruler to create a geometrically proportional female nude based on his study of Vitruvius (Figure 102). On the reverse of the folio, Dürer drew a much more naturalistically rendered and clothed figure, yet retained the foreshortened circle used to measure the figure's proportions (Figure 103). The oval

³³⁵ Daniela Laube, "The Stylistic Development of German Book Illustration, 1460–1511," in *A Heavenly Craft: The Woodcut in Early Printed Books*, ed. Daniel de Simone, 47 – 71 (New York: George Braziller, 2004), 55.

³³⁶ One of Burgkmair's most significant advancements came after his sojourn to Venice in 1507. His *Lovers Surprised by Death*, produced in 1510, is considered the earliest known chiaroscuro woodblock to be composed of a line block and two tone blocks rather than just one tone block. Significantly, this requires all blocks to be printed for the image to be legible, rather than earlier examples in which the line block could be printed independently. See: Cleveland Art Museum, "The Lovers Surprised by Death" <https://clevelandart.org/art/1952.533> accessed 27 March, 2023.

shares a center with that on the other side of the folio, the exact location for which was likely identified during the drawing process by a small puncture through the paper from the compass. The artist's notes on the facing folio reference the use of the foreshortened circle on the reverse of the leaf.

Drawings like this, analyzing human proportions, were a central focus for Dürer in his final years. By the time he died, he had completed a manuscript for all except the final pages of Book IV for what would become *Four Books on Human Proportion* (*Vier Bücher von menschlicher Proportion*). The printed edition was published just months after his death by Willibald Pirckheimer in 1528.³³⁷ Departing from Vitruvian ideals, Dürer explored a variety of figure types of both men and women. These figures are depicted in profile, frontally, and from behind. Corresponding tables are populated with the proportional measurements of points on the body. Some figures take advantage of the codex format to display front and back views side-by-side across an opening of the book. Others, however, align figures on either side of single folio, as in the case of the male figure on folios L4r (front) and L4v (back). When viewing this transfoliate diagram in transmitted light, the full human figure becomes visible (Figure 104). The repetition of this design, again with a female figure on fols. M2r– M2v, suggests intentional organization of visual information that allows the viewer to produce an almost three-dimensional figure as the folio is turned.

It cannot be determined for certain that Dürer's use of the folio in his early drawings of human proportion, in his manuscript for the *Four Books on Human Proportion*, and in Pirckheimer's printed publication is the direct result of influence from Ratdolt's experiments

³³⁷ Walter L. Strauss, "Albrecht Dürer: The Human Figure, The Complete 'Dresden Sketchbook'" (New York: Dover Publications, 1972), vi. For more on the relationship between Dürer and Pirckheimer, see: Joseph Leo Koerner, *The Moment of Self-Portraiture in German Renaissance Art* (Chicago: University of Chicago Press, 1993), 411–449.

with transfoliation. Yet, the mobility of Ratdolt's publications and Dürer's own experiences in Venice in 1494–95 and again in 1505–07 would have offered him the occasion to interact with a culture incorporating translucency in many aspects of their visual production.

As a final example, I turn to Hieronymous Rodler whose [...] *Instruction of the Art of Measuring* [...] (*Eyn schön nützlich büchlin und underweisung der kunst des Messens* [...]) was published in Simmern in 1531. Although Ratdolt's influence on Dürer may have taken from Ratdolt is uncertain, the transmission of ideas from Dürer to Rodler is explicit. The preface to the 1531 book on measuring, proportion, and perspective states that Rodler considered his work an adaptation and simplification of Dürer's 1525 Treatise on Measuring, *Underweysung der Messung*. The book opens with a description of single-point perspective and a diagrammatic woodcut sketching outlines of basic architectural structures stretching back toward the vanishing point. On the verso of this folio is a full-page woodcut illustration of an interior complete with furnishings, floor tiles, and rafters. These aligned woodcuts function as transfoliate diagrams. Here, the orthogonal lines on the recto align with the space of the illusionistically rendered interior (Figure 105).

Although direct influence may be difficult to ascertain, one begins to see the innovative technique of transfoliate diagrams emanating from Venice in multiple ways: through Ratdolt's return to Augsburg, through the dissemination of his printed books, through Dürer's experience of Venetian visual and material culture, his subsequent drawings and text on human proportions, the posthumous publication of his *Vier bücher* [...] in Nuremberg, and Rodler's desire to distill Dürer's work into applicable lessons for craftsmen. While chiaroscuro woodblock printing may be a more lasting legacy of Ratdolt's advancements in print registration (especially via Burgkmair), these later publications evidence the effects of the print technique within the

complex dynamic system of visual culture that continued beyond Venice at the turn of the sixteenth century.

Chapter 4 Printing at Scale: Lucantonio Giunta and Printed Music

The publisher Lucantonio Giunta (1457–3 April 1538) moved to Venice from his native Florence in 1477, at age 20.³³⁸ Initially working as a bookseller, he ultimately developed a model in which he acted as a publisher collaborating with specialized printers, editors, woodblock designers, and block cutters to produce volumes in a range of categories but with strength in liturgical texts. A major achievement of the Giunta press in Venice was the production of the 1499/1501 Gradual (*Graduale Romanum*), a book containing the sung portions of the Mass throughout the liturgical year. This became the largest book printed in terms of overall size in the fifteenth century, measuring 557 x 383 mm.³³⁹ The large scale required an exceptional amount of paper, new and larger letter- and musical-type, and sophisticated woodblocks. The woodblocks, likely commissioned from Benedetto Bordon (already discussed for his illuminated first folios in Chapter 2) and possibly cut by Jacob von Strassburg, in the so-called “shaded” style, were reused in at least nine other publications by Giunta ranging from a second large-scale liturgical book, an antiphonal issued in 1503/4, to folio sized Psalters, to books of hours printed in octavo format for use in domestic devotion. This chapter considers both the unique challenges of printing musical notation in liturgical books on such a large scale as well as the broad distribution of the intended audience, whose liturgical needs and musical preferences varied. It also considers how the

³³⁸ Paolo Camerini, *Annali dei Giunti* Vol. I: *Venice* (Florence: Sansoni Antiquariato, 1962), 20.

³³⁹ Extant copies of the Gradual survive in 38 collections, varying from incomplete single volumes to complete, two-volume sets. At least three of these are documented as imprinted on parchment: Venice, Biblioteca Nazionale Marciana; Vatican City, Biblioteca Apostolica Vaticana; and Washington, D.C., Library of Congress, Rare Book Division. For complete records, see: Gesamtkatalog der Wiegendrucke (hereafter, GW) 10982: (<https://www.gesamtkatalogderwiegendrucke.de/docs/GW10982.htm>. Accessed 14 June 2022); Incunabula Short Title Catalogue (hereafter, ISTC) ig00332000: (<https://data.cerl.org/istc/ig00332000>. Accessed 14 June 2022).

modular woodblocks allowed the Venetian Giunta press to take advantage of these issues of scale to maximize the economic returns of the investment and to create meaning across books intended for public liturgy and private devotion.

Two years after issuing the Gradual, Giunta coordinated the production of a second large liturgical text. This one was an antiphonal (*Antiphonarium*), a book for monastic use recording the sung portions of the divine office, published in 1503/04, reusing the woodcuts, large letter type, and musical notation.³⁴⁰ The Antiphonal contains a massive woodblock printed diagram known as the Guidonian Hand, measuring 419 by 267 mm (Figure 106). Representing the palm-side of a left hand, the mnemonic device associated the twenty-one notes of the medieval musical range with each joint of the fingers, beginning with the top of the left thumb and proceeding in a spiraling fashion up the little finger, across the fingertips, and into the middle knuckles.³⁴¹ In keeping with Isidore of Seville's notion that music, by its very nature could not be written down but only confined to memory, the hand associates six syllables with various musical intervals.³⁴² Having memorized these classes of intervals, for example a major third with the syllables *ut-mi*, a singer could then correctly sight-sing any major third.³⁴³ That an antiphonal with innovative

³⁴⁰ Universal Short Title Catalogue Number (hereafter, USTC) No. 820057. For holdings and additional information, see: <https://www.ustc.ac.uk/editions/820057> (accessed 13 June 2022).

³⁴¹ The mnemonic device's association with Guido of Arezzo may come from Guido's claim to have created a new notational system so that a "studious person may learn the chant by means of it." See: Guido of Arezzo (in translation) in David Hiley, *Gregorian Chant* (Cambridge: Cambridge University Press, 2009), 174. However, the hand was not once mentioned by name by the alleged inventor, and only began to be credited to Guido a century after he died. See: John Hanes, "The Visualization of Music in the Middle Ages: Three Case Studies" in *The Visualization of Knowledge in Medieval and Early Modern Europe*, ed. Marcia Kupfer, Adam S. Cohen, J.H. Chajes (Turnhout, Belgium: Brepols, 2020.) 327 – 340, especially 331. Around the year 1100, in *On Music with a Tonary* (*De Musica cum tonario*) an author named John implied that the hand was in common use, connected the device with Guido's method of the *Epistola*, and as early as 1110, Sigebert of Gembloux had attributed the hand to Guido specifically. See: Mary Carruthers and Jan M. Ziolkowski, eds. *The Medieval Craft of Memory: An Anthology of Texts and Pictures* (Philadelphia: University of Pennsylvania Press, 2004), 79. For additional information see: Joseph Smits van Waesberghe, *Musikerziehung: Lehre, und Theorie der Musik im Mittelalter, Musikgeschichte in Bildern: Music des Mittelalters und der Renaissance*, vol. 3 (Leipzig: Veb Deutscher Verlag für Musik, 1969), 126–41.

³⁴² Hanes, "Visualization of Music," 327.

³⁴³ Stefano Mengozzi, "Constructing Difference: The Guidonian Hand and the Musical Space of Historical Others," *Studies in Medievalism* 16 (2008): 102.

movable-type musical notation should open with an aid for *embodied* memorization of music rather than the reading of encoded musical notation is intriguing.

On one hand, the diagram was undergoing a kind of classicization by Franchino Gaffurio who, in his treatise *Practica musicae* of 1496 proposed a new understanding of Guidonian theory, not only for its connections to Christian music but also as the direct heir of the classical tetrachord.³⁴⁴ In this way, the diagram might appeal to antiquarian efforts to justify printed texts, as discussed in the first chapter. On the other hand, I believe it speaks to the complicated position of the Antiphonal, both in terms of the challenges of printing such a volume and also in the reception and use of printed sacred music by various communities. In particular, the Guidonian hand—in a text with printed musical notation—signifies the presence of overlapping systems of music theory. A *cantor*, concerned mainly with the practicalities of memorizing and performing Latin chant for daily rituals, would have been particularly reliant on the mnemonic knowledge embodied in the Guidonian hand. Learned theorists, however, steeped in *musica* as a liberal art—particularly its connection to mathematics and astronomy—would have emphasized the importance of written (or in this case printed) musical notation.³⁴⁵

Furthermore, the act of *printing* chants—both their text and musical notation—necessarily produced a standardized model. Giunta employed Francesco de Brugis to edit the music of the chants.³⁴⁶ The Flemish monk had lived in Venice for much of his life and was educated within the Franciscan order, a tradition already highly regarded for its musical knowledge.³⁴⁷ In addition to editing the chant, Francesco de Brugis updated and codified the

³⁴⁴ Ibid., 109.

³⁴⁵ Hanes, “Visualization of Music,” 328.

³⁴⁶ Marianne C.E. Gillion “Editorial Endeavours: Plainchant revision in early modern Italian printed graduals,” *Plainsong and Medieval Music* 29, no. 1 (2020): 51-80.

³⁴⁷ Giuseppe Massera. “La ‘Mano Musicale perfetta’ di Francesco de Brugis: Dalle prefazioni ai corali di L.A. Giunta (Venezia, 1499–1504)” *Historiae Musicae Cultores Bibliotheca* 18 (Florence: Leo S. Olschki Editore, 1963), 39.

syllables and tones associated with the Guidonian hand and explained these changes in his introduction included in the antiphonal.³⁴⁸ While the editor has been praised by twentieth-century music historians for the clarity of the notation, placing the Guintine editions at the highest levels of liturgical choir books, the frequent emendation present in the extant printed copies suggests another layer of editorial oversight following the printing, perhaps on the part of Francesco de Brugis himself, as well as variations based on personal, communal, and regional preference.³⁴⁹ It was precisely because of these variations that the Roman Curia had emphasized the need for a standardized liturgy across western Christendom.³⁵⁰ Yet, until this point, chants were transmitted via manuscript and memorization. While the words of chants were regulated by the Church to some success, the notes, and even the role of the organ within liturgical services, was unregulated until well after the conclusion of the council of Trent.³⁵¹ Printing this music *en masse* then, took up multiple challenges: addressing varied modes of musical knowledge and offering a standardized text and melody that was desired by few outside of the Papal court.

An additional challenge was achieving the monumental scale. Like the Gradual of 1499/1501, the Antiphonal required a substantial economic investment in terms of paper, types, and woodblocks. While large letter and musical type could only be used on similarly large editions, the woodblocks were created in modular scale so that they could be deployed across folio, bifolio, quarto, and octavo texts. The most obvious explanation for this system lies in the

³⁴⁸ Massera, “La ‘Mano Musicale perfetta,’” 26.

³⁴⁹ Massera, “La ‘Mano Musicale perfetta,’” 41. See also: R. Molitor “Die nach-tridentinische Choralreform zu Rom” Part 1: *die Choralreform unter Gregor XIII* (Leipzig, 1901), pp. 107–109, particularly 111–12.

³⁵⁰ Duggan, Mary Kay. “Politics and Text: Bringing the Liturgy to Print” *Gutenberg-Jahrbuch* 76 (2001): 104–117.

³⁵¹ L’utilizzo dell’organo nella liturgia latina ricevette una precisa regolamentazione solo con il Caeremoniale episcoporum, la cui editio princeps fu stampata nell’anno 1600. Il ruolo attribuito allo strumento nel corso del XV e del XVI secolo, però può essere dedotto da altre fonti on ufficiali: una di queste, forse la più importante, è costituita dal copioso repertorio musicale che si diffuse sia in forma manoscritta, sia (al partire dal Cinquecento) in edizioni a stampa. See: Massimo Bisson, *Meravigliose Macchine di Giubilo: L’architettura e l’arte degli Organi a Venezia nel Rinascimento* (Venice: Fondazione Giorgio Cini; Verona, Scripta, 2012), 29.

need to offset initial costs through the profit of multiple editions. Additionally, I will argue that by bridging the scale of books intended for both public and private use, new meaning was generated. While the technological achievement of printed music was met with alteration by local choirs and monastic communities, the visual cues of the texts unified a diverse readership.

The study of the physical emendation of these choir books accesses a particular mode of reception known as reading history. Rather than focusing on the production of the book, analyzing the material record of the emendation of printed chant and notes offers access to something closer to the kind of active reading Anthony Grafton has described with respect to the French humanist Guillaume Budé (1467–1540).³⁵² In addition to scrupulous marginalia, the Greek and Latin philologist also created *sammelband* “hybrids” which, for example, reunited the printed and manuscript-copied letters of Pliny the Younger from various sources. Grafton explains that Budé’s reading was active and archival, recording not only his own progress in learning, but creating a monument of his scholarship in conversation with the ancients.³⁵³ As we will see in the painted out, scraped off, and pasted over notes and chant in copies of Giunta’s Gradual and Antiphonal, the liturgy was only “fixed” within these printed texts until it reached the hands of those who would enter into conversation with it.

4.1 Lucantonio Giunta, Johann Emerich, and Johann Hamman

Although he lived in Venice from 1477 until his death in 1538, Lucantonio continued to identify as a Florentine throughout his life, imprinting each colophon with *Luc’Antonio Giunta*

³⁵² Anthony Grafton, “Is the history of reading a marginal Enterprise? Guillaume Budé and His Books,” *Papers of the Bibliographical Society of America* 91, no. 1 (1997): 139–157; also related, but of slightly later chronological purview is Bill Sherman’s study of reading practices in relation to John Dee, see: William Sherman, *John Dee: The Politics of Reading and Writing in the English Renaissance* (Amherst: University of Massachusetts press, 1995). See also: Roger Chartier, *Cultural History Between Practices and Representations* (Cambridge: Polity, 1993), 33–34.

³⁵³ Grafton, “History of Reading,” 155.

fiorentino.³⁵⁴ In contrast, a print privilege addressed to the Venetian Senate granted to Lucantonio, described him warmly as “Lucantonio Giunta, your printer” (*Lucaantonio di Gionta, impressore vostro*).³⁵⁵ It is likely that his insistence on an identity from elsewhere, particularly Florence with its own emerging print production and style, lent his work some additional prestige. It was also accurate in the sense that he maintained connections with the printing, editing, and bookselling business of his family based in Florence. While his brother Filippo focused on humanistic publications, in Venice Lucantonio specialized not only in liturgical texts, but also in commercially popular works such as illustrated books in the vernacular.³⁵⁶

While he did not own his own printing press until about 1500, Lucantonio was extremely productive through partnerships with specialist printers. The biographer and cataloger Paolo Camerini identified 406 editions associated with Giunta’s Venetian publishing firm.³⁵⁷ His most frequent collaborator was Johann Emerich da Spira (considered in greater detail below), with whom he produced 31 volumes.³⁵⁸ Lucantonio was the first publisher to recognize the importance of developing an international network and, in 1501, began publishing Spanish legal texts for export.³⁵⁹ By 1520, he had established an important subsidiary warehouse in Lyon, France, which provided a foothold for book sales across the European continent.³⁶⁰ Ever a

³⁵⁴ Camerini, *Annali dei Giunti*, 22.

³⁵⁵ Early Modern Book Trade, “Repubblica di Venezia – Senato. 1522-4-3” <https://emobooktrade.unimi.it/db/privileges/803> (accessed 13 June 2022).

³⁵⁶ Camerini, *Annali dei Giunti*, 23.

³⁵⁷ *Ibid.*, passim.

³⁵⁸ In addition to Johann Emerich da Spira, Lucantonio collaborated with a total of 19 other printers throughout his career, though most of these produced only a handful of publications. For a full list see: Massimo Ceresa, “GIUNTI, Lucantonio, il Vecchio,” in *Dizionario Biografico degli Italiani* 57 (2001) https://www.treccani.it/enciclopedia/giunti-lucantonio-il-vecchio_%28Dizionario-Biografico%29/ (accessed 14 June 2022).

³⁵⁹ This was possible in part because shipping from Venice did not incur the same customs fees that transportation over land from Florence would have. See: Ceresa, *ibid.*

³⁶⁰ While Lucantonio died in 1535, his nephew Iacopo di Francesco (born 1486) continued to expand the business from Lyon, ultimately establishing warehouses in Antwerp, Frankfurt, Medina, Salamanca, Zaragoza, Lisbon, and Paris. See: Ceresa, *ibid.*

Florentine, Lucantonio was buried in Santa Maria Novella in Florence in accordance with his will of 1523.

While in Venice, Lucantonio collaborated frequently with Johann Emerich da Spira (often latinized as Iohannes Emericus), from Udenheim near Speyer, in the Rhineland. Johann Emerich was active in Venice by 1487 when he collaborated with Johannes Hamman of Landau. Together, the two Teutonic printers specialized in liturgical texts. Hamman printed largely on commission, with liturgical work consisting of about 60% of his output, making him one of the most prolific liturgical printers of his age.³⁶¹ The printers were also specialists in the printing of musical notation, a frequent necessity of liturgical texts containing chant.³⁶² This expertise made Emerich an ideal collaborator for Lucantonio Giunta in the production of his ambitious Gradual. Emerich ended his collaboration with Hamman and began working with Lucantonio in time to produce the 1499/1501 volume.

4.2 Venice as a Center of Music

Toward the end of the fifteenth century, Venice emerged not only as an important center for print, but specifically as a site of innovative music publishing. Italy, in general, was responsible for the publication of nearly 40% of all European music incunabula and Venice represented the lion's share of that output, producing 85 of the total 156 Italian musical texts before 1500.³⁶³ Nearly half of these Venetian books with printed notes were produced by Johann Hamman and Johann Emerich.³⁶⁴ This was due in part to the Venetian legal system of privileges,

³⁶¹ David Rogers, "Johann Hamman at Venice: A Survey of His Career with a note on the Sarum Horae of 1494," in *Essays in Honour of Victor Scholderer*, edited by Dennis E. Rhodes, 349 – 365 (Mainz: Karl Pressler, 1970), 350.

³⁶² Mary Kay Duggan, *Italian Music Incunabula: Printers and Type* (Berkeley: University of California Press, 1992), 19.

³⁶³ Duggan, *Italian Music Incunabula*, 18, 20.

³⁶⁴ Duggan, *Italian Music Incunabula*, 19.

which offered protection to those experimenting with the new technology of movable type for musical notation. It was also because privileges were issued to protect the production of new musical instruments, creating a rich environment of competition and regulation to foster innovation.³⁶⁵ For example, on the 25th of May 1498, the Council of Ten awarded a privilege with the exceptional duration of 20 years to Ottaviano Petrucci for the publication of “figured music” (*canto figurato*), or music in “florid” polyphonic counterpoint rather than monophonic melody.³⁶⁶ After Petrucci transferred his presses outside of the Venetian domain to his hometown of Fossombrone in 1511, a new privilege was granted to Jacomo Ungaro to produce *canto figurato* with the caveat that he respect the work of the previous publisher.³⁶⁷ These protections along with other factors led to Venice becoming the music publishing capital of Europe, particularly as polyphonic music expanded and required individual books to be published for each part.³⁶⁸

Although music did not originally factor into humanist studies, by 1424 it was included in the curriculum of the school founded by Vittorino da Feltre at the court of Gianfrancesco Gonzaga in Mantua. By the last quarter of the fifteenth century, a “music-theoretical madness” seized Italy.³⁶⁹ In 1492, Franchino Gaffurio began teaching music in an academy established by

³⁶⁵ On privileges for new instruments, see: Pompeo G. Molmenti, *La Storia di Venezia nella vita private dale origine alla caduta della repubblica: Parte Seconda: Lo Splendore* (Turin: Roux e Favale, 1880), 316. For music publishing, see: Horatio F. Brown, *The Venetian Printing Press: an historical study based upon documents [...]* (London: Chiswick Press for John C. Nimmo, 1891).

³⁶⁶ Privilege granted to Ottaviano Petrucci consulted at: <https://emobooktrade.unimi.it/db/privileges/197> (accessed 14 June 2022). See also: Helen Hewitt, ed. *Harmonice Musices Odhecaton A*. (Cambridge, Mass: Medieval Academy of America, 1942).

³⁶⁷ Privilege granted to Jacomo Ungaro consulted at: <https://emobooktrade.unimi.it/db/privileges/642>. (accessed 14 June 2022).

³⁶⁸ Claude V. Palisca claimed in 1985 that Venice was the music publishing capital of the *world*, yet this claim likely reflects the Euro-centrism prevalent at the time. See: Claude V. Palisca, *Humanism in Italian Renaissance Musical Thought*. New Haven: Yale University Press, 1985.

³⁶⁹ “... der sozusagen musiktheoretischen Wut, die damals ganz Italien ergriffen hatte.” See: Knud Jeppesen, “Eine musiktheoretische Korrespondenz des früheren Cinquecento,” *Acta musicologica* 13 (1941), 3. For further information concerning Gaffurio’s academic positions see Paul Oskar Kristeller, “Music and Learning in the Early Italian Renaissance,” *Journal of Renaissance and Baroque Music* 1 (1947), 255–74.

Lodovico Sforza in Milan. In the same year, the musical treatise of Boethius was first printed in Venice. With the theoretical study of music firmly in the purview of humanism, its performance was adopted as a status symbol by the Venetian state.

Excellent musical performance was thought to reflect the well-tempered, harmonious, consonant, and balanced government of the *Serenissima*.³⁷⁰ In 1490, a second organ was installed in the Basilica San Marco along with hiring a second organist. In 1491, the procurators of San Marco appointed Pietro Fossa as the first official master of the chapel of singers (*maestro di cappella*).³⁷¹ Music performance also became a status symbol for the *scuole grandi*, which, by way of printed music, were able to replicate the performances that took place in San Marco.³⁷² This emphasis on music also applied to architecture, which had been associated with the harmonies of music by Plato and with the harmony of the celestial spheres by Vitruvius's *De architectura*.³⁷³ Finally, Venetian painting of this period reflected the elevated status of musical performance. Perhaps encouraged by the expansion in lute manufacture in Venice and the Veneto, as well as the publication of instructional manuals published by Ottaviano Petrucci between 1507 and 1511, there was renewed interest in lute performance at the beginning of the sixteenth century.³⁷⁴ This is reflected in the many insertions of musicians in sacred scenes in

³⁷⁰ In particular, the ability to produce extreme volume was seen as a sign of divine legitimation and—devoid of any negative connotations—signified power, public order, military strength, splendor and good governance. While the true volume may have been magnified by spectators' imaginations, the values associated with loudness are instructive. See: Evelyn Korsch, "The 'Loud Joy': Music as a Sign of Power," *Renaissance Journal* 1, no. 8 (June 2003): 4–14.

³⁷¹ Ellen Rosand, "Music in the Myth of Venice" *Renaissance Quarterly* 30, no. 4 (Winter 1977): 517.

³⁷² Rosand, "Myth of Venice," 522.

³⁷³ Deborah Howard and Laura Moretti. *Sound and Space in Renaissance Venice: Architecture, Music, and Acoustics* (New Haven: Yale University Press, 2009), 8. Vitruvius, *De architectura*, I, I, 8, as cited in: Rosand, 515. See also: Rudolf Wittkower, *Architectural Principles in the Age of Humanism*, 3rd ed. (New York: W.W. Norton, 1971), 101–154.

³⁷⁴ Tim Shepard, et al. *Music in the Art of Renaissance Italy 1420–1540* (London: Harvey Miller, 2020), 280–281.

general, and lute players in particular. For example, serene lute players are positioned below the Virgin in Bellini's *San Giobbe* altarpiece (Figure 107).³⁷⁵

It was in this innovative and valorized musical environment in the late 1490s that a number of privileges were granted to publish graduals, antiphonals, and psalters in something of a flurry. On 31 January 1497, Bernardo Stagnino received a privilege to publish an antiphonal and gradual, citing the great labor and expense required for such an undertaking.³⁷⁶ While he received protection for the typical ten years, no fine is assigned for counterfeit productions; instead, the privilege stipulates only that any violators would be subject to forfeit their counterfeit copies. Just over a month later, on 5 March 1497, the Council of Ten again issued a privilege for a gradual, antiphonal, and psalter, this time to Tommaso da Venezia.³⁷⁷ Of these projects, only Lucantonio Giunta's 1499/1501 came to fruition.³⁷⁸ The title page of the 1499/1501 text claims that it was printed with a privilege that also extended to an antiphonal and psalter; however, no such privilege has yet been identified.³⁷⁹

As suggested by the toothless privilege granted to Bernardo Stagnino, the category of devotional and theological publishing often lacked serious legal protections. This created a

³⁷⁵ For a detailed discussion of both angelic and earthly musicians in Venetian painting of this time, see: Lise Henriette Hindsberg, "Enargeia-Energeia: The Heavenly Sounding Image in the Italian Renaissance" (Diss. University of Copenhagen, 2021), [https://artsandculturalstudies.ku.dk/staff/?pure=en%2Fpublications%2Fenargeiaenergeia\(57bd2dde-73bc-4fc8-8e38-cb85234228be\).html](https://artsandculturalstudies.ku.dk/staff/?pure=en%2Fpublications%2Fenargeiaenergeia(57bd2dde-73bc-4fc8-8e38-cb85234228be).html)

³⁷⁶ <https://emobooktrade.unimi.it/db/privileges/90>. (accessed 14 June 2022)

³⁷⁷ <https://emobooktrade.unimi.it/db/privileges/276> (accessed 14 June 2022)

³⁷⁸ Lilian Armstrong, "Benedetto Bordon, Aldus Manutius, LucAntonio Giunta: Old Links and New," in *Aldus Manutius and Renaissance Culture*, edited by David Zeidberg (Villa I Tatti: The Harvard University Center for Italian Renaissance Studies, 15) (Florence, Leo S. Olschki, 1998), reprinted in Armstrong: *Studies of Renaissance Miniaturists in Venice* (London: Pindar Press, 2003), Vol. II, 662.

³⁷⁹ The first folio of the gradual reads: *Graduale s[ecundu]m morem sancta Romane ecclesie integrū[m] & cō[m]pletū[m] videlicet d[omi]nīcale: sanctuariū[m]: cō[m]mune: & cā[n]torinū[m]: siue kyriale: impressii Venetijs cum privilegio: cū[m] quo etiam imprimuntur antiphonarium et psalmista: sub pen[a] vt igratia M.ccccc.* However, lack of a recorded privilege was confirmed by the musicologist Giuseppe Massera in his study of the privileges published by Rinaldo Fulin at the end of the nineteenth century. Of course, extant privileges represent only the historic survivals and lack of evidence does not suffice as proof of a lacking privilege. See: Massera, "La 'Mano Musicale perfetta'" (1963), 11.

somewhat precarious field. The specialized market for large-scale choir books meant that printers were likely to know in advance the demand for their publications.³⁸⁰ At the same time, however, the large books required massive investment. One way in which these riskier investments were offset was through the production of Books of Hours, one of the best-selling items of the period.³⁸¹ The steady income from physically smaller editions helped to stabilize the income of publishers who specialized in devotional and theological texts.

This balancing act was made all the more uncertain as the exclusive legal right to produce the texts was rarely supported by stringent legal protection. For example, on 12 March 1500, Mateo (or *Maseo*) Berto received a privilege to publish a text on the mysteries of the Mass (*Misterii de la Santa Messa*).³⁸² Yet, the privilege was valid only for two years, a fifth of the typical period of protection. Likewise, the fine for counterfeit copies was set at one lira, just 1.6% of the typical 10 Ducat fine. Should these low fines have been collected, they were to be distributed evenly among the church (*pietà*) and the individual bringing the claim (*accusador*). If the accuser was someone other than the privilege holder (i.e. not Mateo Berto), he stood to receive no recompense for counterfeit copies of his religious tracts.³⁸³ Even the great Aldo Manuzio received protections of only one ducat—a tenth of the typical fine—for counterfeit copies of his *Epistles of St. Catherine*.³⁸⁴ The achievement of the 1499/1501 illustrated gradual

³⁸⁰ Lilian Armstrong has argued that the specialized choir books would have appealed to only specific churches, thus publishers would know the demand before executing the print run. See: Lilian Armstrong, “Woodcuts for Liturgical Books Published by LucAntonio Giunta in Venice, 1499–1501,” *Word and Image: A Journal of Verbal/Visual Inquiry*, 17 (2001): 65–93, reprinted in Armstrong, *Studies of Renaissance Miniaturists in Venice* (London: Pindar Press, 2003), vol. II, 683–734.

³⁸¹ Cristina Dondi and Neil Harris, “Bestselling titles and Books of Hours in a Venetian bookshop of the 1480s the Zornale of Francesco de Madiis,” *Bibliofilia* 115, no. 1 (2013): 63–82.

³⁸² <https://emobooktrade.unimi.it/db/privileges/462> (Consulted 15 June 2022).

³⁸³ To my knowledge, there are no female privilege holders; however, women played crucial roles in early print through strategic marriages with printers. See: Deborah Parker, “Women in the Book Trade in Italy, 1475–1620,” *Renaissance Quarterly* 49, No. 3 (Autumn 1996): 509–541.

³⁸⁴ <https://emobooktrade.unimi.it/db/privileges/515> (consulted 15 June 2022).

produced by Lucantonio Giunta's firm are all the more impressive set against the legal and economic challenges present.

As previously mentioned, the sheer scale of the book was also a challenge. Each printed page measures 557 x 383 mm, meaning that the folio, before being folded in half and nested into quires, measured roughly 557 x 766 mm. To achieve such a scale, it is possible that a standard two-pull press—which would normally print the text of two *different* bifolia—was adapted to print one large folio containing both text and music. By rotating the orientation of the type 90 degrees, the press could print the top half of text and music of a single large folio, then the carriage would be lowered and the bottom half could be printed (Figure 108). Evidence of this may be seen in printer's errors repeated throughout multiple copies of the 1499/1501 edition, which I have consulted in person. Folio 26v of the Gradual contains a rubricated initial *O* that was printed twice, with the erroneous impression painted over with a white pigment consistent throughout the copies I have consulted (Figure 109). Similarly, on folio 31r of the same gathering, the rubricated incipit of a chant has been printed over with the black text of the previous chant (Figure 110). It was previously estimated that the folio received four impressions: one for rubricated initials and red musical staves, one for black notes and text (2), multiplied by recto and verso (2). However, if this working method is correct, it would mean that each single large sheet of paper moved through the press 8 times as top and bottom of each folio were printed in black and red.

4.3 Development of Musical Type

The historian of information, Mary Kay Duggan, has traced the development of printing music in Italy across five distinct stages.³⁸⁵ The first, and least technologically sophisticated, was simply to omit the music altogether. Second, printers began to leave blank space in the text for the manuscript entry of the notation. This can be seen in the Missal published by Alvisius de Siliprandis in Venice on 20 September, 1477 (Figure 111).³⁸⁶ In this way, the development of printed music mirrors early printed texts containing Greek, including the first book ever published in Venice in the summer of 1469 by Johannes da Spira, Pliny's *Naturalis Historia*. Lacking Greek type, the publisher simply left blank spaces in the text for later manuscript inclusion of words in non-Latin alphabet.³⁸⁷ A third stage in the development of printed music was to print the lines of the staves while still omitting the notes, which would have required a specialized musical type and second run through the press.³⁸⁸ An example of this can be seen in the Missal edited by Philippus de Rotingo and published by Nicolaus de Frankfordia in 1487 (Figure 112).³⁸⁹ Duggan suggests the printed staves may have been executed with cast metal bars, a process that may have been similar to Renzo Baldasso's proposal for the production of geometric diagrams in Euclid's *Elements* (considered in Chapter 3).³⁹⁰ Duggan has identified

³⁸⁵ Mary Kay Duggan, *Italian Music Incunabula* (1992), 42, 49–75. See also: Alexander Hyatt King, *Four hundred Years of Music Printing* (London: British Museum, 1968); Stanley Boorman, "Early Music Printing: Working for a Specialized Market," in *Print and Culture in the Renaissance: Essays on the advent of printing in Europe*, edited by Gerald Tyson and Sylvia S. Wagonheim, 222–245 (Newark Delaware: University of Delaware Press, 1986); Cristle Collins Judd, *Reading Renaissance Music Theory: Hearing with the Eyes* (Cambridge: Cambridge University Press, 2000).

³⁸⁶ <https://data.cerl.org/istc/im00689100> (accessed 4 July 2022).

³⁸⁷ Martin Davies, "Making Sense of Pliny in the Quattrocento" *Renaissance Studies* 9, Issue 2 (1995): 242.

³⁸⁸ It can be difficult to distinguish printed staff lines from hand-drawn lines using a specialized musical notation tool known as a "rake," in which multiple pen tips are held equidistant. Duggan notes the "telltale" hesitation at the beginning and end of rake-drawn lines as one means of identification. See: Duggan, *Italian Music Incunabula* (1992), 46.

³⁸⁹ <https://data.cerl.org/istc/im00701000> (accessed 4 July 2022).

³⁹⁰ Renzo Baldasso, "La Stampa dell'Editio Princeps Degli Elementi di Euclide Venezia, Erhard Ratdolt, 1482," in *The Books of Venice, Il Libro Veneziano*, Lisa Pon and Craig Kallendorf, 61–100, (Venice, Biblioteca nazionale Marciana; New Castle, Oak Knoll Press, 2008), 78–79.

nineteen Italian incunabula that document this approach. A rarer option, most commonly reserved for music theory texts, was to print shorter passages of music with notes and staves carved into a single woodcut. These xylographic musical phrases can be seen in the treatise on the fundamentals of music, *Regula musicae planae*, written by Bonaventura da Brescia and originally published in Brescia in 1497 but reprinted in Venice in 1505 by Jacobus Pentius de Leuco (Figure 113).³⁹¹ Lastly, and most popular once the technology was developed, was to print staves and notes in two separate print runs—a process that required accurate registration of the folio in the printing press, similar to the aligned transfoliate diagrams in astronomical texts (Chapter 3). Duggan notes seventy-six Italian music incunabula printed with this technique and has identified thirty-eight music types employed in these texts. It is this approach to printing musical notation that was favored by Johann Emerich for Lucantonio Giunta. It is necessary to conclude this history with two final achievements, although falling after the period in which Giunta published the *Gradual and Antiphonal*: printing with movable-type notes in which the lines of the staff were incorporated so that both staff and note could be printed in one impression (1525), and the printing of music by incorporating metal-plate engravings (c. 1536). At the beginning of their careers, Hamman and Emerich used many of the early strategies including leaving blank space for music, printing staves alone—both with lines cast a whole column wide and, later, with cast segments—as well as printing short segments of staves and notes with woodblocks, and finally two-impression printing of staves and notes.³⁹²

³⁹¹ <https://data.cerl.org/istc/ib00973000>. (accessed 4 July 2022).

³⁹² Duggan, *Italian Music Incunabula* (1992) 40, 60: While Hamman and Emerich are associated with the greatest number of Venetian music incunabula, Duggan has made a revisionist argument for elevating the importance of Giacomo Ungaro. The privilege granted to Ungaro in 1513 credits him with the development of music type that had originally been associated with Ottaviano Petrucci (who received the privilege in 1498). Beyond technical innovation, Duggan believes it likely that Giacomo Ungaro cut fonts for Petrucci and Emerich in 1500–1501.

4.4 Editing and Emendation

As noted above, Lucantonio Giunta, in addition to collaborating with the expert Johann Emerich, who specialized in the printing of music, also engaged the services of Francesco de Brugis, a Flemish musician and Franciscan monk, to edit the music of the chant. Francesco penned a brief but dense introduction to the Gradual of 1499/1501 touching on musical theory, which was expanded for the Antiphonal of 1503–1504.³⁹³ In this text he justified the editorial decisions he made, imposing order in a field that had developed organically and perhaps somewhat chaotically as it passed from one generation of musical performer to another via memorization and various forms of manuscript notation.³⁹⁴ Much like humanist efforts to recover more accurate classical histories via “rediscovered” manuscripts, de Brugis sought to compile the ideal melodies of Gregorian chant based upon the best-available Quattrocento manuscripts, while also emending corrupted versions.

Not only did de Brugis organize and edit the music before publishing, I propose that he also edited the folia *by hand* after they were printed. An important—if vague—piece of evidence comes from the preface penned by de Brugis himself in which he says:

Let it suffice at any rate my brothers everywhere who will read this volume of the gradual that I have completed and brought to a conclusion with the greatest care and the most drawn-out attention. As it was brought to me by the printer, I have in particular corrected the errors in it (which so affect the music) which were virtually innumerable; which was a great labor; this was added (which, great as it was, was immeasurable). Signs [of accidentals] were added below.³⁹⁵

³⁹³ For a summary of the contents of the treatise, see: Massera, “La ‘Mano Musicale perfetta,’” 48.

³⁹⁴ Massera, “La ‘Mano Musicale perfetta,’” 8.

³⁹⁵ *Suffecisset utique mi fratres universi que legitis in hoc volumine graduum id me ademplesse: summaque cura: ac longissimus vigiliis perfecisse: quod ab impressore eius a me flagitatum extitit: correxisse scilicet in eo errores (quo ad musicen tantum attinet) que innumerabiles pene extiterunt: absque quod ipsi occupationi: hanc etiam (que grandis plurimum fuit) superadderem: apposuisse videlicet notulas subinferendas.* (As translated by Duggan, 134.)

The nineteenth-century music historian Adrien de La Fage interpreted de Brugis’ “*notulas subinferendas*” at the end of the passage as referring to “interleaved notes.”³⁹⁶ Yet, Giuseppe Massera in his mid-twentieth-century monographic article on de Brugis acknowledges that the meaning of the phrase still remained obscure and no such “interleaved notes” can be identified.³⁹⁷ In her translation above, Mary Kay Duggan understands “*notulas subinferendas*” to mean “signs added below,” figuratively indicating that the signs—which she interprets as musical accidentals—follow the introductory text. Duggan acknowledges de Brugis’ “continual and active part in proofing copy,” but leaves the specific role he played vague.³⁹⁸ Duggan also remarks that nearly every page of the Gradual has corrections either printed or by hand, or both, but that they “vary copy to copy.”³⁹⁹

Through note-by-note and folio-by-folio comparison of four of the surviving 38 copies of the Gradual and comparison of two of only four extant copies of the Antiphonal in person, I have identified two classes of emendation.⁴⁰⁰ The first, I propose, was carried out systematically by Francesco de Brugis after the print run, but before the folios left the publisher. Frequent, identical edits across copies suggest that the printer/publisher either skipped a proof stage, or that many errors made it through this proofing and into the final printed pages—which were then corrected by hand. This systematic correction after printing includes a consistent white pigment applied to copies on paper. This pigment is often oxidized to black, suggesting the presence of

³⁹⁶ Adrien de La Fage, *Extraits du Catalogue critique et raisonné d’une petite Bibliothèque Musicale* (Rennes: after 1856).

³⁹⁷ Il de La Fage crede di poter interpretarle come “note intercalari”, ma non nascondiamo che il senso rimane ancora oscuro. See: Massera, “La ‘Mano Musicale perfetta,’” 49.

³⁹⁸ Duggan, *Italian Music Incunabula*, 134.

³⁹⁹ *Ibid.*

⁴⁰⁰ Of the 38 extant graduals (ISTC No. ig00332000), I have compared individual edits of notes for: British Library IC.24240; Biblioteca Apostolica Vaticana Inc.S.244; Marciana Rari Ven. 708–709. Of the four Antiphonals, I have compared the edits of notes for: Bayerische Staatsbibliothek Inc.C.A.3765; and British Library IC.24247/C.18.3.9.

lead.⁴⁰¹ Secondly, the corrections are frequently practical in nature and unrelated to the realm of the preference of an individual *maestro di cappella* or *cantor*. For example, on folios 150r through 152v, an erroneous accidental has been painted over with a lead white paint in copies on paper in the Vatican and the British library, while they have been scraped away from the parchment copy in the Marciana. The consistency of edits to particular notes, accidentals, and the position of the clef symbol indicate a systematic approach rather than the haphazard hands of individual owners or communities. In this sense, Duggan’s insertion of “[accidentals]” in de Brugis’ introduction is accurate; yet, insufficient. The accidentals added or removed—in addition to many other types of emendation—may be seen as the results of systematic, rather unusual, and extremely time-consuming emendation by the editor himself after the folios were printed.

A second category of emendation appears to be the result of personal, communal, local, or regional variation. Unlike the small, lead-white corrections on erroneous notes or accidentals, this category of edits often involves erasure or pasting over printed text and notes with manuscript variations. These range from stylistic alterations of particular passages of the chant; to the austere erasure of garnished, “liquescent” notes requiring singers to vocalize the transition from one note to another; to the complete removal or replacement of entire lines of chant and notes. The most extreme example of this I have seen is the pasting over of ten folios of printed music with manuscript alternative in the Antiphonal now held in the British Library.⁴⁰²

⁴⁰¹ The production of lead white pigment (2PbCO₃) was mentioned by Theophrastus (371–287 BCE) and Pliny the Elder (23/24–79 CE) and was in use throughout the Middle Ages and Early Modern period. While lead white set in oil and protected with varnish may endure for centuries without oxidizing, lead white that is exposed to air reacts to traces of hydrogen sulfide in the atmosphere and turns black. See: Rutherford J. Gettens, Herman Kühn, and W.T. Chase “Lead White,” in *Artists’ Pigments: A Handbook of their History and Characteristics*, ed. Robert Feller, et al. 67–81 (Washington D.C.: National Gallery of Art, 2012), 67, 71–72. Errors in copies of the Gradual printed on parchment, which I consulted in the *Marciana*, have instead been scraped off and rewritten.

⁴⁰² ISTC No. ia00774000, British Library C.18.e.9 (Formerly IC.24247).

This kind of stylistic emendation, rather than simple correction, can be seen within the luxurious copy of the Gradual now held in the Biblioteca Nazionale Marciana in Venice. Objectionable text and notes were erased by scraping the uppermost dermal layers of the animal-skin parchment and either leaving it blank or adding manuscript notation on the palimpsest. Folio 30 verso of the Gradual contains the chant “Serve joyfully” (*Jubilate servite*) based upon the text of Psalm 99/100.⁴⁰³ After the text strictly drawn from the Psalm, “Sing joyfully to God all the earth, serve the lord with gladness” (*Jubilate deo omnis terra/ [ser]vite domino in letici*), a particularly curmudgeonly editor scraped away two full lines of additional “hallelujah, joyful hallelujah” (*alleluia, alleluia in leticia*) (Figure 114).

This type of erasure had been, of course, common during the millennium of manuscript manufacture before print; however, evidence of editing is made more complex in the manuscript tradition due to the possibility of scribal error. A manuscript gradual dated c. 1420–30, now in the Bodleian Library (MS Add. D. 48, hereafter referred to as the Bodleian Gradual), was originally held in a northern Italian monastery dedicated to St. Peter.⁴⁰⁴ It may be concluded that this was a particularly important gradual for this community considering it includes “ferial” masses of Christmas, Epiphany, Easter, the Ascension and Pentecost, and the Assumption and Nativity of the Virgin among others. Each of these masses begins with an illuminated initial, but only the first is historiated—with an illumination of St. Peter and two hooded monks kneeling at his feet in supplication.

⁴⁰³ The Hebrew numbering of the Psalms (known as Masoretic) and the Greek numbering (Septuagint) differ by one number. Roman Catholic official liturgical texts use the Greek numbering, while Protestant translations often use the Hebrew numbering. I include both as it facilitates identifying the primary text (N.B. The first number refers to the Septuagint numbering used by the Roman Catholic church and the second number refers to the Masoretic or Hebrew system).

⁴⁰⁴ Otto Pächt and J.J.G. Alexander, *Illuminated Manuscripts in the Bodleian Library, Oxford*, Vol. 2 (1970), no. 784.

At first glance, the musical content of the manuscript appears to have less editing than is frequently present in the printed graduals published under Lucantonio Giunta. Upon closer inspection in raking light, areas of rasped parchment indicate erasure of the handwritten music. Yet, the examples present in the Bodleian Gradual appear to reflect the correction of scribal errors rather than adjustment for personal preference. One example of this practice can be seen on folio 23 recto, with the Nativity chant beginning, “Blessed is the womb of the Virgin Mary, that bore the son of the everlasting Father” (*Beata viscera Mari[a]e Virginis que portaverunt [a]eterni Patris Filium*). Here, the clef, which indicates the pitch of the musical notes with relation to the red lines of the stave, has been scraped off and rewritten one space below (Figure 115). It seems unlikely that personal or regional performance-preference would dictate lowering one line of chant by two musical steps, particularly in the middle of a word (*virginis*). Instead, scribal error might better explain why the clef was accidentally written the same as those that come before and after, but then adjusted to reflect the correct melody.⁴⁰⁵

Returning to the printed gradual, edits made within the communities who sang from the large texts often incorporated a variety of media. Folio 180 recto of the gradual contains the prayers for the fourth morning and night of advent and an invocation of the Holy Spirit: “Come, O holy Spirit, fill the hearts of thy faithful, and enkindle within them the fire of thy love,” (*[Veni sancta Spi]ritus, reple tuorum corda fidelium, et tui amoris in eis ignem accende*). In the copy held in the British Library (Figure 116), a pastedown causes the underlined text above to read (text of pastedown in bold):

Come, Holy Spirit,
fill the hearts of your faithful,
and let those who hate you flee.

*([Veni sancta Spi]ritus,
reple tuorum corda fidelium, et tui amo
[fu]giā[n]t q[ui] ode[run]t*

⁴⁰⁵ In the fifteenth century, and indeed still for some vocal/instrumental parts, it was considered poor form to indicate notes above or below the stave lines. To avoid this, the clef can be repositioned to indicate different values for the notes on that line. See: Duggan, *Italian Music Incunabula* (1992), 62.

kindle the fire

ignem accende

This alternate text appears to be a brief excerpt from Psalm 67/68:2,

“May God rise up, and may his enemies be scattered, **and may those who hate him flee from before his face,**” (*Exurgat Deus, et dissipentur inimici eius, et fugiant qui oderunt eum, a facie eius*).

Psalm 67/68, a hymn of praise describing God’s victory over his foes, is disjointed and notoriously difficult for biblical commentators.⁴⁰⁶ The verse cited in the pastedown has been understood as a citation of an earlier biblical text, Numbers 10:35: “Whenever the ark [of the covenant] set out, Moses would say, “Arise O LORD, let your enemies be scattered, and your foes flee before you.” Unfortunately, this sheds little light on the significance of altering an invocation of the Holy Spirit to include threats to the enemies of the Hebrew/Christian god. Did this militant citation hold particular meaning for the geo-political situation of a local community? Did a *maestro di cappella* desire to enkindle the fear of God rather than the fire of his love?⁴⁰⁷ What can be said, from a material perspective, is that the pastedown is attached only on the left edge so that it may be lifted to reveal the original text (Figure 117).⁴⁰⁸ Perhaps more than “correcting” the chant, this presented the singers with variations appropriate for differing circumstances.

⁴⁰⁶ For more on the difficulties of interpreting the poetry of the Psalms, see: C.S. Rodd, “Psalms: A Problem of Interpretation,” in *The Oxford Bible Commentary*, edited by John Barton and John Muddiman (Oxford: Oxford University Press, 2001, published online 2022), particularly section 7.

⁴⁰⁷ In posing these types of questions, I draw upon a methodology developed by Saidiya Hartman called “critical fabulation,” which displaces the received or authorized account in order to imagine what might have happened or might have been said or done. The refusal to fill in gaps and answer the questions posed is a form of “narrative restraint” that is a requirement of this method. See: Saidiya Hartman, “Venus in Two Acts” *Small Axe* 26, Vol. 12, no. 2 (June 2008): 1–14, especially 11–12.

⁴⁰⁸ In addition to scraping off and painting or papering over, another removable intervention was to pin strips of paper onto the folio, covering over the original text of the chant with manuscript. This can be seen on folio 140v of the Giunta Antiphonal now held in the *Biblioteca nazionale Centrale di Firenze*, Manoscritti N.A. 362.

It was not only the text of the chant that was altered by local communities, but also the musical notation. The gradual held in the British Library contains manuscript “marginalia” in which manuscript staves of music notation seamlessly connect with the printed notation (Figure 118). On folio 179, the introitus for Pentecost, additional notes have been added on a manuscript stave that completely fills the margins on the recto and continues onto the verso, where it is once again seamlessly incorporated back into the printed musical notation. Presenting a contrast to the work of the abstemious editor of the Marciana Gradual, this copy reflects the desire for additional musical flourishes between chants. Similarly, many of these liturgical texts—particularly more portable quarto and octavo missals, containing the text and portions of musical notation of the mass—include additional folios “tipped in” at the end of the text-block.⁴⁰⁹ These folios often contain additional prayers and chants particularly useful to the individual celebrant or community by which they were used.

Lastly, edits after publication do not always reflect personal or communal preference. Instead, common edits across multiple copies appear to represent individual solutions to printing errors not spotted by Francesco de Brugis, or allowed to remain. On folio 42 recto of the Gradual, the offertory drawn from Psalm 118/119:12, “Blessed art thou, O Lord: teach me thy justifications” (*Benedictus es domine doce me iustificationes tuas*) has the opening verse printed twice, with identical notes above. In the Marciana copy, the solution was to strike through the first with a large red x and to capitalize the second *Benedictus* in rubricated manuscript (Figure 119). However, in the Vatican copy, the error was resolved by scraping off only the notes above the second occurrence—perhaps indicating that it should not be sung (Figure 120). While the Gradual has been praised for its elegant innovation and unprecedented achievement, on account

⁴⁰⁹ A “tipped-in” folio is not part of the original structure of folios nested into quires or gatherings. Instead, a small edge (tip) is folded around the outside of a gathering to secure the additional folio.

of the highly specialized and complex character of the musical notation, errors certainly slipped past its printers and editor, creating opportunities for local communities to intervene and express their own practice. While an individual might simply overlook printed repetition, the communal nature of both the Gradual and Antiphonal required clear visual solutions that maintained group cohesion during rehearsal and performance.

The emendation of these texts at the personal, local, and regional levels and for a variety of reasons was not unique to print. Long before the Reformation and even before the arrival of movable type in Europe, there was a call for the text of the liturgy to be reformed. In the Councils of Constance (1414–1418) and Basel (1431–1449) a desire for “uniformitas” or standardization of the liturgy was established as an important goal.⁴¹⁰ Yet, due to political divisions, particularly between German-speaking regions and the Roman Curia, the first printed liturgical books were not produced until the 1470s.⁴¹¹ While smaller portions of texts used in the Mass were being printed, threats of excommunication for using incorrect Missals or liturgies prevented large-scale publication. Even when printing became more common, Missals and calendars still reflected regional variations such as preferences for local martyrs, bishops, and rulers in the feast days chosen for calendars in regions beyond the Papal States. While originally clandestine, these editions actually became authorized for a short time until the selection of a single text at the Council of Trent.

Similarly, there was a call for the standardization of the melodies of liturgical chant by the Spanish Cardinal Juan Carvajal beginning in 1448. While text had always received close scrutiny due to the threat of blasphemy, the melodies of the chant were essentially unregulated. As previously mentioned, musical knowledge often passed from one singer or organist to another

⁴¹⁰ Mary Kay Dugan, “Politics and Text: Bringing liturgy to Print,” *Gutenberg-Jahrbuch* 76 (2001): 104.

⁴¹¹ *Ibid.*, 110.

via manuscript or memorization. This applied not only to vocals, but even the official role of the organ in liturgical service was not formally regulated until 1600.⁴¹² While the variation and emendation of texts and melodies represents a longer history, the introduction of *printed* liturgical texts necessarily produced standardized versions determined by Johann Emerich and the hand and ear of Francisco de Brugis. It can be difficult to determine the causes and chronology of material alterations made to individual copies, but as I hope to have demonstrated, the systematic analysis of this emendation accesses the unique reading—and in this instance performance—histories of choir directors (*maestri di cappella*) and their choirs.

4.5 The Use and Reuse of Woodcuts

Alongside the innovative printed music and grand scale of the 1499/1501 Gradual, the edition is important as it was also the first to be printed with woodblock illustrations. An earlier gradual was printed by Damiano and Bernardo Moilli in Parma in 1477, but it lacked illustration.⁴¹³ The only other illustrated graduals to be printed in this period were those of Galeazzo and Pietro Paolo and Porro in Turin in 1512, and by the firm associated with Petrus Liechtenstein in Venice in 1562—although the firm’s namesake died in 1528.⁴¹⁴ It is instructive

⁴¹² On the role of the organ, see: Bisson, *Meravigliose Macchine di Giubilo*, 2012, 29. In the final decades of the fifteenth century, heated debate arose surrounding whether the chant should be monophonic (voices performing a single melody) or polyphonic (multiple voices in harmony). It became popular for wealthy individuals to endow polyphonic services, as the greater expense of multiple voices was thought to receive additional spiritual benefit—often reduced time spent in purgatory. Yet, such services were decried as a flagrant waste of funds and were banned or simply beyond the financial means of major centers including Florence (banned under Savonarola), Barcelona, Bruges, the Burgundian Court, Notre Dame of Paris (banned), and Treviso Cathedral. See: Andrew Kirkman, *The Cultural Life of the Early Polyphonic Mass: Medieval Context to Modern Revival* (Cambridge: Cambridge University Press, 2010), 168. See also: Rob C. Wegman, *The Crisis of Music in Early Modern Europe: 1470–1530* (London: Routledge, 2005), 39.

⁴¹³ The publishers are frequently latinized as Damianus and Bernardus de Moyllis, see ISTC: <https://data.cerl.org/istc/ig00329800>. (Accessed 20 June 2022).

⁴¹⁴ Also latinized as Petrus Paulus and Galeazius de Porrio, see Gradual, 1512: <https://www.ustc.ac.uk/editions/820099>. (Accessed 20 June 2022).

to contextualize the achievement of this illustration within the larger history of woodblock illustration in printed books.

The first printed volume to contain woodblock illustration, *Der Edelstein*, was printed by Albrecht Pfister in Bamberg from 1460–1464.⁴¹⁵ These woodcuts have been characterized as unsophisticated outlines intended to be hand colored to resemble illuminated miniatures, although at lower quality.⁴¹⁶ The first illustrated book produced in Italy was printed in Rome by Ulrich Han in 1467; this was the *Meditationes* of Johannes Turrecremata, containing 34 woodcuts.⁴¹⁷ In Venice, the first illustrated book was not printed until 1489, when Matteo Capasca published the *Devote meditatione* of pseudo-Bonaventura with woodcut illustration.⁴¹⁸ Although still fairly rudimentary, these printed vignettes began to define the characteristics of Venetian book illustration at the end of the fifteenth century.

Like their earlier German counterparts, these images rely on simple outlines to describe figures and even more abstracted shapes to define distant elements of the landscape, as seen in the illustration of Christ carrying the cross surrounded by Roman soldiers (Figure 121). Unlike Pfister's earliest illustrations, here parallel hatching suggests some three-dimensional modeling and the folds of drapery within the outlined figures, moving the imprint beyond a template to be hand-colored and into an image in its own right. Capasca's *Lamento della Vergine Maria* of

⁴¹⁵ Leonardas Vytautas Gerulaitis, *Printing and Publishing in Fifteenth-century Venice* (London: Mansell Information Publishing, 1976), 17. Ulrich Boner, *Der Edelstein* (Bamberg: Albrecht Pfister, 14 February 1461) ISTC No.: ib00974500. <https://data.cerl.org/istc/ib00974500>.

⁴¹⁶ Daniela Laube, "The Stylistic Development of German Book Illustration, 1460–1511," in Daniel de Simone, ed. *A Heavenly Craft: The Woodcut in Early Printed Books*, 47–71 (New York: George Braziller, 2004), 48. See also: Sabine Häussermann, *Die Bamberger Pfisterdrucke: Frühe Inkunabelillustration und Medienwandel* (Berlin: Deutscher Verlag für Kunstwissenschaft, 2008).

⁴¹⁷ Gerulaitis, *ibid.* Johannes de Turrecremata, *Meditationes seu Contemplationes devotissimae* (Rome: Ulrich Han [Udalricus Gallus], 31 December 1467) ISTC No.: it00534800. <https://data.cerl.org/istc/it00534800>.

⁴¹⁸ [Pseudo] Bonaventura, *Meditationes vitae Christi: Le devote meditatione sopra la passione del nostro signore* (Venice: Matteo Capasca (earlier scholarship notes his surname as di Codeca), 26 April 1490), ISTC No. ib00906000. <https://data.cerl.org/istc/ib00906000>.

1490 continued to define a Venetian illustration aesthetic (Figure 122). For example, in the opening *pietà*, a greater restraint in the use of parallel hatching emphasizes a two-dimensional, linear graphic quality that came to exemplify Venetian woodcuts at this time.

This Venetian style has often been contrasted with the style of woodcuts that emerged in Florentine incunabula. The Florentine style consisted of outlined figures, their skin and drapery the color of the folio, depicted against a printed black background (Figure 123). This inky backdrop was often achieved through dramatic mountain ranges and rocky outcroppings pitched above the height of the figures. While the individual Florentine figures are not necessarily more refined than their Venetian counterparts, the overall effect of linen-colored figures against an ink-black ground achieves something visually akin to the low-relief carving of a cameo or nielli with their incised, blackened lines against a silver ground. These woodcuts are often framed by decorative borders containing white flowers, diagonals, or diamonds against a black ground that further characterize Florentine woodcuts. While these elegant woodcuts often earn Florence recognition for producing more visually appealing incunabula, the sheer quantity of print produced by Venice's publishers speaks beyond the local and begins to characterize western European printed books more broadly.

The next major advancement in Venetian woodcut illustration returns us to the printers associated with Lucantonio Giunta. The first Bible printed in Italy that was fully illustrated was a vernacular translation by Nicolò Malermi (or Malerbì), printed in Venice in 1490 by Giovanni Ragazzo for Lucantonio Giunta.⁴¹⁹ A much more complex visual apparatus is present in these volumes. An elaborate architectural frame contains six scenes of Creation on the verso of the

⁴¹⁹ Lilian Armstrong, "Venetian and Florentine Renaissance Woodcuts for Bibles, Liturgical Books, and Devotional Books," in *A Heavenly Craft: The Woodcut in Early Printed Books*, edited by Daniel di Simone, 25–46 (New York: George Braziller, 2004), 25. *Biblia Italiana* (with additions), translated by Niccolò Malermi (Venice: Giovanni Ragazzo for Lucantonio Giunta, 15 October 1490). ISTC No. ib00644000. <https://data.cerl.org/istc/ib00644000>.

first opening and the text of Genesis on the recto (Figure 124). *All'antica* details of the monuments situate the foundational Judeo-Christian text within the ancient Roman world. The architectural framing is repeated again at the opening of the book of *Proverbs* thought to record the wisdom of the biblical king Solomon (Figure 140). While these texts contain more sophisticated composite woodblocks, they largely adhere to the sparse style of outline present in Matteo Capasca's editions. This style was deemed the "popular style" by A.M. Hind in his 1935 survey and introduction to the history of the woodcut.⁴²⁰ Building upon this, Lilian Armstrong identified this woodblock designer as the Master of the Pico Pliny (or Pico Master), an illuminator of manuscripts who then turned to decorating printed books (as seen in Chapter 2) and finally to designing woodcuts as incunabula began to require more sophisticated illustration.⁴²¹

Emerging around 1490, and fully present by 1500, was a Venetian style of illustration which Hind identified as the "classical style."⁴²² In contrast to the illustrations present in the printed volumes by Capasca and others, the printed images in this period appear more three-dimensional as a result of more subtle application of finer parallel shading. Costumes and figures also came to more closely resemble ancient Greek and Roman exemplars than in previous Venetian volumes. The corpus of woodcuts first printed in the Giuntine Gradual and central to this investigation are constituents of this shaded style and the first to be incorporated into a book.

⁴²⁰ Arthur M. Hind, *An Introduction to a History of Woodcut: With a Detailed Survey of Work Done in the Fifteenth Century* (London: Constable and Company, 1935), Vol. II, 469–481.

⁴²¹ Armstrong, *Heavenly Craft*, 27. Armstrong has identified an earlier printed *Biblia Italica*, which was published by Antonio di Bartolommeo Miscomini in 1477 (Vienna, Österreichisches Nationalbibliothek, Inc.5.D.22, fol. 11r) which contains a similar architectural frontispiece drawn in pen and ink and tinted with watercolors by the Pico Master which may have served as the prototype for the woodblock designs. For other copies of the 1477 *Biblia Italica*, see: ISTC No. ib00640500. <https://data.ceur.org/istc/ib00640500>.

⁴²² Hind, *Woodblock Prints*, 475.

While Hind named this artist as the “Classical Designer,” Armstrong has associated the woodcuts with Benedetto Bordon.⁴²³ Regardless of the woodblock designer’s identity, it is clear that this style was greatly influenced by the drawings and prints of the Paduan artist Andrea Mantegna (1431–1506), which were well known to both Paduan and Venetian artists. Their incorporation into the ambitious gradual mark a turning point for the history of the Venetian woodcut before Titian.⁴²⁴ The initials are replete with *all’antica* detail. For example, in the folio illustrating the Resurrection of Christ—the highpoint of the annual liturgical calendar and therefore a moment of heightened musical performance—represents Christ in an elegant contrapposto pose. The initial *R* surrounding the resurrected Christ is composed of acanthus leaves and an urn on the ascender; a grotesque hybrid composed of human, acanthus, and dolphin elements rounding the top of the letter; and a full dolphin for the descender (Figure 125). Parallel shading suggests a continuous light source and lends three-dimensionality to the letter, while the dense lines convene into inky darkness in the empty tomb behind. Visual comparison between this tomb and the earlier imprint by Matteo Capasca (Figure 122) demonstrates the transition from the sparse lines of Hind’s “popular style” or the artist identified by Lilian Armstrong as the Pico Master, and this “classical style” likely by Benedetto Bordon.

The attribution to Bordon by Armstrong is based upon similarities to the size and composition of painted initials from the manuscript Antiphonal of San Nicolò della Lattuga (or dei Frari) executed by the same artist.⁴²⁵ Like his alliance with the specialist music-printer, Johann Emerich, and the musical editor Francesco de Brugis, Lucantonio Giunta’s collaboration

⁴²³ Hind, *Woodblock Prints*, 469. Armstrong, *Heavenly Craft*, 35.

⁴²⁴ *Ibid.*

⁴²⁵ Lilian Armstrong, “Benedetto Bordon, Aldus Manutius, LucAntonio Giunta: Old Links and New” in *Aldus Manutius and Renaissance Culture*, edited by David Zeidberg (Villa I Tatti: The Harvard University Center for Italian Renaissance Studies, 15) (Florence, Leo S. Olschki, 1998), reprinted in Armstrong, *Studies of Renaissance Miniaturists in Venice* (London: The Pindar Press, 2003), vol. 2, 644–683, particularly 664.

with a designer of woodblocks would have been calculated. His choice would doubtless fall on a figure already well-known for his work in both the print industry and luxury manuscripts (Chapter 2); familiar with the traditional iconography of graduals, yet capable of innovation in translating new styles into woodblock. It is also nearly certain that the woodblocks appearing in the gradual were commissioned specifically for that publication since they appear there for the first time and fit within the scale of the large text and musical notation, measuring about 110 x 95 mm.⁴²⁶ Based upon stylistic association with previous works, Armstrong contends that the woodcutter for the designs was Jacob von Strassburg.⁴²⁷

The 24 woodcuts first published in the 1499/1500 Gradual were reused across Giuntine liturgical and devotional texts for over 30 years, including the following texts: Book of Hours, 1501; Missal, 1501; Antiphonal, 1503–4; Antiphonal, 1505; Psalter, 1507; Breviary, 1507; Missal, 1508; Gradual, 1513; Antiphonal 1515; and the Gradual 1527.⁴²⁸ While some of these reused woodblocks are historiated initials, part of Bordon's innovation was to separate illustration from initial, allowing for greater modularity and reuse. By placing an illustration *next* to the printed initial, the texts fulfill expectations of luxurious manuscripts containing historiated initials; however, by separating image and letter, the illustrations are not limited in their reuse by the initial letter of the text. Scenes from the life of the Virgin and the life of Christ could thus be employed in the relevant liturgical cycle, in Psalters used as tools for typological interpretation of the Hebrew scriptures, and for added impact alongside prayers in Books of Hours.

⁴²⁶ Ibid.

⁴²⁷ Armstrong, "Benedetto Bordon, Aldus Manutius, LucAntonio Giunta," 710.

⁴²⁸ Gradual, 1501: <https://www.ustc.ac.uk/editions/998925>; Book of Hours, 1501: <https://www.ustc.ac.uk/editions/819824>; Missal, 1501: <https://www.ustc.ac.uk/editions/819819> ; Antiphonal, 1503–4: <https://www.ustc.ac.uk/editions/820057>; Psalter, 1507: <https://www.ustc.ac.uk/editions/820078>; Breviary, 1507: <https://www.ustc.ac.uk/editions/827201> Missal, 1508: <https://www.ustc.ac.uk/editions/820083>; Antiphonal 1515 and Gradual 1527: <https://polovea.sebina.it/SebinaOpac/resource/graduale-secundum-morem-sancte-romane-ecclesie-integrum-completum-videlicet-dominicale-sanctuarium-c/VEA2856174?locale=eng>

Previous scholarship has focused on the economic aspects of Giunta's reused woodblocks.⁴²⁹ The investment in the design and labor of creating high-quality matrices at the same moment as the publication of the 1499/1501 Gradual, which also required massive investments in the form of new types and large folios of paper, may have been something of a gamble—particularly in light of failed attempts by earlier publishers to produce such a text. The ability to distribute that initial investment across additional publications by reusing the woodblocks not only defrayed costs, but also raised the quality of smaller, more private publications to that of the publicly visible, legally privileged, and clerically sanctioned choir book. Beyond this bottom-line thinking, this body of publications offers an opportunity to rethink reuse not just in relation to the printing press, but also in relation to the Venetian visual and material culture of which it was a part. I argue that the distribution of woodblocks across a geography of public and private devotion—at a moment of particular Venetian innovation in the medium—served to unify the religious experience of the faithful.

Traditional art historical arguments have been divided in their judgment of the repeated use of a woodblock within a single volume. Perhaps most frequently cited is the repetition of woodcuts in Hartmann Schedel's *Nuremberg Chronicle* (*Liber chronicarum*, 1493) to represent diverse cityscapes.⁴³⁰ Ernst Gombrich characterized the repetition as the Chronicle's "indifference to truthful captions," in his influential *Art and Illusion* (1960).⁴³¹ Stephen Orgel quipped that, "the generic looks very much like the particular" in the *Chronicle*.⁴³² More

⁴²⁹ Armstrong, "Woodcuts for Liturgical Books," 730. See also: Lesley T. Stone, *From Chapel to Chamber: Liturgy and Devotion in Lucantonio Giunta's Missale Romanum, 1508*. (M.A. Thesis, University of South Florida, 2005); Martin Davies, "Benedetto Bordon, a Life in the World of Books," Exhibition Catalogue (New York: PrPh Books, 2015).

⁴³⁰ ISTC: <https://data.cerl.org/istc/is00307000>

⁴³¹ Ernst Gombrich, *Art and Illusion: A Study in the Psychology of Pictorial Representation* (London: Phaidon, 2002), 68.

⁴³² Stephen Orgel, "Textual Icons: Reading Early Modern Illustrations," in *The Renaissance Computer: Knowledge Technology in the First Age of Print*, edited by Neil Rhodes and Jonathan Sawday (London: Routledge, 2000), 63.

generously, Elizabeth Carson Pastan understood the “homographs” as serving to provide a visual organizational armature, not only beautifying the volume but also offering “imaginative prompts” for distant places.⁴³³ Even before this reassessment of the *Chronicle*, Michael Camille considered how the reader presented with a repeated image at the end of a copy of the *Pilgrimage of Human Life (Pèlerinage de la vie humaine)*—having encountered new information and perhaps spiritual enrichment—was not the same reader who began the text, even if the woodblock image was identical.⁴³⁴

The Giuntine implementation of woodblocks introduces a useful distinction to this historiography: the differences between the kind of repetition described above and reuse. According to this distinction, repetition consists of a single image used for the same or similar purpose, often in the same text (e.g., one cityscape representing multiple cities in the *Chronicle*). Reuse, however, is the same image deployed for a new purpose. For example, printing a woodblock as an initial in an Antiphonal and then reprinting the same woodblock as a full-page illustration in a smaller Book of Hours is reuse (Figure 126). I contend that additional meaning was produced through this type of reuse and that pre-existing visual cultural strategies of reuse informed the construction of that meaning, at least in part.

One particularly Venetian understanding of this reuse may derive from the relationship with spolia in order to claim a classical past for the city despite its later-antique and Byzantine roots. Spolia decorating the surface of the Basilica San Marco—much of which was looted during the sack of Constantinople by Venetian “Crusaders” in 1204—was highly visible and

⁴³³ Elizabeth Pastan, “Representing Architecture” in *The Bayeux Tapestry and Its Contexts: A Reassessment* (Woodbridge, Suffolk, U.K.: Boydell Press, 2014), 184.

⁴³⁴ Michael Camille, “Reading the Printed Image: Illuminations and Woodcuts of the *Pèlerinage de la vie humaine* in the Fifteenth Century,” in *Printing the Written Word: The Social History of Books, circa 1450–1520*, edited by Sandra Hindman (Ithaca: Cornell University Press, 1991), 259–291. (*Pèlerinage de la vie humaine* in ISTC: <https://data.cerl.org/istc/ig00636000>).

politically charged.⁴³⁵ There were also mythical claims that Venice was constructed entirely from the stones of Troy, thus predating even Rome.⁴³⁶ These claims to antiquity, through the very stones rising out of the lagoon, sought to legitimate Venetian autonomy and status in anxious comparison with more ancient, neighboring *commune* such as Padua.

Spoliation requires that a non-fungible object is forcibly removed from one location and reinstalled in a new setting. While the impression of a woodblock in a Gradual and later in a Book of Hours does not represent this kind of removal and relocation, it may participate in what Richard Brilliant has called *spolia in re*. Brilliant distinguishes between *spolia in se*, the traditional notion of theft and relocation, and *spolia in re*, in which images, motifs, visual formulas, and even verbal or written citation are reused in a new setting.⁴³⁷ Expanding upon this distinction, Dale Kinney offers a definition of reuse that sheds light on the Guntine corpus of woodblocks deployed across titles:

In cultural economies, the reuse of melodies, stories, images, symbols, and other abstract forms of expression creates an aura of familiarity and provides a common store of self-identifying topoi or emblems that foster cultural cohesion.⁴³⁸

This metaphorical taking-by-citation leaves the primary context intact while elevating the stature of the new context.

Andrea Mantegna, whose style of shading in drawing has been connected to the Giuntine blocks, was keenly aware of the value of spoliation. His *St. Sebastian* (1456–1459), now in the Kunsthistorisches Museum, Vienna, depicts the saint tied to an ancient triumphal arch likely

⁴³⁵ San Marco has been described as “the largest preserved store of spolia in any building anywhere.” See: Friedrich Wilhelm Deichmann, Joachim Kramer, and Urs Peschlow, *Corpus der Kapitelle der Kirche von San Marco zu Venedig* (Weisbaden: F. Steiner, 1981), 12.

⁴³⁶ Arnold Esch, “On the Reuse of Antiquity: The Perspectives of the Archaeologist and of the Historian,” in *Reuse, Value, Erasure: Critical Views on Spolia and Appropriation in Art and Architecture*, edited by Richard Brilliant and Dale Kinney, 13–32 (Farnham: Ashgate, 2011), 17.

⁴³⁷ Richard Brilliant, “I piedistalli del giardino di Boboli: Spolia in se, spolia in re,” *Prospettiva*, 31 (1982): 2–17.

⁴³⁸ Dale Kinney, “Introduction,” in *Reuse, Value, Erasure*, 1–11, especially 2.

converted into a medieval city gate (Figure 127). The painting is replete with other classical references including fragments of ancient marble sculpture, an urn and acanthus low relief, and the artist's signature in Greek.⁴³⁹ While *spolia in re* addresses some of the meaning generated by Lucantonio's engagement with this corpus of woodblocks throughout his career, the fact that the images exist in multiple copies—without destroying the original setting—fundamentally differs from traditional notions of spoliation.

Instead, the notion of a contact relic, which does not diminish, but expands “aura” across readership, might be more descriptive. Contact relics, or tertiary relics, include materials like ampoules of water or textile fragments pressed against saintly relics or shrines often thought to be miracle-working in order to imbue—or indeed, imprint—the materials with thaumaturgic charisma.⁴⁴⁰ Rather than depleting the relics' agency, tertiary contact relics allow for the power of the holy figure or object to expand geographically, while the “original” remains intact. A pilgrim who impressed a cloth to a reliquary shrine in a distant church would then return home with that blessed object. Similarly, a parishioner who purchased a Book of Hours imprinted with the same woodblocks from a gradual she had seen and heard performed in the Mass extended that experience into her personal dwelling and private devotional practice—perhaps even associating the music of the chant with the corresponding image in her prayerbook. Beyond Graduals and Books of Hours, the Giuntine corpus of woodblocks also circulated through the restricted space of monasteries via their reuse in Antiphonals. They were present at the high altar in the Missal of a celebrant and entered into the wider community as priests traveled to perform rites. Like small, portable altarpieces, Lucantonio's quarto and octavo Missals allowed these

⁴³⁹ Esch, “On the Reuse of Antiquity,” 25.

⁴⁴⁰ Scott Montgomery, “Contact Relics,” in *Encyclopedia of Medieval Pilgrimage*, <http://dx.doi.org/10.1163/2213-2139-emp-SIM-00235>. (Consulted online on 21 June 2022).

printed images not only to circulate into the public sphere but also to blur distinctions between public and private devotion.⁴⁴¹

Printing, the act of impressing a support like paper or parchment on a “charged” matrix, has been understood as analogous to the process of creating a tertiary contact relic.⁴⁴² Furthermore, printing connects with a particular type of miracle-working or miraculous image known as *acheiropoieta* (αχειροποίητα), or images “not made by human hands” such as the veil of Veronica—which was understood to have miraculously reproduced the appearance of Christ after being “impressed” against his face during the Passion.⁴⁴³ Images reproduced by mechanical means are “literally acheiropoetic” and early modern printmakers sometimes drew upon this significance in their prints, such as Albrecht Dürer’s image of the so-called *sudarium* in the 1510–11 Passion series (*Passio Christi*) and especially the slightly later *Sudarium Held by One Angel* (1516), in which an angel lifts the veil with the image of Christ in a motion similar to a printmaker removing an imprinted folio from the press (Figure 128, Figure 129).⁴⁴⁴

There is some evidence present in the corpus of woodblocks frequently reused by Lucantonio that may suggest this kind of self-referential awareness of the nature of printed images. The 1501 Book of Hours contains a woodblock with the *Annunciation to the Shepherds* on folio 42 verso (Figure 130). The banderole held by the angel reads “Glory to God in the highest” (*Gloria in excelsis Deo*). Yet, the first two words of this printed annunciation appear reversed. One understanding of this reversal could be that the text is meant to depict speech

⁴⁴¹ Stone, *From Chapel to Chamber* (2005), 22. I consider here Michael Baxandall’s discussion of the period eye as well as Alfred Gell’s “index,” which maps out relationships in meaning between makers, patrons, primary and secondary audiences. Yet, I push this one step further so that the reiterated conventional image is literally reproductive. See: Alfred Gell, *Art and Agency: An Anthropological Theory* (Oxford: Clarendon Press, 1998), sections 2.6–2.7.

⁴⁴² Lisa Pon, *Madonna of Fire* (Cambridge: Cambridge University Press, 2015), 59.

⁴⁴³ *Ibid.*, 44.

⁴⁴⁴ Christopher Wood, *Forgery, Replica, Fiction: Temporalities of German Renaissance Art* (Chicago: University of Chicago Press, 2008), 40.

emanating from the divine messenger on the right. This kind of reversed text-as-speech can also be seen in the mid-fourteenth century, miracle-working fresco of the *Annunciation* in the Basilica the *Santissima Annunziata* in Florence (Figure 131). In response to the Archangel Gabriel’s proclamation of the impregnation of the Virgin, Mary is thought to have responded, “Behold the handmaid of the Lord (*Ecce ancilla Domini*).”⁴⁴⁵ In the fresco, these words emanate from the Virgin on the right toward the angel on the left with the letters reversed.

It may also be possible that a woodblock designer such as Benedetto Bordon, highly attuned to the transitions between manuscript illumination and printed illustration, called attention to the nature of print—which requires images and text to be carved in the woodblock in reverse, to appear correct once imprinted.⁴⁴⁶ This reversal can be seen in a copy of Petrarch’s *Famous Men* (*Homini Famosi*) printed in Verona in 1476.⁴⁴⁷ The text contains woodblock-printed frames for each biography. In most extant copies, the frames are left blank with only the text describing the famous figure; however, in two copies (Bibliothèque nationale de France Rés.J.603 and British Library IB.32901) the figures were painted by hands contemporaneous to the printing of the text. In the London copy, the sensitive ink washes attributed to the Master of the Pico Pliny and the Master of the Rimini Ovid are frequently highlighted with gold leaf. Within the representations of Fabius Maximus and Hannibal, the figures hold banners depicting the gold-leaf letters of the Latin acronym S.P.Q.R. in reverse (Figure 132).⁴⁴⁸ As with the angel’s

⁴⁴⁵ As recorded in the Gospel of St. Luke (1:38).

⁴⁴⁶ Consider also Albrecht Dürer’s print of a witch riding a goat backward, in which he also reversed his well-known AD monogram. See: British Museum 1868,0822.188, https://www.britishmuseum.org/collection/object/P_1868-0822-188 (Accessed 4 July 2022).

⁴⁴⁷ ISTC No. ip00415000, <https://data.cerl.org/istc/ip00415000>. (Accessed 4 July 2022).

⁴⁴⁸ SPQR is an abbreviated phrase referring to *Senatus Populusque Romanus* (the Senate and People of Rome). For further discussion on this emblematic abbreviation and its mobilization in relation to print and manuscript, see the discussion of illuminated first folios where the abbreviation appears in Chapter 2 of this study. The volume in question is: Francesco Petrarca, *De viris illustribus/Libro degli uomini famosi*, translated by Donato degli Albanzani, printed by Felix Antiquarius and Innocens Ziletus in Pojano on 1 October 1476. ISTC No. ip00415000. <https://data.cerl.org/istc/ip00415000>.

banderole above, one explanation may be that the artist was interested in depicting the translucent properties of the banner (as seen in the printed astronomical diagrams of chapter 3). Another is that the illuminator, working within the woodblock-printed frame of a book produced with movable type, was referencing the reversal required by the print process.⁴⁴⁹ This interest appears to have continued beyond illumination in proximity to print and into the earliest printed book illustration in Venice. In a scene from the Passion in Matteo Capasca's *Meditationes vitae Christi*, considered previously, one Roman guard displays a shield with the iconic letters SPQR, while another holds a standard in which only the *order* of the letters has been reversed rather than their orientation: RQPS (Figure 121). Here, there is no question that the woodblock designer and carver were capable of reversing the orientation of the letters on the matrix so as to appear correct in the impression, as seen on the shield. Instead, they seem to call attention to the many reversals required by the printing process through a humorous outcome on the standard—a common site of visual reversal.

The Missal published by Lucantonio in 1508 continues this engagement with letters printed in reverse. Here, they appear in an angelic banderole framing the scene of Pentecost, a biblical event traditionally understood as the birth of the Catholic church with St. Peter as its first Pope. This annunciation reads “I bring you tidings of great joy...” (*annunctio vobis gaudium magnum*), with the first half of the word *annunctio* in reverse (Figure 133). Far from being a typographical oversight, the reversal appears on a particularly sophisticated modular block set

⁴⁴⁹ Along with the reversed banner, Lilian Armstrong has noted that many of the famous figures appear in the same pose or that pose in reverse. She has interpreted this as evidence that the illuminations served as designs for later woodblocks, which would require them to be in reverse. Yet, some banners appear in the correct orientation and the reversal of the figures' pose has no significant effect on their identity. Furthermore, most copies contain empty woodblock-printed frames, suggesting that no blocks were employed to represent the figures. See: Lilian Armstrong, “Copie di miniature del Libro degli uomini Famosi, Poiano 1476, di Francesco Petrarca, e il cielo perduto di affreschi nella reggia carrese di Padova,” in *La Miniatura a Padova: Dal medioevo al settecento*, edited by Giordana Canova Mariani, et al. (Modena: Franco Cosimo Panini, 1999), 514–515.

within an elaborate architectural frame. Together with the frequently reused woodblock at center depicting the descent of the Holy Spirit, the images set into the frame provide visual exposition of the miraculous biblical event.

The “printedness” of the Guntine woodblocks is also emphasized through selective hand coloring.⁴⁵⁰ The luxurious parchment copy of the Gradual now held in the Marciana boasts finely illuminated woodblock prints. Many of the sensitively rendered scenes record varied flesh tones, draperies modeled through light and shadow, and gold-leaf highlights. Given this attention to detail, the frequent decision to leave the printed lines of the woodblock exposed is of particular interest. In the opening initial *A* with King David in prayer, for example, the king’s robe has received delicate modeling in a range of oranges, yet the wash has been applied lightly enough to collaborate with the parallel hatched shading of the printed image below (Figure 13).⁴⁵¹ Around the kneeling figure, the fuchsia wash of the initial derives its darkest shadows from printed lines, while its brightest highlights were hand-illuminated in white. Carefully applied gold leaf around the outside of the initial and on David’s crown evokes the manuscript tradition of illumination while clearly proclaiming the printed nature of this image. Every woodblock-printed initial in the Marciana gradual received this sensitive treatment *except* the initial *R* with the resurrected Christ (Figure 125). Considering that the resurrection represented not only the emotional highpoint of the Mass in the form of the eucharistic host, but also of the entire liturgical year at Easter, the

⁴⁵⁰ Jun Nakamura, *Prints and Printedness: Mark Making, Meaning, and Perceptions of Print in the Seventeenth-Century Netherlands* (Ph.D. Dissertation, University of Michigan, 2022).

⁴⁵¹ Although Massera describes this illumination as making “true and real miniatures” (*vera e propria miniature*) of the illustrations, the printed lines remain clearly visible. See: Massera, 13.

choice to leave the Resurrection initial completely unadorned lays bare its importance as a *printed* image.⁴⁵²

The gradual is not the only instance of selective hand-coloring to generate meaning. In a Giuntine Book of Hours, now in the *Biblioteca civica Angelo Mai* in Bergamo, a criblé woodblock deployed repeatedly throughout the book's borders depicts Death aiming an arrow at a group of martyrs (Figure 134). In each of the nine impressions of this woodblock throughout the book, all of the figures are sensitively colored except Death, who retains only the pallid color of the parchment support. In these instances of death and resurrection, the choice of whether or not to embellish a printed image seems to reflect a systematic, semantically activated process. Perhaps Christ's relationship with death and his liminal nature after the resurrection, which placed greater emphasis on his divinity, were best represented by an unadorned printed image not made by human hands.⁴⁵³

Of course, the hand coloring by communities or individual owners after publication may not always have had strictly organized meaning. A Book of Hours published by Johann Hamman—that early collaborator of Johann Emerich—now in the *Biblioteca del Museo Correr*, often repeats identical woodcut borders across consecutive folios.⁴⁵⁴ In some cases the first instance of a border is left unpainted then fully colored on the following folio (Figure 135). It is

⁴⁵² “From beginning to end, but especially during the Canon and Communion, the Mass is a rememorative drama depicting the life, ministry, crucifixion, and resurrection of Christ.” See: O.B. Hardison Jr. “The Mass as Sacred Drama,” in *Christian Rite and Christian Drama in the Middle Ages: Essays in the origin and Early Modern History of Drama* (Baltimore: The Johns Hopkins Press, 1965), 44. Andrew Kirkman explains that the reenactment of Christ's Passion, particularly the moment of the transubstantiation of the host indicated by the ringing of a bell, was the “climax” of the Mass. See: Andrew Kirkman, *The Cultural Life of the Early Polyphonic Mass: Medieval Context to Modern Revival* (Cambridge: Cambridge University Press, 2010), 177.

⁴⁵³ The Gospel of St. John describes, in Chapter 20, that the disciples were together in the “upper room” with the doors locked for fear of the Jewish authorities. The resurrected Christ then “came and stood among them,” undeterred by the locked doors. John also records that a week later Christ reappeared to Thomas behind locked doors, inviting the saint to touch the unhealed wounds of his hands and side.

⁴⁵⁴ Biblioteca del Museo Correr Inc.L.002, ISTC No. ih00366400. <https://data.cerl.org/istc/ih00366400>

tempting here to identify a progression from darkness or monochromatic palettes into light and color, or to draw metaphorical meaning from the incarnation of Christ; yet, other times, the opposite is true and a fully painted border on one folio has received no additional embellishment in the subsequent impression (Figure 136).⁴⁵⁵ In a 1506 Giuntine Missal now in the Huntington Library, there is selective coloring of some woodcuts and sometimes only small portions of them with a logic that may have been specific to the celebrant using the text (Figure 137).⁴⁵⁶ Rather than making self-aware assertions of the nature of the technology of movable type, this kind of personalization may be more similar to the editing and emendation of printed music based on personal, communal, or regional taste.⁴⁵⁷

While spoliation and tertiary contact relics access a great deal of meaning regarding the reuse of the corpus of Giuntine woodblocks, notions of scale may be the most productive conceptual framework for understanding the significance of images imprinted across a wide range of books with various devotional purposes and, importantly, vastly different sizes. Returning to the Guidonian hand diagram with which this chapter opened, scale can be understood as providing an avenue of connection across distance. Although the diagram was

⁴⁵⁵ Natacha Pernac has connected the selective use of monochrome and polychrome palettes at the turn of the sixteenth century with an attempt to associate monochromatic images with antiquity due to the popularity of low-relief cameos and architectural carving. Polychromatic images, on the other hand were intended to be associated with the epoch beginning with the incarnation of Christ up to the present day. See: Natacha Pernac, “Des expériences sur la monochromie dans la peinture autour de 1500: le cas négligé de l’Italie centrale,” in *Aux limites de la couleur: monochromie et polychromie dans les arts 1300–1600*, edited by Marion Boudon-Machuel, Maurice Brock, et Pascale Charron, 61–68 (Turnhout: Brepols, 2012), 64. Similarly, Cyril Mango has connected the monochromatic with the Old Testament and bright colors with the New Testament in the Byzantine period. See: Cyril Mango, *The Art of the Byzantine Empire 312–1453: Sources and Documents* (Toronto: University of Toronto Press, 1986), 47–48, especially 48n136.

⁴⁵⁶ *Missale Romanum* (Venice: Lucantonio Giunta, 1506). Huntington Library call number 441423: <https://catalog.huntington.org/record=b1160344> accessed 22 June 2022.

⁴⁵⁷ When referring to “taste,” I employ Michael Baxandall’s notion: “Much of what we call “taste” lies in this, the conformity between discriminations demanded by a painting and skills of discrimination possessed by the beholder. We enjoy our own exercise of skill, and we particularly enjoy the playful exercise of skill which we use in normal life very earnestly. If a painting gives us opportunity for exercising a valued skill and rewards our virtuosity with a sense of worthwhile insights about that painting’s organization, we tend to enjoy it: it is to our taste.” See: Michael Baxandall, *Painting and Experience in Fifteenth-Century Italy* (Oxford: The Clarendon Press, 1972), 34.

printed at a larger-than-life scale, when placed atop a stand at the center of the choir and viewed from the stalls it must have appeared at more human proportions. Furthermore, it would be impractical for the *maestro di cappella* to refer back to the didactic diagram mid-chant. Instead, the presence of the large Guidonian hand at the beginning of the text may have simply reminded *cantors* of the embodied knowledge they had mentally encoded into their own left hand.⁴⁵⁸

The period of the publication of the Gradual and Antiphonal was certainly a moment in which Venetian woodcut was experimenting with the possibilities of scale. Jacopo de' Barbari completed his “bird’s eye view” of Venice in 1500 (Figure 138). This monumental project likely involved a team of surveyors and sophisticated mathematics to produce six woodblocks, each measuring 980 x 680 mm (Figure 139). Carved of pearwood, the matrices required multiple planks of wood fitted together to achieve the desired size of the map.⁴⁵⁹ The final result, when imprinted and pasted together, covers nearly four square-meters with Venice’s labyrinth of canals and buildings—seen from an elevated vantage point that would have been physically unachievable in the period. Yet, the intricate detail of the map, by which individual edifices can be identified, invites viewers of the immense work to constantly shift scales of reference, between macroscopic comprehension of all 118 islands of the lagoon city to microscopic investigation contemporaneous events such as the construction of the Rialto bridge.

Not only was scale being explored during this exciting time in the history of woodcut in Venice, but also the modular function of woodblock printing was pushed to new heights.

⁴⁵⁸ This connection between the printed Guidonian hand and a chorister’s own left hand assumes a body that looks like that of the diagram. For singers with bodies that differ from the diagram, embodied knowledge would likely function according to epistemologies that best served those individuals.

⁴⁵⁹ In distinguishing between size and scale, I refer to size as a numeric value within a given system of measurement (e.g. metric), while scale represents a ratio or relationship between two objects (or between object(s) and viewer(s)). As Joan Kee notes, disagreements regarding “size” and “scale” reflect various cultural hegemonies and values. See: Joan Kee, “Scale to Size: An Introduction” in *To Scale*, Joan Kee and Emanuele Luigi, ed. *Art History* 38, Issue 2 (2015): 9–12.

Certainly, modularity had long-since been a function of book publishing.⁴⁶⁰ The hand-colored borders of the book of hours published by Johann Hamman, analyzed above, demonstrate the use of a modular system of repeated blocks to produce illustrated borders in 1490, roughly a decade before the publication of the Gradual with the first edition of the Malermi Bible (Figure 124). In a 1494 reprinting of the *Biblia italica* by Johannes Rubeus Vercellensis, again for Lucantonio's publishing firm, the reuse of the modular woodblocks became more sophisticated. Here, the same architectural framing design is used, but in combination with columns of text to introduce the book of *Proverbs* (Figure 140). There the *all'antica* blocks frame the depiction of King Solomon, the traditionally acknowledged author of most of the book of *Proverbs*. Additional elements within the architectural frame could also be exchanged depending on the subject matter. In its framing of *Genesis*, the lunette at the top of the architectural monument contains the dove of the Holy Spirit; yet, at the beginning of *Proverbs*, God the Father looks down from the lunette upon Solomon as the king records his divinely inspired wisdom. These examples demonstrate the beginning of more conscious reuse of blocks to achieve diverse meanings rather than in the simple service of efficiency.⁴⁶¹ This emerging sophistication did not preclude publishers working with Lucantonio from the mere repetition of woodblocks, as seen in the nine visitations of Death in the 1501 Book of Hours. Yet, the way in which the printer Johann Emerich and the publisher

⁴⁶⁰ For a brief history of modularity in woodblock printing, see: Stephen Goddard, "Modular Prints: A Special Case of the Assembled Woodcut in the Fifteenth and Sixteenth Centuries," in *Grand Scale: Monumental Prints in the Age of Dürer and Titian*, ed. Larry Silver and Elizabeth Wycoff (New Haven: Yale University Press, 2008), 86–97.

⁴⁶¹ This modularity that allows for the rearranging of visual elements as required by the narrative relates to what Martin Kemp described as "component pictures" in characterizing copies within the ambit of Leonardo da Vinci. See: Martin Kemp, "The 'Madonna of the Yarnwinder,' in The Buccleuch Collection Reconsidered in the Context of Leonardo's Studio Practice," in *I Leonardeschi a Milano: Fortuna e Collezionismo*, ed. Maria Teresa Fiorio (Milan: Electa, 1991) 35–49. Within the copying practices of the artist known as the Lippi and Pesellino Imitator, Megan Holmes describes the "cut-and-paste" mode of image construction as "pastiche." See: Megan Holmes, "Copying Practices and Marketing Strategies in a Fifteenth-Century Florentine Painter's Workshop," in *Italian Renaissance Cities: Artistic Exchange and Cultural Translation*, eds. Stephen. Campbell and S. Milner (Cambridge: Cambridge University Press, 2004) 38–74.

conceived of reuse across publications of various scale seems to build upon the patterns of reuse established by Johannes Rubeus Verzellensis in the 1494 reprint of the vernacular Bible for Lucantonio Giunta.

While previous scholarship has explained this reuse purely in terms of its economic practicality, I contend that a series of woodcuts which could be used across extra-large folio, bifolio, quarto, and octavo sized publications necessarily demonstrates foresight of the possibilities of modularity and reuse.⁴⁶² By considering which partner in this complex collaboration may have conceived of the scale of the woodblocks, we may garner additional significance in their deployment. It is likely that Lucantonio, a publisher familiar with the expenditures of paper needed to feed a press and the practicalities of folding large folios into variously sized books, would commission valuable images that could be reused in thoughtfully designed variant page layouts. It is also conceivable that Benedetto Bordon, an artist working at the highest levels of book production (both manuscript illumination and woodblock illustration) might take the increasingly standardized scale of printed books into consideration—although this might mean less business in future.⁴⁶³ In a more abstract approach, I propose that Johann Emerich, a printer particularly attuned to the reproduction of music may have conceived of images capable of reuse according to various scales.

During this period, musical theorists began a complex process of associating the tones of a scale with the reemerging arithmetical theory of ratios. According to a classical experiment, Pythagoras developed the most important consonances in ancient Greek music by first plucking

⁴⁶² “Their subsequent use in the later choir books shows the publisher adapting to the excessive financial burden of that anachronistic project, and their selective reappearance in Giunta’s finest editions shows his economically shrewd appreciation of their aesthetic appeal.” See: Lilian Armstrong, “Woodcuts for Liturgical Books,” 730.

⁴⁶³ See: Simonetta Cavaciocchi, ed. *Produzione e Commercio della carta e del libro secc. XIII–XVIII: Atti della Ventitreesima Settimana di Studi* (Florence: Le Monnier, 1991).

the whole string of an instrument, and consecutively half, three-fourths, and two-thirds, obtaining the intervals of the octave, fourth, and fifth.⁴⁶⁴ This experiment informed musical theorists that mathematical ratios underlie musical intervals.

In the fifteenth and early sixteenth centuries, the humanist translation of Greek mathematics into Latin, including Euclid's theorizing of proportions to solve geometrical problems (Book V), equipped those working in a Latin context to apply ratios more theoretically to music.⁴⁶⁵ An influential application of this thinking was Nicolas of Cusa who worked with the music theorist Prosdocimus de Beldemandis at the University of Padua and applied geometrical thinking to musical problems.⁴⁶⁶ Influenced by Cusa, the musical theorist Franchino Gaffurio wrote *Theorica musice* in 1480.⁴⁶⁷ The first of three treatises written by Gaffurio, the *Theorica* provided a synthesis of previous traditions. The edition printed in Naples by Francesco di Dino includes woodcut diagrams that relate arithmetical, geometrical, and musical proportionality (Figure 141). Gaffurio was so deeply influenced by the principle of proportion that he applied it not only to music, but also to the organization of the text itself.⁴⁶⁸ Within the complex, dynamic network that generated so much innovation within the printing industry in Venice, and more particularly within the circle of collaborators centered around Lucantonio Giunta, I would argue for the possibility that the most prolific music printer, Johann Emerich, may have helped to conceive of woodblocks that would function on the proportional scale of the newly standardized

⁴⁶⁴ Oscar João Abdounur, "Ratios and Music in the Late Middle Ages: A Preliminary Survey," in *Music and Mathematics in Late Medieval and Early Modern Europe*, ed. Philippe Vendrix, 23–69 (Turnhout, Belgium: Brepols, 2008), 25.

⁴⁶⁵ Abdounur, "Ratios and Music," 56.

⁴⁶⁶ David Paul Goldman, "Nicholas Cusanus' Contribution to Music Theory," *Rivista internazionale di musica sacra*, 10 (1989), 308.

⁴⁶⁷ Franchinus Gafurius, *Theorica Musicae* (Naples: Francesco di Dino, 8 October 1480). ISTC No. ig00005000. <https://data.cerl.org/istc/ig00005000>

⁴⁶⁸ Vendrix *Music and Mathematics*, 2008, 11–12.

printed folio, just as emerging theorists were rediscovering a proportional understanding of the musical scale.⁴⁶⁹

A contemporaneous publication printed by Johann Emerich for Lucantonio Giunta demonstrates that the two had employed this proportional system before the Benedetto Bordon blocks were imprinted in the Gradual. An octavo-sized psalter published on 23 July 1499 contains an initial *B* with King David which begins Psalm 1: “Blessed is the man who hath not walked in the counsel of the ungodly” (*Beatus vir qui non abiit in consilio impiorum*). In this 1499 psalter, the woodblock occupies seven lines of text. In a slightly later and infinitesimally small psalter, unfortunately lacking a colophon but dated in estimation to around 1500, the same woodblock was again used to begin the first Psalm. This time it occupied ten lines of smaller text in the 32nd sized text block (Figure 142).⁴⁷⁰ While the date of the smaller psalter is uncertain, the date of 23 July 1499 for the octavo psalter places it just over two months before the first Graduals were issued under the Giuntine aegis on 28 September 1499. Although these earlier psalters contain no printed music, they may represent proof of concept for the proportional woodblocks just before the freshly cut blocks based on Benedetto Bordon’s designs were imprinted.⁴⁷¹

⁴⁶⁹ As Michael Friedman has claimed, “[...] paper was not only the conveyor of mathematical knowledge by means of the written word that spread mathematical ideas to a larger audience, but that it also enabled, due to its mass production [in contrast with vellum which cannot be mass-produced] a new form of mathematical knowledge by means of the folding techniques involved in the printing process.” See: Michael Friedman, *A History of Folding in Mathematics: Mathematizing the Margins* (Cham: Springer International Publishing, 2018), 65.

⁴⁷⁰ The terms used to describe the sizes of printed books are derived from the successive divisions of the folio in half through folding. A folio must be folded in half once in order to create a quire or gathering, the basic structure of the book. So, the largest size is a bifolio (or bifolium, $\frac{1}{2}$ folio). Folded again, this becomes a quarto ($\frac{1}{4}$ folio); with another fold in half, the book becomes an octavo. After octavo ($\frac{1}{8}$ folio), the size of the book is noted only by number, a 16th, 32nd, and (though unlikely) so on. Also note that the copy in the British Library is the only known, extant copy (ISTC No. ip01057730), making comparison impossible. See ISTC: <https://data.cerl.org/istc/ip01057730>.

⁴⁷¹ As already noted, it is not that a modular use of woodblocks was new. Stephen Goddard has tracked modularity as early as block printed northern Italian textiles from the second half of the fourteenth century and southern German or Austrian altar cloths from 1420 to 1430. What appears to be an exciting development is the conception of scale

While innovative Venetian woodblock printers were incorporating massive size and the scale of books into their considerations, the printers working with Giunta also considered modularity on a much smaller scale within individual blocks. The block for the initial V, depicting the Ascension of Christ was printed in the 1503–04 Antiphonal and reused in the 1507 Psalter (Figure 143). The feet of Christ, just visible at the top of the woodblock as his body rises into the heavens in the depiction of the Ascension in the liturgical calendar, have been masked out in the later cases of reuse (Figure 144). With the presence of Christ removed, the disciples who glance upward—some with mouths agape—can now be understood as emphatically singing the music presented in the Old Testament Psalter.⁴⁷²

Regardless of whether Lucantonio Giunta, Benedetto Bordon, or Johann Emerich contributed in greater part to the experimentation with modularity and scale, their publications were an influential part of a dynamic moment in Venetian woodblock design. Evidence of this can be seen in the single-sheet graphic print of St. Roch (*San Rocco*) by Titian, likely designed as early as 1516.⁴⁷³ This early date, though originally contested, supports the notion that these prints were designed to be sold to fundraise for the construction of the new confraternity

incorporated into the modularity. Goddard notes that even at its most grandiose—Dürer’s use of modular woodblocks to create the Triumphal Arch of Maximilian I (1515–1518)—modular printing has fundamental connections to processes developed for the printing of books. See: Stephen Goddard, “Modular Prints: A Special Case of the Assembled Woodcut in the Fifteenth and Sixteenth Centuries” in *Grand Scale: Monumental Prints in the Age of Dürer and Titian*, eds. Larry Silver and Elizabeth Wycoff (New Haven: Yale University Press, 2008), 94–97.

⁴⁷² This technique may have influenced Petrus Liechtenstein, who developed an elaborate system of modular initials (as discussed in chapter 3). See: Frederick R. Goff, “The Factotum Initials of Petrus Liechtenstein at Venice”, *Gatherings in honor of Dorothy E Miner*, ed. Ursula E. McCracken (Baltimore: The Walters Art Gallery, 1974), 241–256.

⁴⁷³ Although the print was originally dated to 1523, in 2002, Lisa Pon published a document of 1516, by the *Scuola Grande di San Rocco* calling for the creation of such a print. See: Lisa Pon, “A Document for Titian’s St Roch” *Print Quarterly* 19, no. 3 (September 2002): 275–77. For earlier dates, see: Hans Tietze and Erica Tietze-Conrat, “Tizian-Graphik: Ein Beitrag zur Geschichte von Tizians Erfindungen,” In *Die graphischen Künste* 3 (Baden bei Wein: R.M. Rohrer, 1938), 63, 71, and Tietze and Tietze-Conrat, “Titian’s Woodcuts” *Print Collector’s Quarterly* 25, (1938): 468–70.

beginning in 1517.⁴⁷⁴ The print takes the established format of “vita icon,” with a central, devotional image of the saint surrounded by smaller narrative hagiographic scenes (Figure 145). Titian has positioned St. Roch in a *contrapposto*, three-quarter stance with one leg exposed to reveal the *bubo* or inflammation of the lymph node caused by the bubonic plague. Surrounding the central iconic image are eight scenes from the life of the saint. At the top is a depiction of Christ carrying the cross, likely derived from a painting attributed to Giorgione and/or Titian in the church of *San Rocco* and thought to be a miracle-working image. At the bottom of the print is a dedicatory inscription requesting the intercession of the saint. Near the text at the bottom of the folio is an *ex-voto* painting similar to the one Titian would later include in his monumental *Pietà*; an *ex-voto* head, likely cast in wax; and a coffer for alms. While the flat, narrative scenes create a certain two-dimensionality, the animated figure of St. Roch represented as if behind the central opening, the projecting visionary image of Christ set within a cloud, and the *ex-voto* objects positioned on a ledge in the foreground below create a complex overlapping of visual thresholds similar to those explored in Chapter 2.

This visual composition did not begin with Titian, but can be found in earlier “altarpiece” prints. One of the earliest of these on the Italian peninsula is the *Virgin and Child Enthroned Surrounded by Six Scenes of the Life of the Virgin*, printed to celebrate the marriage of the Emperor Maximilian I and Bianca Maria, daughter of Galeazzo Maria Sforza on 30 November 1493 (Figure 146).⁴⁷⁵ An important distinction, however, is that the earlier format was an engraving produced from a single metal plate. In contrast, Titian’s image was created through the

⁴⁷⁴ Matthias Wivel, “Titian’s ‘St Roch’” *Print Quarterly* 29, no. 2 (June 2012): 131–141.

⁴⁷⁵ Gisèle Lambert, “No. 385: “La Vierge et l’Enfant sur un trône, entourés de dix scènes de la vie de la Vierge, Milan, after 1490” in *Les Premières gravures italiennes—quattrocento—début du cinquecento* (Paris: Éditions de la Bibliothèque nationale de France, 1999. Accessed online: <https://books.openedition.org/editionsbnf/1346>.

impression of modular blocks.⁴⁷⁶ Gaps running vertically between the frame of the central image and the vignettes along the sides demonstrate that the margins were printed from two separate woodblocks.⁴⁷⁷

Rather than the history of single-sheet graphic print, it is the history of the book which better traces the development of this complex altarpiece format. In the same year as the execution of the Gradual, Lucantonio's presses were already reusing the woodblocks to create modular borders.⁴⁷⁸ At the opening of the Hours of the Virgin, on folios 20v – 21r, is an *Annunciation* woodblock that would come to be reused many times throughout future Giuntine publications (Figure 147). On the recto of this opening are seven woodcuts creating a modular border. A similar format was used in the Giuntine Missal published in 1501.⁴⁷⁹ By 1508, this modularity became much more complex. The opening of the quarto-sized Missal contains an elaborate *all'antica* altarpiece on the verso (Figure 148). While the architectural elements of this frame are reused throughout the Missal, the two images flanking the central scene can be swapped out. Here, they represent an *Annunciation* with the angel Gabriel on the left and the Virgin Mary on the right. These two scenes embedded into the *all'antica* architecture frame the central image of the *Crucifixion*. The selection of woodblocks within this modular system encapsulates the earthly mission of Christ from miraculous conception to Passion.

Facing the printed altar is a modular border composed of sixteen scenes. Unlike the 1501 Book of Hours and Missal, these scenes were not all printed from individual blocks but only four

⁴⁷⁶ Matthias Wivel has enumerated fifteen separate blocks. Matthias Wivel, "Titian's 'St Roch'" *Print Quarterly* 29, no. 2 (June 2012), 133. Goddard notes that this construction is indebted to the way that illustrations and type were combined in books. See: Stephen Goddard, "Modular Prints" (2008), 86–97.

⁴⁷⁷ Wivel, "Titian's 'St Roch,'" 133.

⁴⁷⁸ *Officium beate Marie secundum usum Romanum* [...] [Book of Hours] (Venice: Lucantonio Giunta, 1501). USTC No. 819824. <https://www.ustc.ac.uk/editions/819824>.

⁴⁷⁹ *Missale romanum* [Missal] (Venice: Lucantonio Giunta, 1501). USTC No. 819819. <https://www.ustc.ac.uk/editions/819819>.

separate matrices. Like the Titian image of St. Roch, the two gaps are cleverly disguised between solid black borders. In this way, the final result avoids the many frequent gaps introduced between individual woodblocks that gave the earlier publications a slightly rickety appearance. Interestingly, the descriptive text accompanying the images in the Giunta publication was executed in a more sophisticated manner. The Giuntine text was printed with movable type in red ink during a separate print run whereas the xylographic text of the Titian St. Roch was roughly carved into each block.

Beyond his likely engagement with the visual solutions of the Giuntine press, Titian was in conversation with other formats of woodblock printing, evidenced by his well-known print *The Submersion of the Pharaoh's Army in the Red Sea* (1514–1515, Figure 149). While not quite reaching the size of Jacopo de' Barbari's *View of Venice*, translating Titian's drawing into printed format required twelve large blocks—resulting in an image of 2.42 square meters.⁴⁸⁰ From this modular print, it is clear that Titian was interested in large size prints, but it is the St. Roch produced just a few years later that demonstrates his interest in scale.

That Titian's single-sheet print for pilgrims and the opening images of a Giuntine Book of Hours visually reference an altarpiece supports the notion that these images mobilized scale, not just across texts, but also across geographies, between public and private spaces, and within sacred architecture to evoke additional significance. For devoted pilgrims to the church of San Rocco, and members of the related *Scuola Grande*, the print combined thaumaturgic images from the space with ex-votos donated at an altarpiece. These elements visually summarized the

⁴⁸⁰ It has been suggested that there are no extant prints from the original print run because the large-scale print was intended to be hung or pasted on a wall, exposing the prints to the elements (and destroying them if removed after being pasted). Instead, extant impressions come from the 1549 print run by Domenico dalle Greche. See: Cleveland Museum of Art, "*The Submersion of Pharaoh's Army in the Red Sea*" <https://clevelandart.org/art/1952.296> accessed 27 June 2022.

culmination of a pilgrimage or devotional experience for their viewers. For owners of the Giuntine Book of Hours, the very images contained in Missals that were read from an altar were now present in a printed, hand-held altarpiece for private worship.

Although the Giuntine woodcuts were easily transferred from printed books of one scale to another, they often incorporate additional decorative borders such as Solomonic columns or *all'antica* reliefs of urns and acanthus (Figure 150). While it may be argued that these additional decorative borders were necessary to fill gaps in publications of different sizes, they also evoke the framing devices of altarpieces like Titian's *Assumption of the Virgin* in Santa Maria Gloriosa dei Frari (Figure 151), or Mantegna's earlier *San Zeno* Altarpiece in nearby Verona (Figure 152). Given that the modular prints were intended to evoke devotional images on a smaller scale, it is also possible that the additional framing devices suggest the external, decorative, and increasingly *all'antica* framing structures of these altarpieces.⁴⁸¹ Another visual evocation of altarpieces and their use could come from the curtains that frequently veiled altarpieces, particularly those believed to be miracle-working. These curtains were drawn to the side in order to reveal the miraculous panel only on days of significant liturgical celebration.⁴⁸² The additional imagery flanking important illustrations could convey this kind of additional framing or festive occasion of revelation.

⁴⁸¹ Alison Wright has “repositioned” framing devices in illuminated manuscripts and incunabula by “reconsidering its dialogue with other, monumental, visual forms.” Wright addresses the “production of threshold spaces in the book in order to highlight the various kinds of cultural translation that frontispiece illumination could perform—between social groups, distant places, and different media.” See: Alison Wright, *Frame Work: Honour and Ornament in Italian Renaissance Art* (New Haven: Yale University Press, 2019), 255–256.

⁴⁸² Megan Holmes has described that a common arrangement for a veil was to “install two curtains suspended from several fixed points above the image that met together in the middle and were drawn and gathered at the side during unveilings.” See: Megan Holmes, *The Miraculous Image in Renaissance Florence* (New Haven: Yale University Press, 2013), 222. This arrangement is depicted fictively in Fra Angelico's *San Marco Altarpiece*, 1438–43, now in the Museo di San Marco, Florence, and in the tomb of the Cardinal of Portugal by Antonio and Bernardo Rossellino, c. 1461–66 at San Miniato al Monte, Florence. See: Alison Wright, *Frame Work*, 52 and 230.

Finally, given their frequent proximity to musical notation in the Gradual and Antiphonal, the ancillary decoration alongside the woodcuts may also evoke organ shutters, which remained closed when not in use to protect the pipes from dust and damage and were only opened during performance. A set of organ shutters, painted by Giovanni Bellini around 1500 for the organ of Santa Maria dei Miracoli in Venice, contains the scenes of the Annunciation on the exterior and St. Peter and St. Paul (the latter now lost) on the interiors (Figure 153). When closed, these panels evoke the audible word of God spoken by an angelic messenger to the mother of Christ. When opened, two of the most foundational disseminators of Christ's message would be accompanied by reverberating music. Just as the format of Lucantonio's Missal and Titian's *St. Roch* referenced large public altarpieces on the hand-held scale of the printed page, so too do these scenes with additional borders evoke the celebratory unfolding of painted covers to unveil organ pipes for the performance of sacred music.

4.6 Conclusion

The specialized collaboration between Lucantonio Giunta, Johann Emerich, Francesco de Brugis, Benedetto Bordon, and Jacob von Strassburg achieved what other publishers attempted and failed: an appropriately large-sized gradual with elegant printed musical notation and woodcut illustration. Francesco de Brugis' codification of Gregorian chant approached the kind of "*uniformitas*" desired by the Roman Curia.⁴⁸³ Yet, evidence of emendation by local religious communities—whether through scraping out, pasting over, or manuscript addition—attests to the persistence of personalized or localized performance preferences.

⁴⁸³ Mary Kay Dugan, "Politics and Text: Bringing liturgy to Print" *Gutenberg-Jahrbuch* 76 (2001), 104.

The overall appearance of this musical and typographical innovation was enhanced with woodcut illustrations that were created on a scale to take advantage of the modularity of printed books. While this represents an economic strategy to distribute costs across multiple publications, it also drew upon exiting strategies of reuse to construct meaning. First, the reused blocks drew upon spoliation, a strategy foundational to justifying Venice’s mythical antique origins. Second, by disseminating a sacred image across public and private devotion—as well as across the geographical networks of the early modern book trade—the images may have participated in the model of expanded “aura” generated by tertiary contact relics. Evidence for this kind of self-aware acknowledgement of their “miraculous” impression without human hands due to the innovative printing press can be seen in the frequent reversal of text and the selective hand-coloring of printed figures.

Finally, executed at the same moment as Jacopo de’ Barbari’s monumental cartographic achievement, the images capable of use across printed books of all sizes participated in the Venetian exploration of scale and modularity of woodcuts at the time. The reuse of woodcuts in Giuntine missals may have influenced Titian’s “altarpiece” format for the image of St. Roch—exactly the type of object that would spread saintly protection across a wide geography when distributed by pilgrims. That these reused woodcuts referenced altarpieces and organ covers suggests yet another mobilization of scale along with the intermedial translations seen throughout this study, that between the sacred visual environment of the church and the private devotions of the home. Emerging musical and mathematical theory of the time allows us to connect the rediscovery of proportional ratios within musical scales with the inherent proportions of the printed and folded folio and their relation to this sacred space.

Chapter 5 Epilogue

The arrival of Johannes da Spira in Venice in September of 1469 initiated an explosive period of growth, innovation, and competition for printers and publishers attempting to profit from the technology of movable type. Initially, the legally protected and commercially viable space of the printed page encouraged daring visual experiments. However, a certain drying up of creative freedom is apparent as the system of print privileges became increasingly corrupt and convoluted. What began as a simple request for the exclusive right to print a single title or to protect a single technological innovation devolved into privileges claiming broad swathes of content. Democrito Terracina's unsuccessful claim to, "print works in Arabic, Moorish, Syrian, Armenian, Indian, and Barbaresque languages" is an instructive example.⁴⁸⁴ The eruption of publications in non-Latin alphabets after this wide-reaching privilege finally expired after twenty-five years is fertile ground for additional study of the interaction between movable type and broader administrative and cultural conditions. Even the *successful* printer Paganino Paganini complained that he constantly feared, "[...] being ruined by the perfidious competition that ruled the poor and miserable art of print."⁴⁸⁵ In 1517, the legal granting of privileges for print was overhauled. The power to grant privileges shifted from the Council of Ten, which resided in the *Signoria*, a branch of Venetian government with executive oversight, to the Senate,

⁴⁸⁴ Archivio di Stato di Venezia (ASV), Collego Notatorio, Registro 14, Fol. 178v (Fulin, 133–134, No. 82), 15 July, 1498, "Far stampar alcune opere in lingua arabica, morescha, soriana, armenicha, indiana, et barbarescha, cum grandissima et quasi intollerabel spesa."

⁴⁸⁵ ASV, CN, Reg. 16. Fol. 8r, (Fulin, 166, No. 162), 16 June 1507: "teme esser ruinato da la perfida concorrentia, la quale regna in questa povera et miserabel arte..."

in a more appropriately legislative branch (the *Consulta*).⁴⁸⁶ Privileges, which had previously required a majority of the Council of Ten for approval, now needed support from two-thirds of the Senate, making them more difficult to attain. These regulatory changes along with increased censorship during the Counter Reformation beginning in 1563,⁴⁸⁷ and the plague of 1575–76, which is estimated to have resulted in the death of nearly a third of the Venetian population, brought an end to the Serenissima’s claims as the center of European book production.

5.1 Afterlives of the Print Revolution

Each previous chapter presented a case study considering roughly a decade of this volatile early period of print in Venice: the illuminated, printed works of Nicolas Jenson in the 1470s; the mathematical and astronomical works of Erhard Ratdolt in the 1480s; and the illustrated music produced by Lucantonio Giunta from the 1490s onward. While these periods were most instructive for this study in terms of visual responses to the new technology of movable type, the artistic and commercial innovation they developed rippled out beyond this chronological period. Below, I consider some of the “afterlives” of the topics of each chapter: illumination adorning luxurious legal documents in Venice throughout the eighteenth century; later printed geometric diagrams of Euclid; and Lucantonio Giunta’s innovative business model that extended throughout Europe and eventually into Spanish colonies across the Atlantic.⁴⁸⁸ Finally, I suggest how aspects of this study may better inform the current mass digitization of

⁴⁸⁶ For more on the complex structure of the Venetian government, see diagram 0.11 in: Helena Katalin Szépe, *Venice Illuminated: Power and Painting in Renaissance Manuscripts* (New Haven: Yale University Press, 2018), 24.

⁴⁸⁷ Federico Barbierato, *The Inquisitor in the Hat Shop: Inquisition, Forbidden Books, and Unbelief in Early Modern Venice* (Farnham: Ashgate, 2012).

⁴⁸⁸ Here, I am inspired by Fritz Saxl and Aby Warburg’s concept of *Nachleben der Antike*: Fritz Saxl, “Das Nachleben der Antike: zur Einführung in die Bibliothek Warburg,” in *Hamburger Universitäts-Zeitung*. *W.* -S. 4, no. 2, (1920/21): 11.

incunabula, and may also resonate with contemporary cultural encounters with transformative forms of new media.

Hand-painted illumination continued to adorn printed books after the initial introduction of movable type in Venice. Rather than operating as a visual strategy for publishers to convince wealthy investors of the merits of print or adding value to higher-end printed products, however, illumination was increasingly applied to bespoke books as a sign of the status and the artistic taste of the collectors. Helena Szépe has identified over sixty copies of books printed by Aldo Manuzio containing illuminations of varying scope and quality, often by the hands of Albrecht Dürer or Benedetto Bordon.⁴⁸⁹ An unusual survival of this style can be seen in the Manuzio/Dürer now held in the National Gallery of Art, Washington D.C., in which the illumination has been cut out and carefully applied around the printed Greek text (Figure 154).

Additionally, books with formulaic Flemish-style borders of illusionistic plants, moths, and flowers applied to printed pages were avidly collected in Venice, as a lower-cost, lower-quality imitation of Flemish manuscripts.⁴⁹⁰ An early indication of the popularity of this imitative Flemish style can already be seen in a Breviary printed by Nicolas Jenson in 1478 now in the Huntington Library (Figure 155). Finally, manuscript documents in codex forms containing the oaths and regulations by which Doges and other high officials were sworn into elected office—known variously as *Promissioni*, *Commissioni*, *Giuramenti*, or *Capitolari*—were often lavishly illuminated.⁴⁹¹ Like early printed and illuminated presentation copies, the illuminations appear to have been organized either by the patrician taking office or with that individual in mind. As in

⁴⁸⁹ Helena K. Szépe, “Bordon, Dürer and Modes of Illuminating Aldines,” in *Aldus Manutius and Renaissance Culture: Essays in Memory of Franklin D. Murphy: Acts of an International Conference Venice and Florence*, 14–17 June 1994, edited by David S. Zeidberg, 185–200 (Florence: Leo S. Olschki, 1998), 185.

⁴⁹⁰ Szépe, 193–194.

⁴⁹¹ For a discussion of these types of documents as well as their shifting terminology, see: Helena Katalin, Szépe, *Venice Illuminated: Power and Painting in Renaissance Manuscripts* (New Haven: Yale University Press, 2018), 20.

the examples studied in Chapter 2, illuminations in these later legal documents also shaped broader visual strategies of architecture, painting, and sculpture.⁴⁹² However, instead of pushing visual culture forward as in the experimental and highly illusionistic illuminated printed texts of the 1470s, these later illuminations were often derived from earlier monumental works and adopted a conservative visual stance with the purpose of preserving and perpetuating the familial status of patricians.⁴⁹³

At the end of Chapter 3, I argued for the immediate influence of Erhard Ratdolt's innovative transfoliate diagrams in a multitude of ways. In 1486 he sold the woodblocks he created for Hyginus' *Poeticon Astronomicum* which continued to be printed and reworked in Venice. Back in his native Augsburg, Ratdolt employed the complex alignment and registration techniques he had developed in Venice to produce frontispieces printed in four colors. Further developing this technique, Ratdolt's assistant from this period, Hans Burgkmair, would go on to produce what are recognized as the first chiaroscuro woodblock prints. Perhaps most closely taking up the mantle of transfoliate diagrams, Dürer's study of the proportions of the human body utilized alignment on either side of the folio in both the drawings by his own hand and the posthumously printed books. In his monumental *Feast of the Rosary* altarpiece completed in 1506, Dürer included his signature on a translucent folio of paper held by his own self-portrait (Figure 156). That he represented himself in paint, partially seen *through* his painting, is a delightful legacy of the dialogue between translucency and opacity of the time, which Ratdolt participated in furthering.⁴⁹⁴

⁴⁹² Ibid., 16.

⁴⁹³ Giorgio Vasari described the illuminator Giulio Clovio as the greatest miniaturist of all time and a "new, if smaller Michelangelo." Giorgio Vasari, *Le Vite* (Florence: Giunti Press, 1568), vol. 2, 852.

⁴⁹⁴ The inscription reads, "Exegit quinquemestri spatio Albertus Dürer Germanus." Approximately, Albrecht Dürer the German executed this in the space of five months. As transcribed by: Jaroslav Pešina, *German Painting of the 15th and 16th Centuries*, Translated by Finlayson-Samsourová (Prague: Arita, 1962).

Beyond these immediate influences, Eunsoo Lee has enumerated later sixteenth-century editions of Euclid's *Elementa* inspired by Ratdolt's printed diagrams.⁴⁹⁵ Lee describes various "visual auxiliaries," such as dotted lines indicating compass marks, that facilitated comprehension of the complex diagrams. Of direct interest to Ratdolt's attempts at illusionistic space and the mental manipulation of three-dimensional objects is the first English translation of the *Elements* by Sir Henry Billingsley and published by John Dee (or Day) in London in 1570. Throughout Book XI about three dozen pop-up models illustrating solid geometric figures were created using pasted in paper slips (Figure 157). Ratdolt's early transfoliate diagrams, particularly those depicting solid objects using unified illusionistic space through the folio, resonate with Lee's suggestion to consider the three-dimensional diagrams within the Quattrocento development of perspective.⁴⁹⁶ While Ratdolt's innovations lent themselves more readily to the chiaroscuro woodprint, his quest to mobilize print techniques in service of greater mathematical clarity was taken up well into the sixteenth century.

Lucantonio Giunta's successful business model as a publisher working between specialized printers, capital investment, and the market was addressed in Chapter 4. In 1520, Lucantonio began expanding his business by creating an affiliate warehouse in Lyon, France, with the help of his nephew Iacopo di Francesco. Although Lucantonio died in Venice in 1538, by 1546, Iacopo had expanded the Giunti business to Antwerp, Frankfurt, Medina, Zaragoza, Lisbon, and Paris.⁴⁹⁷

⁴⁹⁵ Eunsoo Lee, "Let the Diagram Speak: Compass Arcs and Visual Auxiliaries in Printed Diagrams of Euclid's Elements" *Endeavour* 42 (2018): 78–98.

⁴⁹⁶ Lee, 92.

⁴⁹⁷ Massimo Ceresa, "GIUNTI, Lucantonio, il Vecchio," in *Dizionario Biografico degli Italiani* 57 (2001) https://www.treccani.it/enciclopedia/giunti-lucantonio-il-vecchio_%28Dizionario-Biografico%29/ (accessed 20 August 2023).

This international network of book distributors would ultimately take the Giunti name across the Atlantic. An affiliate in Salamanca was established in 1523 by another nephew of Lucantonio, known in Spanish as Juan de Junta.⁴⁹⁸ Books sold from Salamanca and Zaragoza not only dominated the Iberian Peninsula, but also began to enter into New Spain. In 1550, the Holy Roman Emperor and King of Spain, Charles V, declared that each and every book sold in the “Indies” must be registered with the *Casa de la Contratación* in Seville, according to title and subject matter.⁴⁹⁹ As a result, 97 lists of books survive, documenting the presence of Giunti publications (among others) in the New World.⁵⁰⁰ This transatlantic trade of Giuntine editions offers promising groundwork for future investigation into how the visual innovation of the printed book in Venice ultimately influenced visual culture in the Americas and, more globally, throughout the Spanish Empire.

5.2 Printing and Digital Revolutions

Even before the attempts by Charles V to control the types of books flowing into Spanish colonies, the printing press—and in particular its rapidity—stoked fears. The first call for censorship of the printing press in Europe came from Niccolò Perotti, a papal administrator who wrote to Pope Paul II in 1470. At first, Perotti viewed the “new art of writing” as a benefit to literature. Ultimately, however, he feared that poor editorial practices combined with the observation that a “man prints in a day what could not be written in a year” would destroy the

⁴⁹⁸ Carlos Alberto González Sánchez and Natalia Maillard Álvarez, *Orbe Tipográfico. El Mercado del Libro en la Sevilla de la Segunda Mitad del Siglo XVI* (Austurias: Ediciones Trea, S.L. Gijón, 2003), 40.

⁴⁹⁹ This was an attempt to counteract the spread of Protestantism in the Spanish colonies. *Ibid.*, 23.

⁵⁰⁰ Pedro J. Rueda Ramírez, *Negocio e Intercambio Cultural: El Comercio de Libros con América en la Carrera de Indias (Siglo XVII)* (Seville: Universidad de Sevilla, Consejo Superior de Investigaciones Científicas Escuela de Estudios Hispano-Americanos, 2005), 23. Irving Albert Leonard published these lists in 1949, see: Irving Albert Leonard: *Books to the Brave: Being an account of books and men in the Spanish conquest and settlement of the sixteenth century new world* (Cambridge: Cambridge University Press, 1949). See also: William A. Pettas, *A Sixteenth-Century Spanish Bookstore: The Inventory of Juan de Junta* (Philadelphia: American Philosophical Society, 1995).

Latin language with a flood of corrupt texts.⁵⁰¹ Many early texts were hastily produced, according to Perotti, and contained “gross errors” drawn from poor source material.⁵⁰² Although Perotti’s call for oversight gained some attention in 1482, when it was *printed*, formal censorship in Venice was enforced only in 1527 and tightened again in 1563. As mentioned above, it is thought that this censorship—in combination with other factors—led to the decline of Venice as a major print center.

I would like to close by considering two interrelated technological revolutions of our own time, three-dimensional (3D) printing and the mass digitization of incunabula and other rare material. Like the printing press, the advent of 3D printing, has also brought with it concerns and optimism for the future. As early as 2013, the new technology was used by Cody Wilson in Austin, Texas, to print a handgun.⁵⁰³ Since then, the possibility of widely accessible and untraceable firearms known as “ghost guns,” created without serial numbers and requiring no owner’s permit, have stoked fears and influenced political discourse.⁵⁰⁴ In contrast, in December 2021, April Stringfield became the first owner of a 3D-printed home through the Habitat for Humanity Homebuyer Program.⁵⁰⁵ The three-bedroom, two-bathroom house was printed in a mere 28 hours with an Alquist 3D printer. It also came with a miniature 3D printer to reprint any necessary household items that may require future replacing. While this is not the first 3D

⁵⁰¹ John Monfasani “The First Call for Press Censorship: Niccolò Perotti, Giovanni Andrea Bussi, Antonio Moreto, and the Editing of Pliny’s Natural History” *Renaissance Quarterly* 41 no. 1 (Spring, 1988), 7–8. Perotti’s fears were not unfounded, estimates of the production speed for a well-run press in the sixteenth century suggest 200 impressions per hour, or about 18 seconds per impression. For estimations of machining rates in the sixteenth century, see Michael Pollak, “The Performance of the Wooden Printing Press,” *Library Quarterly* 42, no. 2 (1972): 246–49. See also: Elizabeth Upper (Savage), “Red Frisket Sheets, ca. 1490–1700: The Earliest Artifacts of Color Printing in the West” *Bibliographical Society of America* 108 no. 4 (2014), 477–522.

⁵⁰² Martin Davies, “Making Sense of Pliny in the Quattrocento” *Renaissance Studies* 9, Issue 2, (1995), 242.

⁵⁰³ Dan Tynan, “‘I wouldn’t waste my time’: firearms experts dismiss flimsy 3D-printed guns” *The Guardian: US Gun Control*, 1 August 2018.

⁵⁰⁴ Rina Torchinsky, “The Biden Administration is Regulating ‘Ghost Guns.’ Here’s What the Rule Does,” *National Public Radio*, 12 April, 2022.

⁵⁰⁵ Jessica Cherner, “Habitat for Humanity Debuts First Completed Home Constructed Via 3D Printer” *Architectural Digest*, 3 January 2022.

printed house, it represents how the technology—which was once seen as a novelty—has now been scaled and democratized to offer housing solutions for those who otherwise might be excluded from home ownership.

Like the printing press, 3D printing combined extant technologies: a mechanical arm builds up layers of concrete in stacked courses according to a computer-programmed design. As a result of this construction method, 3D-printed structures develop a characteristic texture of uneven layers (Figure 158). From a distance, this texture appears similar to the rusticated stone veneer often applied as a luxury finishing on suburban homes. Will this printed texture come to be read as an attempt to reproduce middle-class finery in a new, cheaper medium? Will it become the calling card of innovative and high-tech homes? Will it perhaps, in future, come to be seen as an omen that signaled the end of traditional (and comparatively inefficient) construction methods? It is more likely that this polyvalent visual element will be read in multiple ways, simultaneously, depending on the audience. In an analogous fashion, I hope to have demonstrated that, both visual similarities and differences between fifteenth-century printed books and earlier manuscripts heralded an innovative technology in ways that sought to inform and assuage early adopters.

Lastly, I would like to consider how the findings of this investigation may better inform the mass-digitization of incunabula of recent years. Digital photography has made this historic material much more accessible, particularly in times of reduced travel due to pandemic and increasing cognition of the ecological impact of long-distance research. Yet, scholarship has only just begun to consider the implications of working from digital surrogates alone. On one hand, the anachronistic ability to compare across multiple copies, editions, publishers, and collections is of great aid to the historian of the book. On the other hand, it must be remembered that digital

photographs are mediated objects, each carrying a history of technological and interpretative decisions that produce a flattened, two-dimensional, evenly-lit image from a complex, three-dimensional object. Just as books printed with movable type must be considered according to their remediation of manuscript predecessors, so digitized books must also be contextualized according to their remediation—which calls attention to both the affordances and limitations of new technologies.⁵⁰⁶ In particular, the transition from the physical instantiation of a printed book to an immaterial digital surrogate may alter the types of questions being posed and the assumptions made about the original. Furthermore, Heather Bamford and Emily C. Francomano have warned that digitization and digital accessibility will become the primary determinants of canonization in teaching and scholarly practices.⁵⁰⁷

While digitization poses risks, such as the loss of material information, it also has the potential to offer additional data not available to the unaided eye or hand in the reading room. The International Image Interoperability Framework (IIIF) has offered a standardized format for the viewing of digitized books. Through an Application Programming Interface (API), the photographed folios of historic texts can be “turned” in a digital viewer (Figure 159). While this format approximates the horizontal navigation of a book, page-by-page, I propose an additional vertical component that would allow researchers to access alternate views of covers and folios including—of particular interest to my study—raking and transmitted visible light. It could also incorporate images produced by conservation science with light beyond the visible spectrum (ultraviolet, infrared, x-ray). A flexible matrix for the inclusion of existing alternative views, and

⁵⁰⁶ Allan Galey, Richard Cunningham, Brent Nelson, Ray Siemens, and Paul Werstine. “Beyond Remediation: The Role of Textual Studies in Implementing New Knowledge Environments.” *Scholarly and Research Communication* 3.1 (March 2012).

⁵⁰⁷ Heather Bamford and Emily C. Francomano, “On Digital-Medieval Manuscript Culture: A Tentative Manifesto” *Digital Philology: A Journal of Medieval Cultures* 7, no. 1 (Spring 2018): 31.

indeed of those to come, would allow researchers to continue to pose and answer material questions of the physical codex along a vertical axis of a single folio as a kind of digital gloss, while also allowing for uninterrupted reading of the book along the extant horizontal axis.

While this additional information would—to some degree—address the lack of material context of digitized books on a two-dimensional screen, this study has demonstrated that media revolutions go hand-in-hand with media *evolution*. Already 3D virtual reality (VR), augmented reality (AR), and artificial intelligence (AI) have posed new promises and stoked new fears for our experience of the “metaverse.” While there are fears that these digital technologies will fundamentally alter our lives, they have also already been employed to recuperate some of the materials and materiality in our digital experience of historic objects. Perhaps we may understand the weight and interaction with light of a printed book in virtual reality that would otherwise be too delicate or distant to handle in-person. From manuscript to print to virtual text, the work of remediation is always ongoing.

Figures



Figure 1: Titian (Tiziano Vecellio), *Madonna di Ca' Pesaro*, 1519–1526, oil on canvas, 478 x 266.5 cm, Basilica of Santa Maria Gloriosa dei Frari, Venice.



Figure 2: Titian (Tiziano Vecellio), *Madonna di Ca' Pesaro*, 1519–1526, oil on canvas, 478 x 266.5 cm, Basilica of Santa Maria Gloriosa dei Frari, Venice, with superimposed lines.



Figure 3: Titian (Tiziano Vecellio), *Madonna di Ca' Pesaro*, 1519–1526, oil on canvas, 478 x 266.5 cm, Basilica of Santa Maria Gloriosa dei Frari, Venice, detail with hands of St. Peter and printed book.

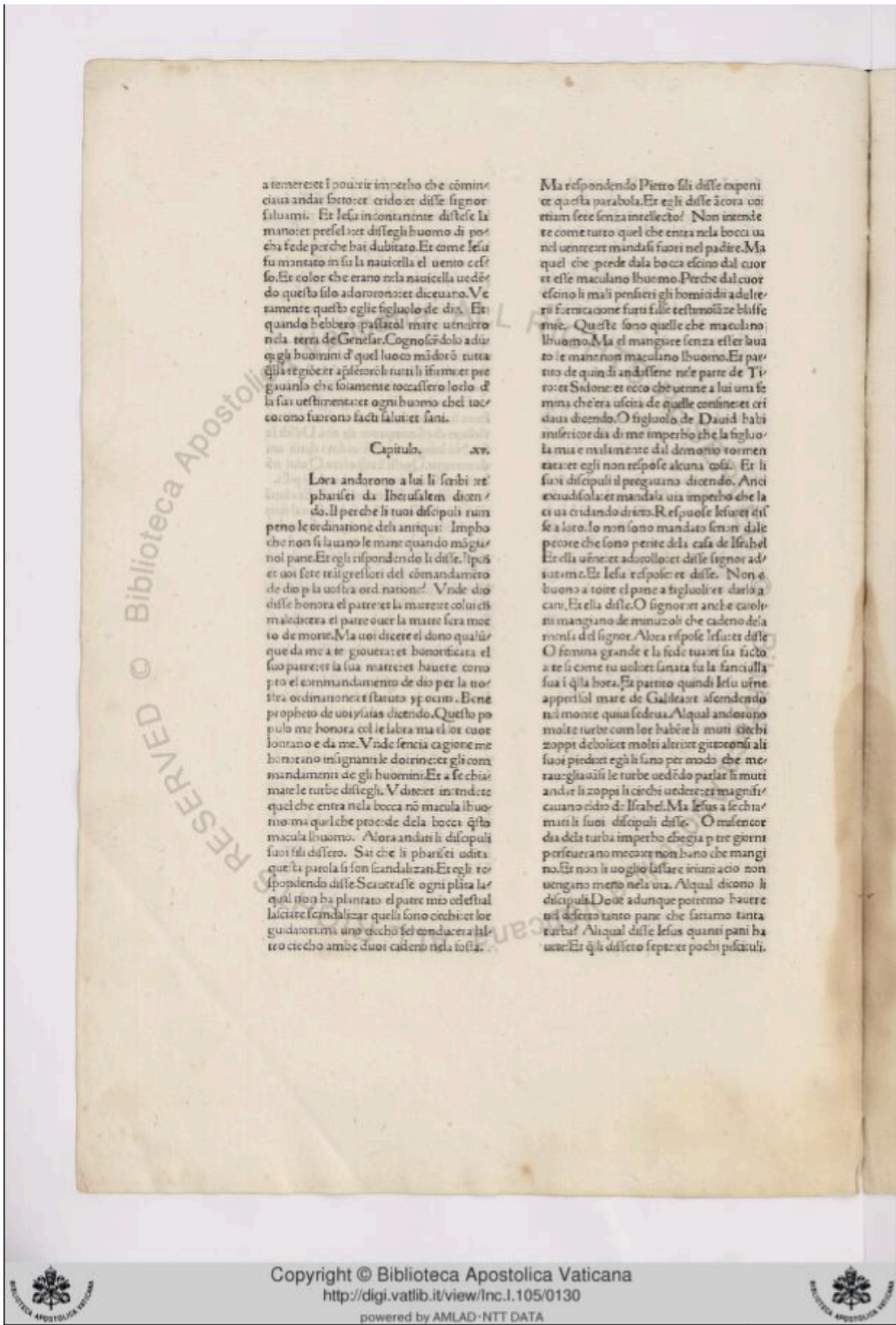


Figure 4: Biblia [Italian] Translated by Niccolò Malermi (or Malerbi), With additions by Hieronymus Squarzafricanus (Venice: Vendelinus de Spira, 1 August 1471), Biblioteca Apostolica Vaticana, Inc.I.105.

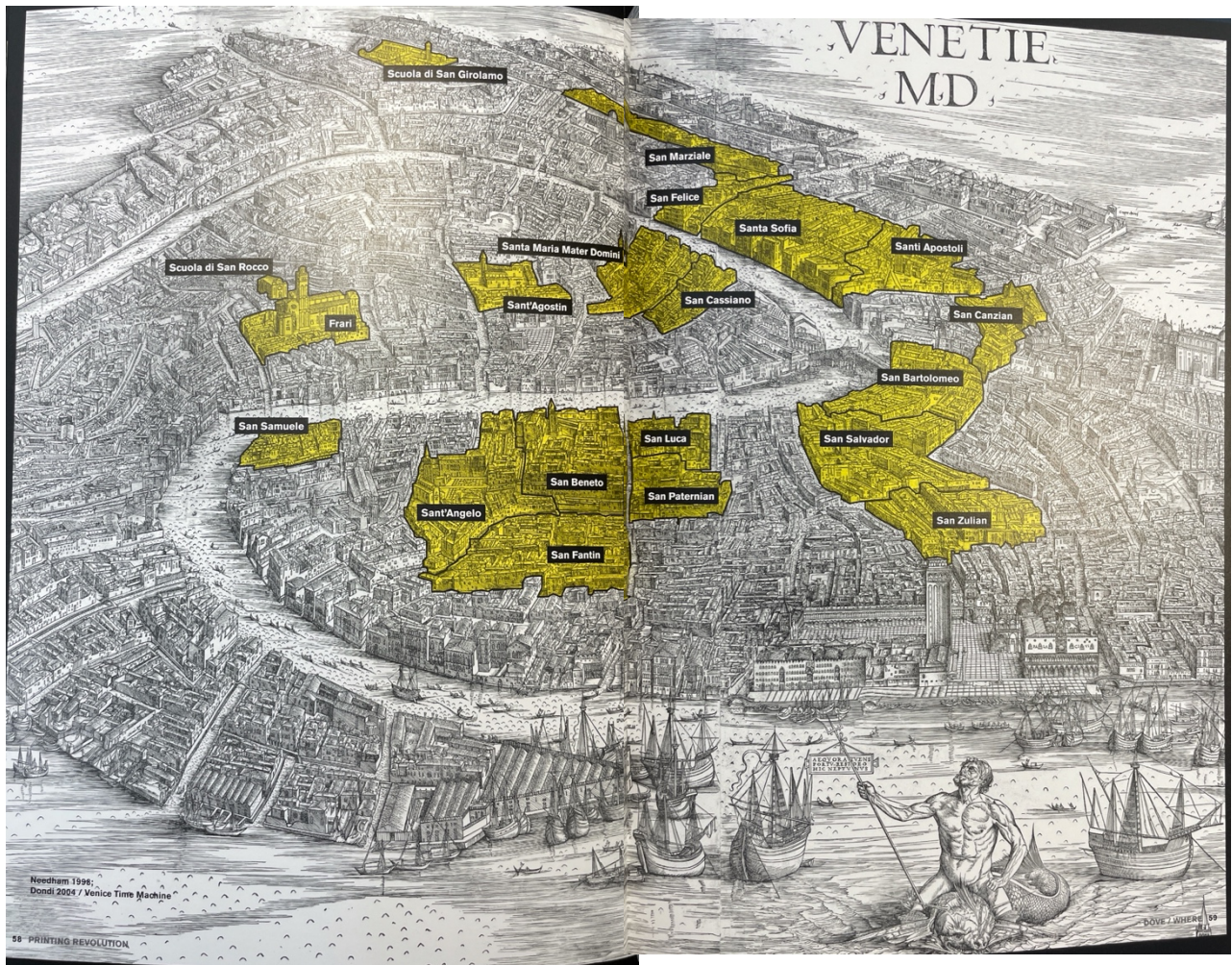


Figure 5: A map of the locations of print shops established in Venice before 1500, as published by Dondi, Cristina ed. *Printing R-Evolution and Society, 1450–1500: Fifty Years that Changed Europe*. Venice: Edizioni Ca’Foscari, 2020. See pages 58–59.



Figure 6: Exhibition graphics for “PRINTING RE-VOLUTION” held in the Biblioteca Marciana, Venice, from 1–30 September, 2018 and the Museo Correr, Venice, from 1 September 2018 to 30 April 2019.



Figure 7: Paolo Uccello, Niccolò Mauruzi da Tolentino at the Battle of San Romano, about 1438–40, egg tempera with walnut oil and linseed oil on poplar, 182 x 320 cm, National Gallery of Art (London), NG583, with detail of textile headpiece.

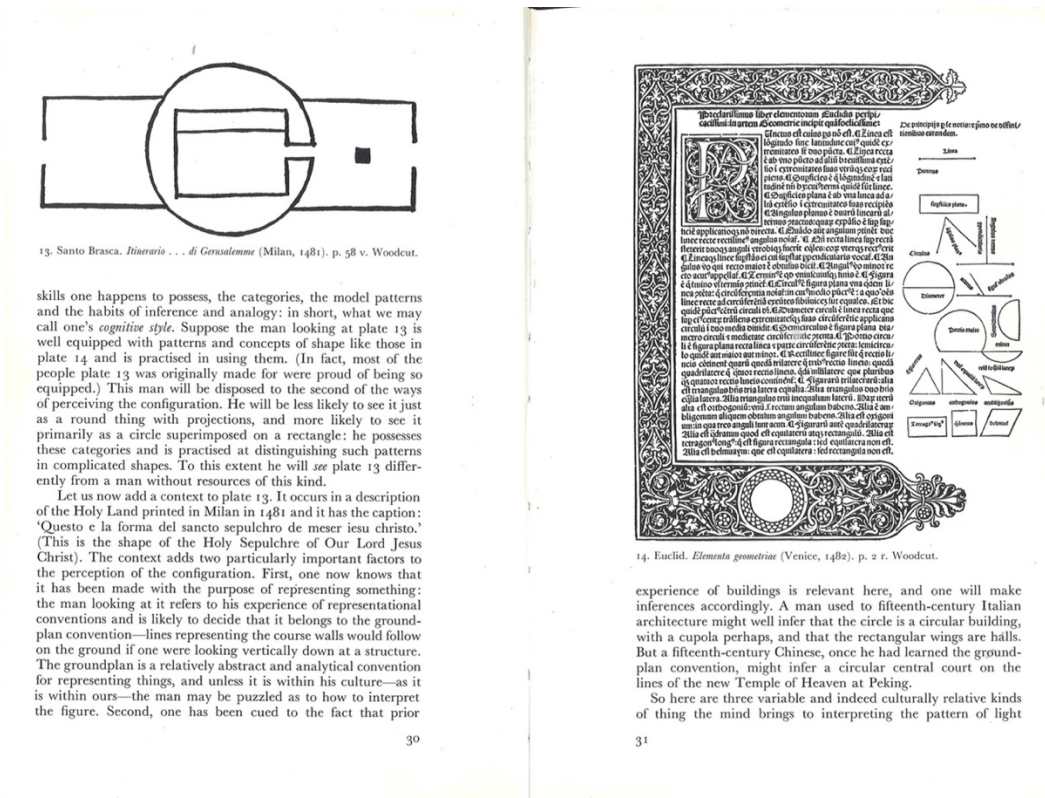


Figure 8: Michael Baxandall, *Painting and Experience in Fifteenth Century Italy: a Primer in the Social History of Pictorial Style* (Oxford: Clarendon Press, 1972), detail of pages 30–31.

**Cupiētes emere libros infra notatos venient ad hospiti-
cuius subnotatum. Venditorem habituri largissimum.**

Cum plurimorum philosophorum sententia sit, omnibus in actionibus maiorem curam adhibendam esse, ut vice perpetuitate stare possim: ad hanc quidem sequendam, quilibet mortalis tenet totis viribus insudare. Quod et assequi posse, a nobis maioribus creditum est: si singulis meditationibus opibusque honesti foras accuratissime proponat. Sed in huiusmodi plurimarum affectionum genere a nonnullis illustribus viris, huiusmodi gloria diuerso calle quaesita est. Nam ab alijs philosophia naturalis, ut Platone et Aristotele: alijs moralis, ut Seneca: nonnullis poemata, ut fama est de Homero et Virgilio: plerisque etiam eloquentia, ut Demostene et Cicerone. Alijs tamen etiam historia, tum uersibus administrandisque legibus, ut legibus de Liguribus, Solone, et Traiano impatore: necnon de Iustiniano, qui profusus iuris corporis in lucem reuixit, qui reductione quae plures iuriscosultis, vice perpetuitate sequi arbitrati sunt: ueluti Quintus Mutius, Paulus Ulpianus, multique praeterea quos loqui est recedere. Quaeque theologia sacra omnium scientiarum corona est: maxime circa materiam quae erigit canonicis legibus fulcita. Quibus enim proficit homo si naturalis, poetis, eloquentia super astra uoluntas: si apicibus uelutque iuris diuitias congreget: etiam si diuine scientiae: omnium lucres: a se suo detrimento patiat. Si christum scias (ait mellifluus doctor) satis est, et si cetera nescis. Quo promotus uir philosophorum clarissimus: dominus Antoninus olim causarum romanae leuis pitissimus: demum archiepiscopus florentinus. Summa egregia in quantum partes distinctas persequitur: quae ut uere uice perpetuitate sequi facile possem. Parte prima creatoris imensitatem, creaturaeque humane nobilitatem, atque ne ab ea laborerem diuina lege fulcitam perduxit. Secunda parte criminosas enormitates quibus homo a sua nobilitate etiam hodie labitur subiunxit. Tertia parte statibus diuersorum sacramentalium remedia quibus quilibet restituere: prescripsit. Et quarta parte ne reciduum patererem persequatur ututem, gratiamque bonorum spiritus sancti: coadiunxit. Et quae sapientissimo teste quae addit scientiam: addit et laborem, plures deterriti magno sumptu quae in operibus uoluntate impeditum erat, otio aut ignauietate debilitati, uel ad alia se potius opera transferunt. Quorum tandem necessitati: siue humano artificio: siue diuina ope subuectum est: ut iuuenta nostra etate hac imprimenda litterarum facilitate, plerique se studijs dedicauerunt: quae pro sumptu plurima librorum uolumina: breui tempore perites, in uiros claros euadere nituntur. Et quibus iam de magno uoluminum numero per hanc litterarum impulsorem proficere uolentium necessitati pulsus sit: necnon tamen eorum id nouissimum (quod quae modernum et utilissimum) operum et ita aggrediuntur: deterriti (ut opinor) magna codicumque litterarum multitudie. Reuoluentes igitur hoc in aetate theologiae sacrae quidem alumni, reze satisfacta, et tanquam nouis moribus, nouis aetatis necessaria, hac litterarum effigie characterizata operum profectumque cor rectum diligenter explicauerunt. Quare uolentes in summi agnitione proficere, et saluti primorum salubriter consulere: omni conamine curare debent huiusmodi summam Antoninam se penes habere. Cupientesque sibi apparere ad hospitium sese recipiant subscriptum uenditorem habituri benignum;

In theologia

- Summa Antonini egregia in quatuor partibus distincta, ut supra claret.
- Pantheologia id est tota theologia.
- Biblias amenissime impressas.
- Glossam ordinariam Petri Lombardi super psalterio.
- Specula vincencij quatuor.
- Item Elitaspatrium
- Summa pisanis alia pisanella
- Rationale diuinorum officiorum.
- Quaestiones de potentia dei, b. Thome.
- Secunda secunde beati Thome.
- Concordantias maiores Biblie.
- Item vitam christi.

Sermones

- Discipulum de tempe et sanctis per totum annum.
- Dugonez de Brato per totum annum.
- Leonhardus de Utino de sanctis.
- Quadragesimale Leonhardi de Utino.
- Quadragesimale grisch tenuo correctum fidelitatis ipsius doctoris eximij
- Vocabularium Salomonis
- Doctum de consolatione philosophiae

In medicina

- Auicennam.
- Aggregatorem.
- Pantecta;

Figure 9: Bayerische Staatsbibliothek, München, Einbl. VIII, 4 BSB-Ink K-36, Book advertisement published by Anton Koberger in Nuremberg, 1480.

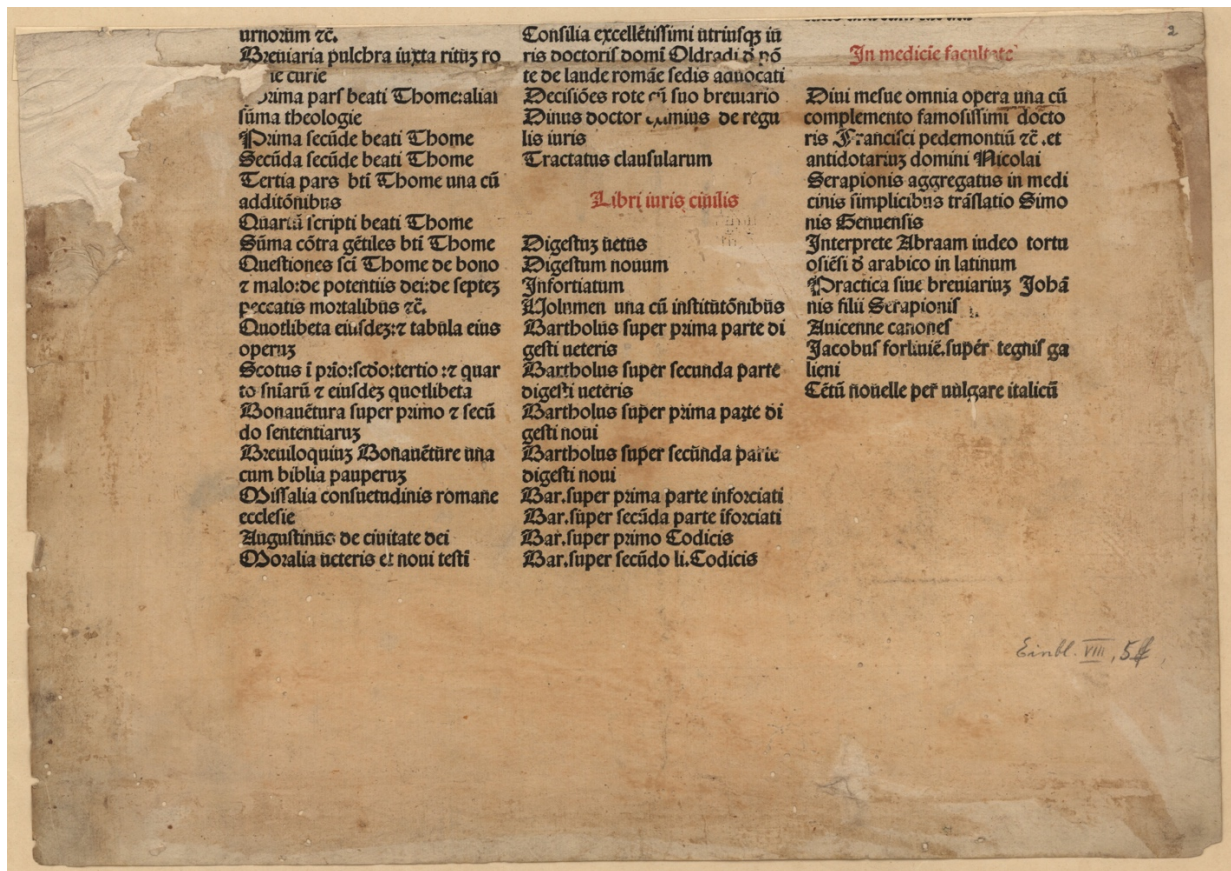
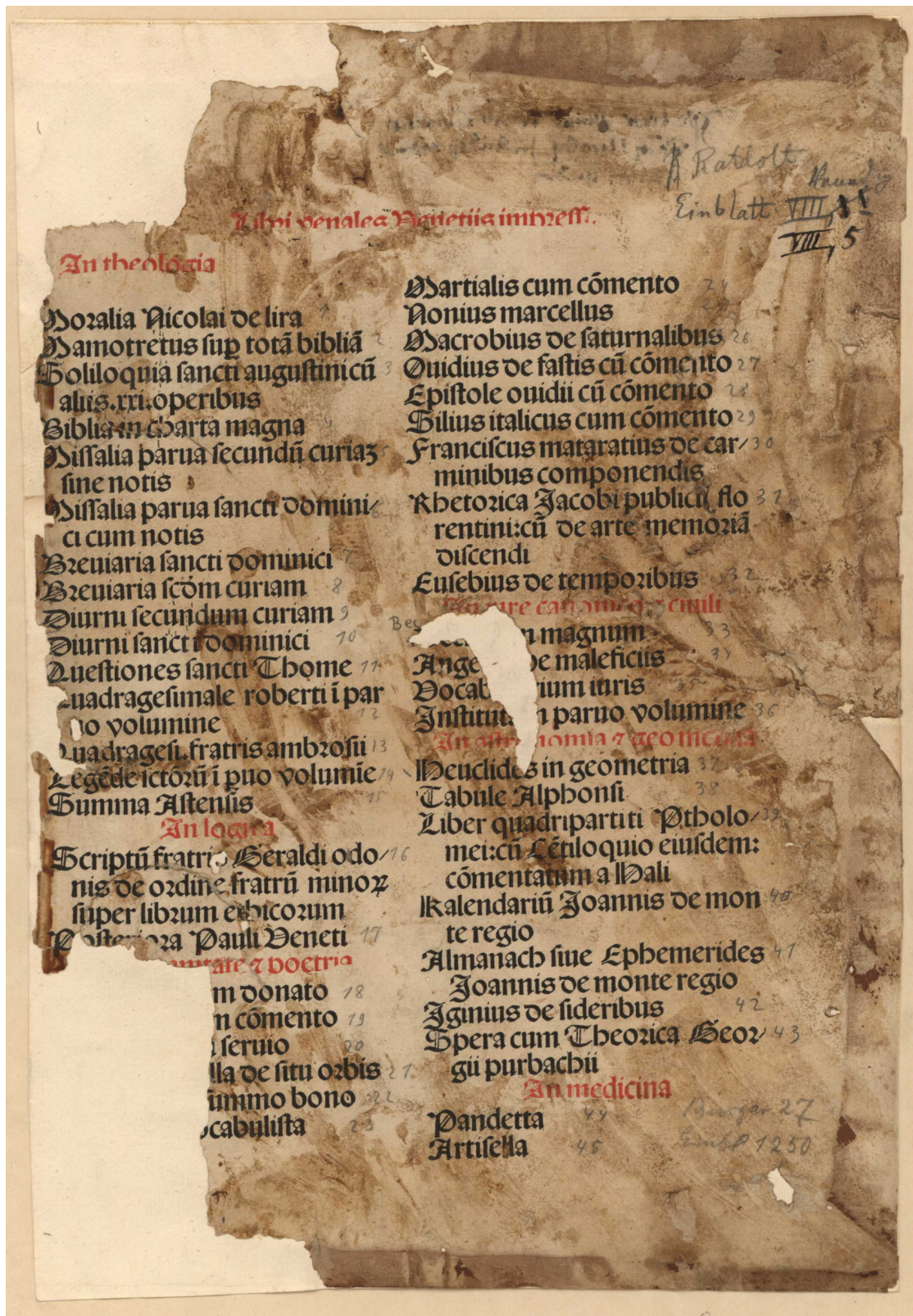


Figure 10: Bayerische Staatsbibliothek, Einbl. VIII, 5f, Book advertisement published by Nicolas Jenson in Venice around 1481.



Libri venalea Venetia impressi.

Ratdolt
Einblatt VIII, 5
VIII, 5

An theologia

Moralia Nicolai de lira	24	Martialis cum cōmento	24
Samotretus sup totā bibliā	25	Nonius marcellus	25
Soliloquia sancti augustini cū	26	Macrobius de saturnalibus	26
aliis. xxi. operibus	27	Quintus de fastis cū cōmento	27
Biblia in charta magna	28	Epistole ovidii cū cōmento	28
Dissalia parua secundū curiaz	29	Silius italicus cum cōmento	29
sine notis	30	Franciscus mataratus de car-	30
Dissalia parua sancti domini	31	minibus componendis	
ci cum notis	32	Rhetorica Jacobi publici flo-	32
Breviaria sancti domini	33	rentini: cū de arte memoriā	32
Breviaria scōm curiam	34	discendi	
Diurnu secundum curiam	35	Eusebius de temporibus	32
Diurni sancti domini	36	<i>De arte can. am. q. civili</i>	
Questiones sancti Thome	37	magnum	33
quadagesimale roberti i par-	38	Angeli de maleficiis	37
uo volumine	39	Docab. iuris	
quadagesi. fratris ambrosii	40	Institut. in paruo volumine	36
Legēde icōrū i puo volumie	41	<i>An astro. nomia 7 geōm. c.</i>	
Summa Astensis	42	Euclides in geometria	37
An logica		Tabule Alphonsi	38
Scriptū fratri Geraldii odo-	43	Liber quadripartiti Ptholo-	39
nis de ordine fratrum minoz	44	mei: cū Lenloquio eiusdem:	
super librum exbitorum	45	cōmentatum a Mali	
Epistola Pauli Veneti	46	kalendariū Joannis de mon-	40
De arte 7 doctria		te regio	
in donato	47	Almanach siue Ephemerides	41
in cōmento	48	Joannis de monte regio	
in seruo	49	Ignius de sideribus	42
illa de situ orbis	50	Spera cum Theorica Geoz	43
in immo bono	51	gu purbachii	
cabulista	52	An medicina	
	53	Pandetta	44
	54	Artifella	45

Figure 11: Bayerische Staatsbibliothek, Einbl. VIII, 5, Book advertisement published by Erhard Ratdolt in Venice in 1484.

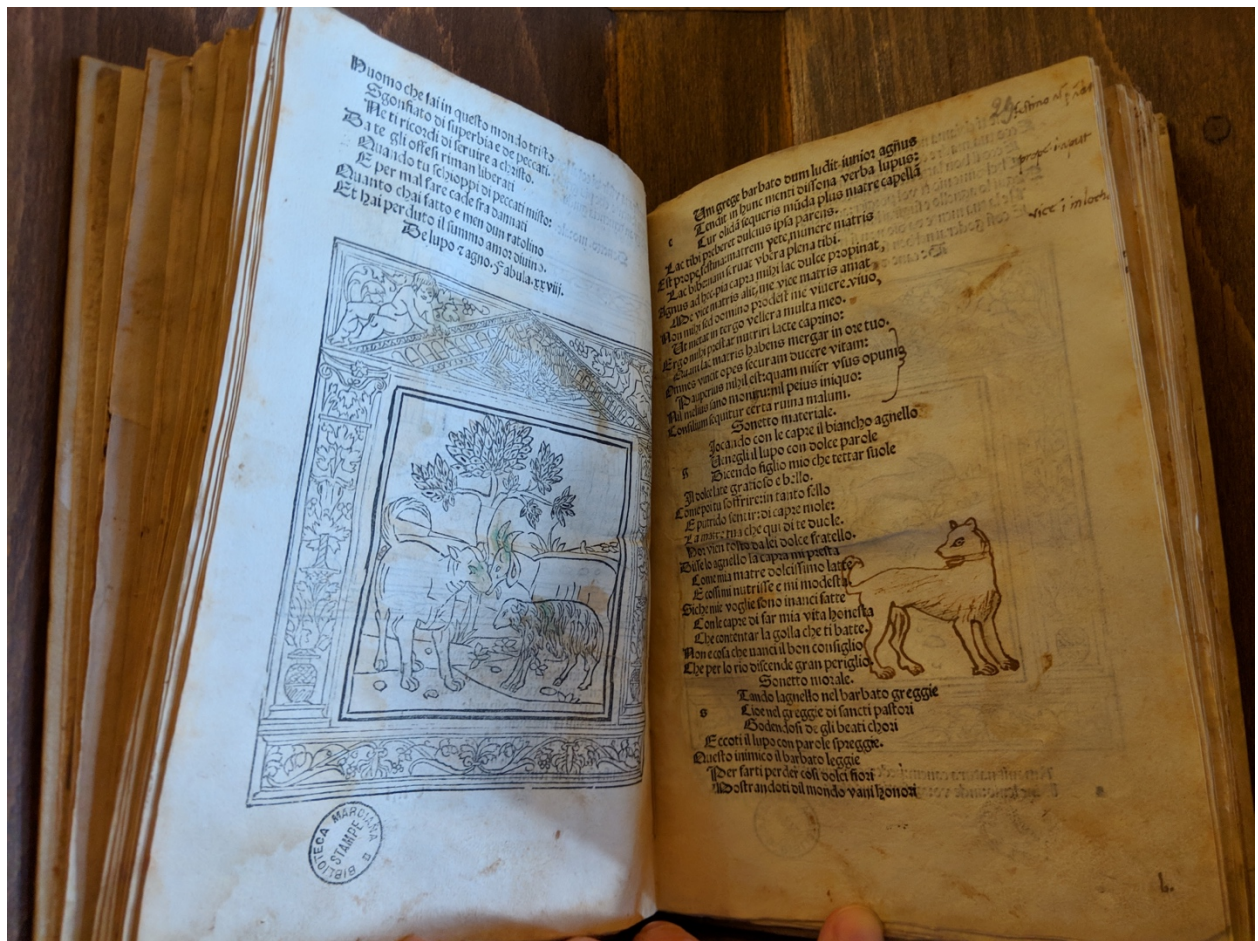


Figure 12: Accio Zucco, trans., Moralized Aesop (Aesopus moralisatus), Venice: Manfredus de Bonellis de Monteferrato, 31 January 1491. Biblioteca Marciana, Inc. V. 0807, ff. 25v–26r.



Figure 13: Graduale Romanum, edited by Franciscus de Brugis, printed by Johannes Emericus de Spira for Lucantonio Giunta in Venice, between 28 September 1499 and 1 March 1500 (m.v.), ISTC No. ig00332000, photo from Biblioteca Nazionale Marciana, Venice, Rari Ven 708, printed on parchment, fol. a1r, woodcut with King David in Prayer with hand illumination.

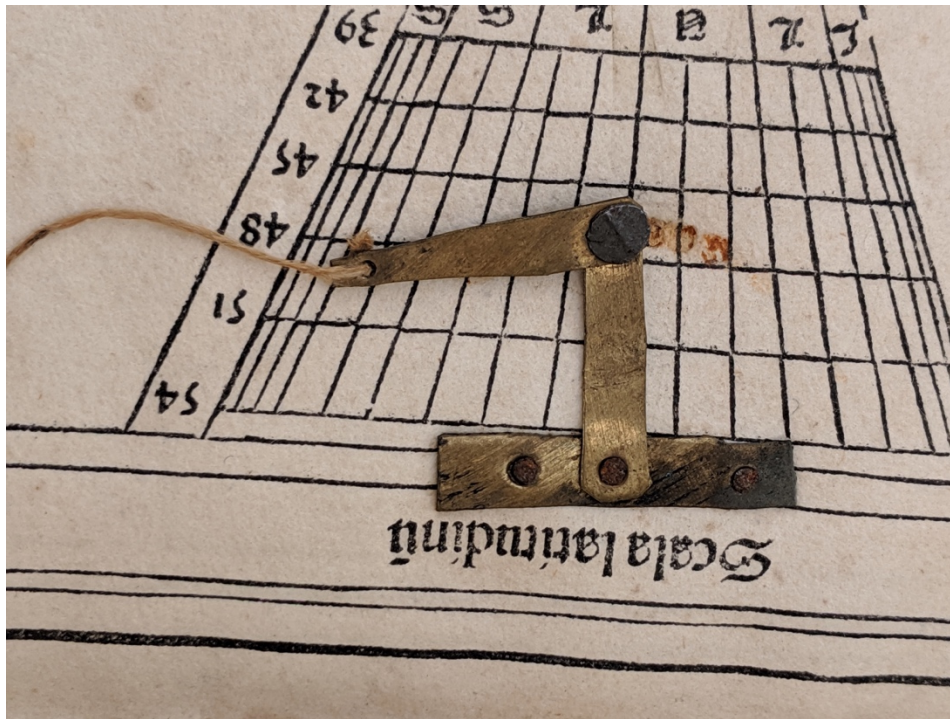


Figure 14: Johannes Regiomontanus, *Calendarium*, Venice: Erhard Ratdolt, 13 September 1483, Huntington Library, 42653.

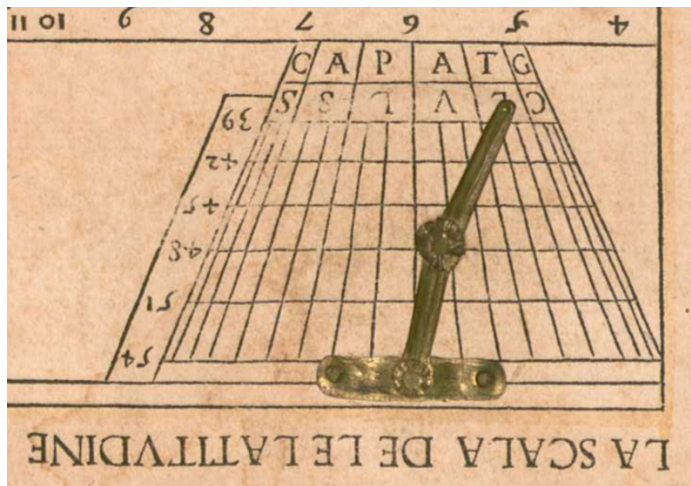


Figure 15: Johannes Regiomontanus, *Kalendarium* (German), Venice: Bernhard Maler and Erhard Ratdolt, 1478, Munich, Bayerische Staatsbibliothek, 2 Inc.c.a.777

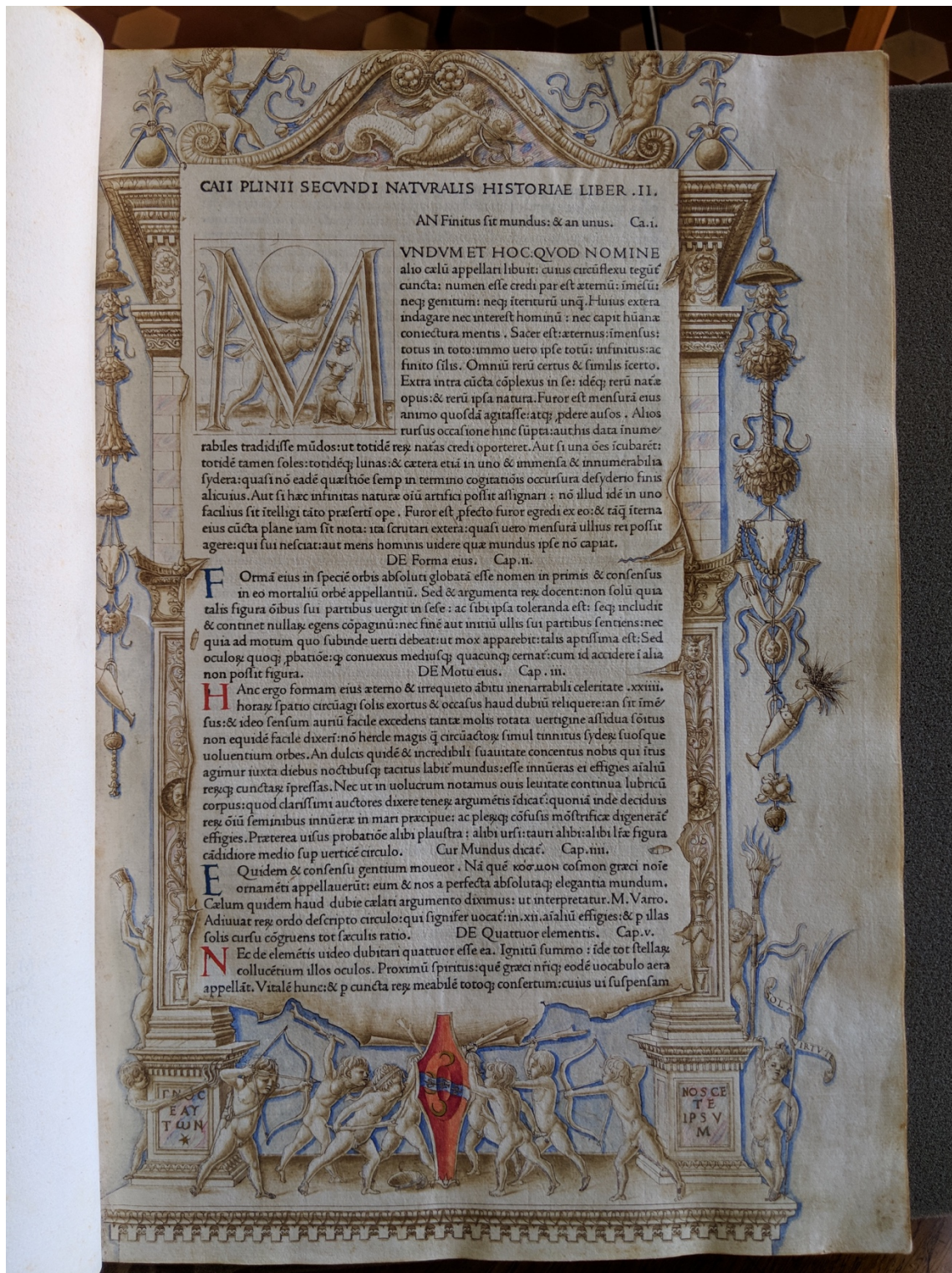


Figure 17: First folio illumination, Book II, Master of the Putti, Pliny the Elder, Natural History (Historia Naturalis), Ed. Johannes Andreas Bussi, published by Nicholas Jenson, Venice, 1472. BVS Forc.K.1.9 on parchment.



Figure 18: Master of the Putti, Initial E, Book XIV, Pliny the Elder, Natural History (Historia Naturalis), Ed. Johannes Andreas Bussi, published by Nicholas Jenson, Venice, 1472. BVS Forc.K.1.9 on parchment.

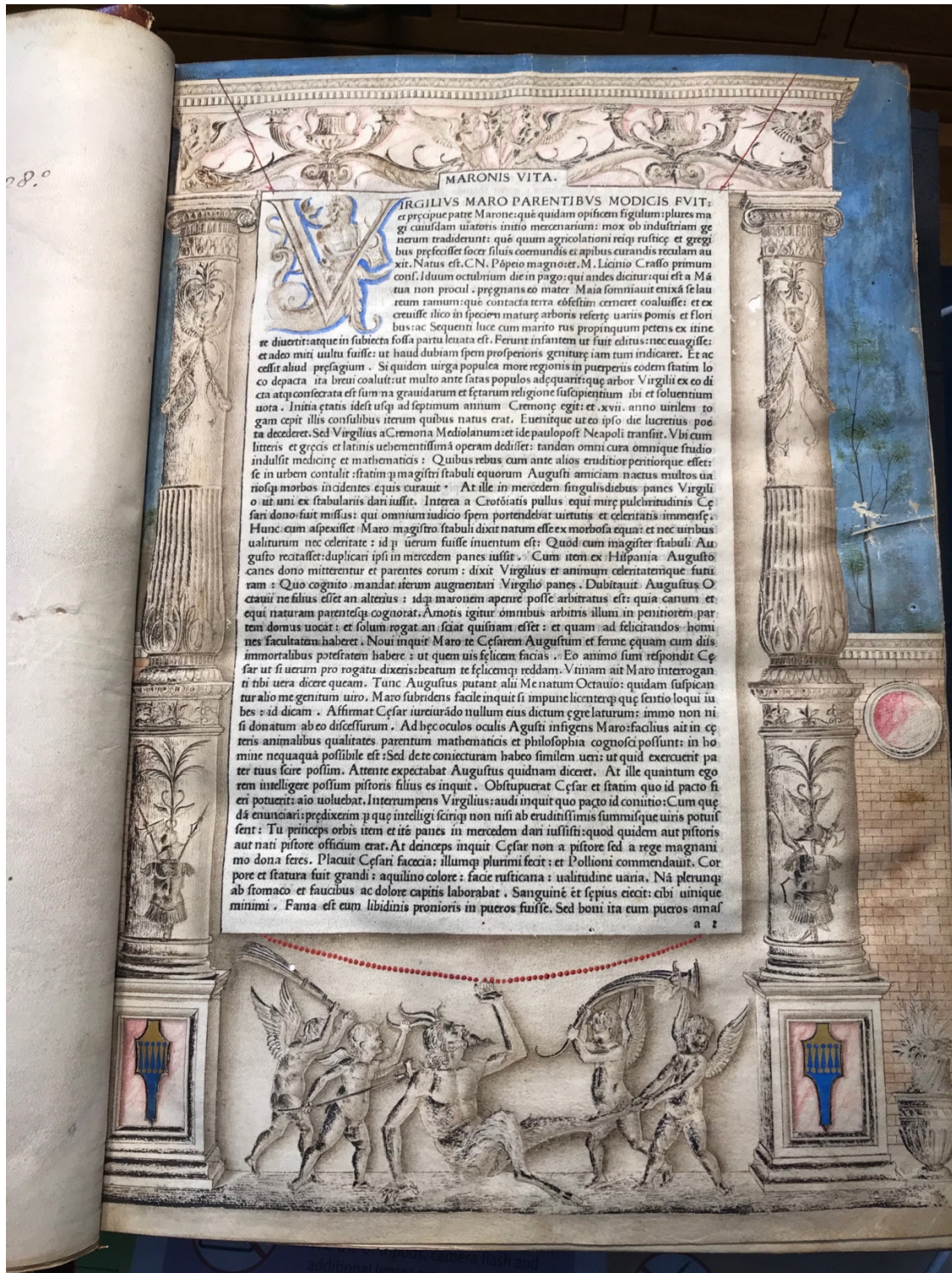


Figure 19: Vergilius Maro, Publius (Virgil). Opera [Bucolica, Georgica, Aeneis with argumenta (comm. Servius)]. Printed in Venice by Jacobus Rubeus, January 1475/1476, on parchment, Illumination attributed to the Master of the London Pliny, British Library IB. 20073.



Figure 20: Suetonius, Lives of the Caesars (Vitae XII Caesarum), Nicholas Jenson, 1471, Milan: Biblioteca Trivulziana, B.87.



Figure 21: So-called “frisket sheet,” parchment verso, St. Bride Library, Miscellaneous Collections. Image courtesy of St. Bride Library & Archives, London. Published by Elizabeth Savage (formerly Upper), 2014.



Figure 22: Giovanni Bellini, Pesaro Altarpiece (containing the Coronation of the Virgin), oil on panel, 262 cm x 240 cm, c. 1471–1483, Civic Museum of Palazzo Mosca, Pesaro.



Figure 23: Photographic Reconstruction of San Giobbe Altarpiece with in situ Frame, Giovanni Bellini, before 1478, oil on panel, Galleria dell'Accademia (panel), San Giobbe, Venice (frame).



Figure 24: Antonello da Messina, Saint Jerome in his Study, ca. 1475, oil on lime, 45.7 x 36.2 cm, National Gallery of Art, London, NG1418.



Figure 25: Detail of sgraffito, Antonello da Messina, Saint Jerome in his Study, ca. 1475, oil on lime, 45.7 x 36.2 cm, National Gallery of Art, London, NG1418.



Figure 26: Begun by Bartolomeo Bon, 1468, completed by Pietro Lombardo, 1475, marble choir screen in Santa Maria Gloriosa dei Frari, Venice.



Figure 27: Photograph of St. Mark's Basilica, interior, choir screen from the west, Venice. Victoria and Albert Museum, photograph, 7751-1936.



Figure 28: Detail of roundel relief of Saint Bernardino in the north-west arch of the marble choir screen in Santa Maria Gloriosa dei Frari, Venice, Begun by Bartolomeo Bon, 1468, and completed by Pietro Lombardo, 1475.



Figure 29: Vittore Carpaccio, *Vision of Prior Ottobon in Sant'Antonio di Castello*, oil on canvas, 121 x 174 cm. c. 1515, Venice, Galleria dell'Accademia.



Figure 30: Detail of Giacomo di Vittore Morosini from Marble Choir Screen in Santa Maria Gloriosa dei Frari, Venice, begun by Bartolomeo Bon, 1468, completed by Pietro Lombardo, 1475.

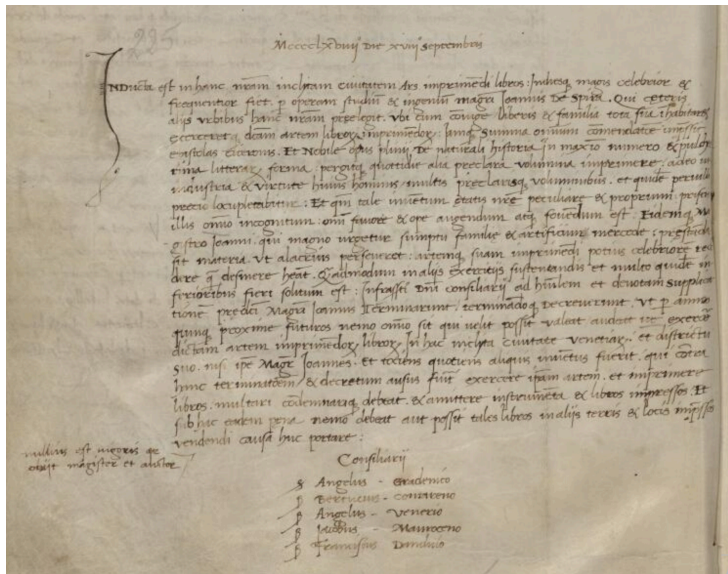
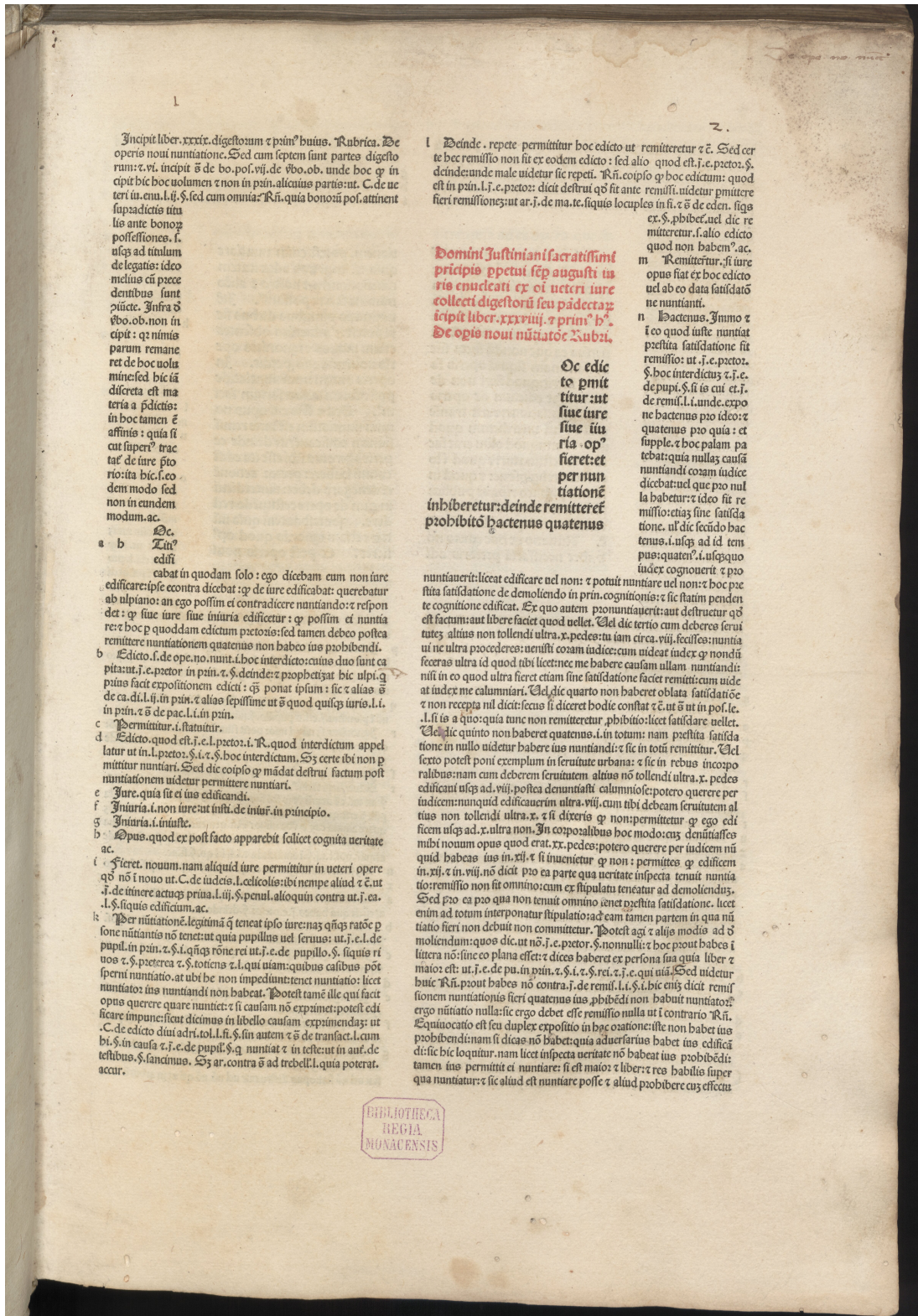


Figure 31: Image of the 1469 print privilege signed by Giacomo di Vittore Morosini [Latinized as: Ser Iacobus Mauroceno].



Figure 32: Detail, Justinian, The Digest (Digestum Novum), with the Commentary of Accursius of Florence, printed by Nicolaus Jenson in Venice, illuminated for Peter Ugelheimer in 1477 by Benedetto Bordon, on parchment, Gotha, Landesbibliothek, Mon. Typ. 1477, fol. 2r.



Incipit liber xxxix. digestorum et primus huius. Rubrica. De operis noui nuntiatione. Sed cum septem sunt partes digestorum: et vi. incipit de bo. po. vii. de vbo. ob. unde hoc qd in cipit hic hoc volumen et non in prin. alicuius partis: ut. C. de uerbi. i. enu. l. ij. §. sed cum omnia: Rñ. quia bonozii pol. attinent supradictis titulis ante bonoz possessiones. f. ulq. ad titulum de legatis: ideo melius cū ptece de uerbis sunt pūctae. Infra d vbo. ob. non in cipit: qz nūmā parum remane ret de hoc uolū minūced hic tā discreta est materia a pūctis: in hoc tamen ē affinis: quia si cat super? tractat de iure pto rior: ita hic. f. eodem modo sed non in eundem modum. ac.

Dc.
a b **Tm?**
edifi

cabat in quodam solo: ego dicebam cum non iure edificare: ipse contra dicebat: qd de iure edificabat: querebatur ab ulpiano: an ego possim et contradicere nuntiatione: et respon det: qd si iure iure siue iudicialiter: qd possim et nuntiare: hoc quoddam edictum pretorio: sed tamen debeo postea remittere nuntiationem quatenus non habeo ius prohibendi.

b Edicto. f. de ope. no. nunt. l. hoc interdico: cuius duo sunt ca pitat. i. e. p. etor in prin. r. §. de iud. r. p. p. h. i. g. p. i. q. p. i. u. s. facit expositionem edicti: qd ponat ipsum: sic et alias d de ca. di. l. ij. in prin. et alias sepissime ut qd quod quis iuris. l. i. in prin. r. §. de pac. l. i. in prin.

c Permittitur. i. statuitur.

d Edicto. quod est. i. e. l. p. etor. i. R. quod interdico appellatur ut in l. p. etor. §. i. r. §. hoc interdico. Et certe ibi non p mittitur nuntiare. Sed die corpore qd mādāt destrui factum post nuntiationem uidetur permittere nuntiare.

e Iure. quia fit et ius edificandi.

f In iuria. l. non iure ut in l. i. de iur. in principio.

g In iuria. l. in ius.

h Dup. quod ex post facto appareret scilicet cognita ueritate ac.

i Fieret. nouum. nam aliquid iure permittitur in ueteri opere qd nō i nouo ut. C. de iudicis. l. edictis: ubi nempe aliud r. et ut. j. de iure actus pūa. l. ij. §. penul. alioquin contra ut. j. ea. l. §. si quis edificum. ac.

is Per nuntiationē legitima q̄ tenet ipso iure: nāz q̄nqz ratōe p sone nūntians nō tenet: ut quia pupillus uel seruus: ut. j. e. l. de pupil. in prin. r. §. i. q̄nqz rōneret ut. j. e. de pupillo. §. si quis rī uos r. §. p. etorea r. §. totiens. l. qui uiam: quibus casibus pōt sperni nuntiatō. at ubi be non impediunt: tenet nuntiatō: licet nuntiatō: ius nuntians non habeat. Pōt est tamē ille qui facit opus quere quare nuntiat: et si causam nō exprimit: potest edifi care impune: sicut dicitur in libello causam exprimendaz: ut .C. de edicto dūi adri. tol. l. i. §. in autem r. §. de transact. l. cum bi. §. in causa r. j. e. de pupil. §. q. nuntiat r. in referut in aut. de testibus. §. sancimus. Et ar. contra s ad rebell. l. quia poterat. acur.

I Deinde. repetere permittitur hoc edicto ut remitteretur r. Sed certe hoc remissio non fit ex eodem edicto: sed alio quod est. i. e. p. etor. §. deinde: unde male uidetur sic repeti. Rñ. corpore qd hoc edictum: quod est in prin. l. j. e. p. etor: dicit destrui qd fit ante remissio. uidetur permittere fieri remissiones: ut ar. j. de ma. te. si quis locuples in fi. r. §. de eden. sigs

Domini Justiniani sacratissimi principis ppetui sep augusti iuris enucleati ex oi ueteri iure collecti digestorum seu pādetaz incipit liber xxxviij. et primus huius. De ogis noui nūntiatōe Rubri.

De edicto pmit titur: ut siue iure siue iū ria op' fieret: et per nuntiationē

inhiberetur: deinde remitteret prohibito hactenus quatenus

ex. §. phibet. uel dic re mitteretur. f. alio edicto quod non habem. ac.

m Remitteretur. si iure opus fiat ex hoc edicto uel ab eo data satisfactio ne nuntiant.

n Hactenus. Immo r i eo quod iuste nuntiat pfecta satisfactio sit remissio: ut. j. e. p. etor. §. hoc interdico r. j. e. de pupil. §. si is cui et. j. de remis. l. i. unde. expo ne hactenus pro ideo: r quatenus pro quia: et supple. r hoc palam ptebat: quia nullaz causā nuntians coram iudice dicebat: uel que pro nullo habetur: ideo fit remissio: et ius sine satisfactio. uel die scido hactenus. i. usq. ad id tempus: quatenus. l. usq. quo iudex cognouerit r pro

nuntiauerit: licet edificare uel non: r potuit nuntiare uel non: r hoc pfecta satisfactio de demolendo in prin. cognitionis: r sic statim pendente cognitione edificat. Ex quo autem pronuntiauerit: aut destruxit qd est factum: aut libere facit quod uellet. Uel die tertio cum deberes seruitutes alius non tollendi ultra. x. pedes: tu tam circa. viij. fecisses: nuntia ut ne ultra procederes: uenisti coram iudice: cum uideat iudex qd nondū feceras ultra id quod tibi licet: nec me habere causam ulla nuntians: nisi in eo quod ultra fieret etiam sine satisfactio faceret remitti: cum uideat iudex me calumniari. Uel die quarto non haberet oblata satisfactio: r non recepta nil dicit: scias si diceret hodie constat r. et ut s ut in pos. le. l. si is a quo: quia tunc non remitteretur. phibito: licet satisfactio uellet. Uel die quinto non haberet quatenus. i. in totum: nam pfecta satisfactio in nullo uidetur habere ius nuntians: r sic in totū remittitur. Uel sexto potest poni exemplum in seruitute urbana: r sic in rebus in corpore: nam cum deberes seruitutem alius nō tollendi ultra. x. pedes edificasti usq. ad. viij. postea denuntiaisti calumniose: potero querere per iudicem: nunquid edificauerim ultra. viij. cum tibi debeam seruitutem alius non tollendi ultra. x. r si dixeris qd non: permittetur qd ego edificem usq. ad. x. ultra non. In corporalibus hoc modo: et denuntiaueris mihi nouum opus quod erat. xx. pedes: potero querere per iudicem nū quid habeas ius in. xij. r si inueniatur qd non: permittes qd edificem in. xij. r in. viij. nō dicit pro ea parte qua ueritate inspecta tenuit nuntiatō: remissio non fit omnino: cum et stipulati tenentur ad demolendum. Sed pro ea pro qua non tenuit omnino tenet pfecta satisfactio. licet enim ad totum interponatur stipulatio: ad eam tamen partem in qua nuntiatō fieri non debuit non committitur. Pōt est agi r alijs modis ad demolendum: quos dicit nō. j. e. p. etor. §. nonnulli: r hoc pout habes i litera nō: sine eo plana esset: r dices habere ex persona sua quia liber maior est: ut. j. e. de pu. in prin. r. §. i. r. §. rei. r. j. e. qui uia. Sed uidetur hūc Rñ. pout habes nō contra. j. de remis. l. i. §. i. hic enī dicit remissionem nuntiationis fieri quatenus ius phibedi non habuit nuntiatō: ergo nuntiano nulla: sic ergo debet esse remissio nulla ut i contrario Rñ. Equiuocatio est seu duplex expositio in hac oratione: ille non habet ius prohibendi: nam si dicas nō habet: quia aduersarius habet ius edificandi: sic loquitur. nam licet inspecta ueritate nō habeat ius prohibendi: tamen ius permittit et nuntiare: si est maior: r liber: r res habitus super qua nuntiat: r sic aliud est nuntiare posse r aliud prohibere euz effectus

BIBLIOTHECA REGIA MONACENSIS

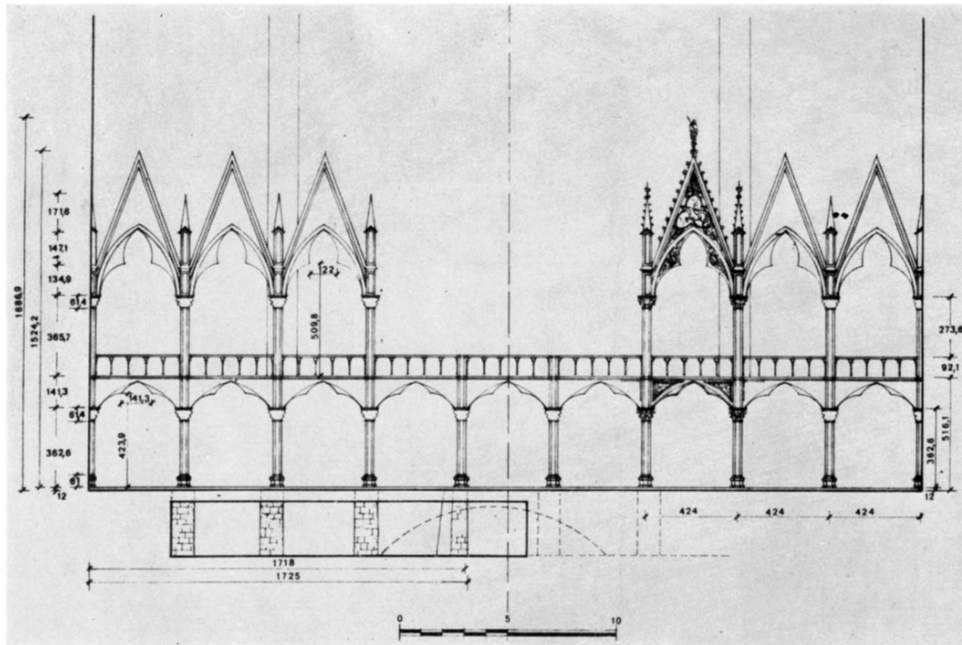
Figure 33: Unadorned example of Justinian, The Digest (Digestum Novum), with the Commentary of Accursius of Florence, printed by Nicolaus Jenson in Venice, fol. 2r.



Figure 34: Aristotle, Works; Porphyrius, Isagoge, with commentary of Averroës, printed in Venice by Andreas Torresanus de Asula and Bartholomaeus de Blavis (in part for Johannes de Colonia), 1483, Vol I, f. 1r, illumination attributed to Girolamo da Cremona, Antonio Maria da Villafora, and Benedetto Bordon, Venice, 1483.



Figure 35: Aristotle, Works; Porphyrius, Isagoge, with commentary of Averroës, printed in Venice by Andreas Torresanus de Asula and Bartholomaeus de Blavis (in part for Johannes de Colonia), 1483, Vol II, f. 1r, illumination attributed to Girolamo da Cremona, Antonio Maria da Villafora, and Benedetto Bordon, Venice, 1483.



Courtesy Soprintendenza ai Monumenti, Florence

Figure 36: Reconstruction of a tramezzo, Florence, Santa Croce, courtesy Soprintendenza ai Monumenti, Florence.



Figure 37: Hertogenbosch rood-loft (choir screen), St. John's Cathedral, Bois-le-Duc, Holland, with candlesticks in beaten brass, 17th century, V&A Museum 1046-1871, 664B,C,F to M-1872.



Figure 38: Vittore Carpaccio, *Hunting on the Lagoon (recto)*; Venice, Italy, about 1490–1495; Oil on Panel, 75.6 x 63.8 cm; 79.PB.72, J. Paul Getty Museum, Los Angeles.



Figure 39: Vittore Carpaccio, *Letter Rack (Verso)*; Venice, Italy, about 1490–1495; Oil on Panel, 75.6 x 63.8 cm; 79.PB.72, J. Paul Getty Museum, Los Angeles.



Figure 40: Vittore Carpaccio, *Ladies on a Balcony*, ca. 1490–95, oil and tempera on panel, Museo Civico Correr, Venice, Cl. I n. 0046.



Figure 41: Intarsia panels, Choir Stalls, in Santa Maria Gloriosa dei Frari, completed around 1468 by Marco Cozzi and a workshop of sculptors from Strasbourg.

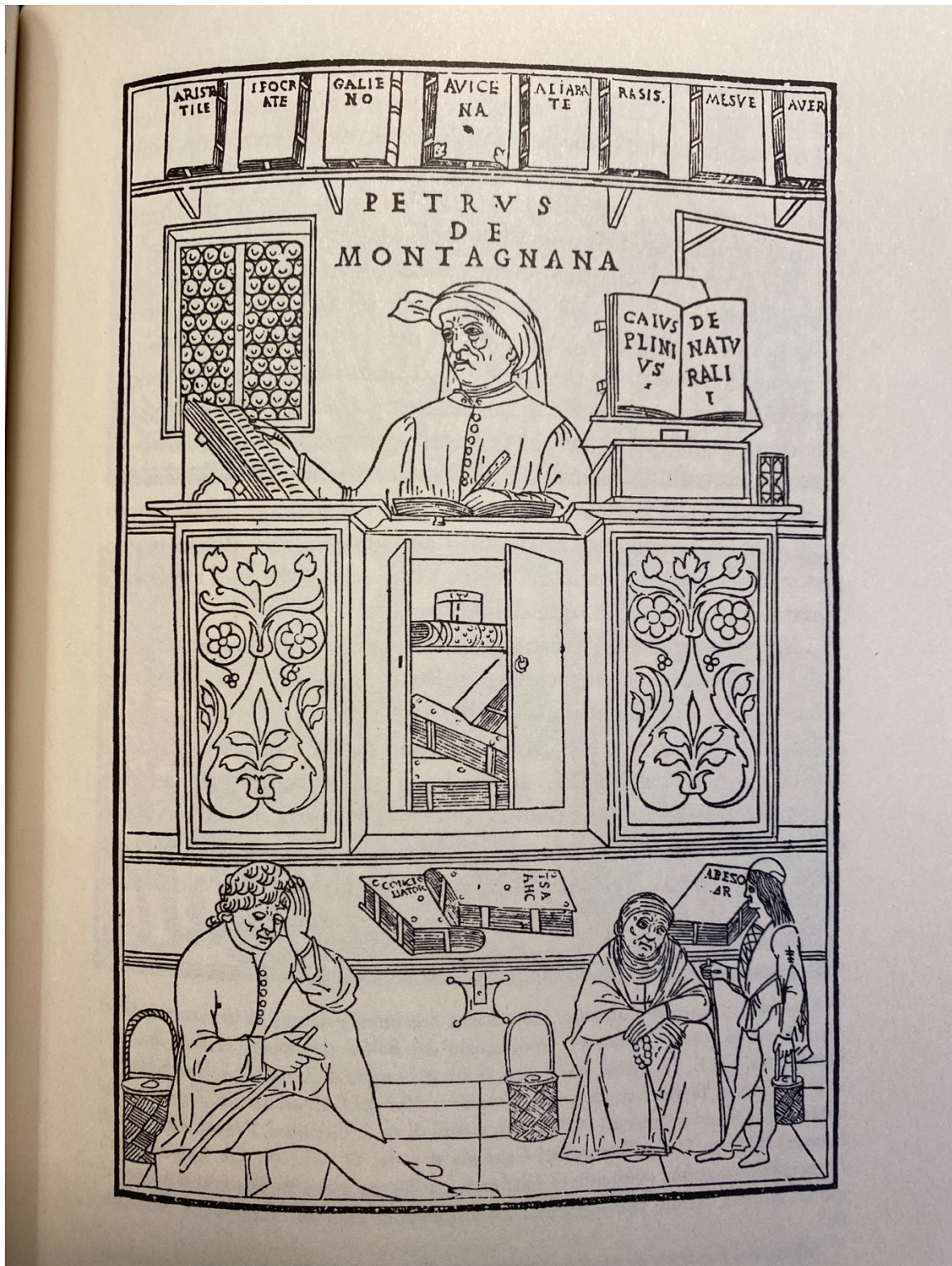


Figure 42: Johannes de Ketham, Fasciculus de Medicina, Venice: Giovanni e Gregorio de Gregori, 1494, fol. a1r.



Figure 43: Gratian, *Decretum* (*Concordantia discordantium canonum*), with the gloss of Bartholomaeus Brixiensis, Published by Nicholas Jenson, 1477, Illumination attributed to Girolamo da Cremona and the Master of the Seven Virtues, Gotha, Landesbibliothek, Mon. Typ. 1477, 2^o (12).



Figure 44: Gratian, Decretum (Concordantia discordantium canonum), with the gloss of Bartholomaeus Brixiensis, published by Nicholas Jenson, 1477, Illumination attributed to Girolamo da Cremona and the Master of the Seven Virtues, Gotha, Landesbibliothek, Mon. Typ. 1477, 2° (12).



Figure 45: Detail of gem with Terme Ruler or Hellenistic Prince, Justinian, The Digest (Digestum Novum), with the Commentary of Accursius of Florence, printed by Nicolaus Jenson in Venice, illuminated for Peter Ugelheimer in 1477, by Benedetto Bordon, on parchment, Gotha, Landesbibliothek, Mon. Typ. 1477, fol. 2r.



Figure 46: So-called Terme Ruler or Hellenistic Prince, 2nd century B.C., Bronze, now in the Palazzo Massimo alle Terme, Rome, discovered in 1885 near the Baths of Constantine on the Quirinal Hill.



Figure 47: Carnelian ring stone with two warriors, Roman Republican Period, circa mid 1st century BCE.



Figure 48: Detail, Official with seal, Book VI, Justinian, The Digest (Digestum Novum), with the Commentary of Accursius of Florence, printed by Nicolaus Jenson in Venice, illuminated for Peter Ugelheimer in 1477, by Benedetto Bordon, on parchment, Gotha, Landesbibliothek, Mon. Typ. 1477, 2^o (13).



Figure 49: Detail, Initial O with Apollo and Marsyas(?), Gratian, Decretum (Concordantia discordantium canonum), with the gloss of Bartholomaeus Brixiensis, Published by Nicholas Jenson, 1477, Illumination attributed to Girolamo da Cremona and the Master of the Seven Virtues, Gotha, Landesbibliothek, Mon. Typ. 1477, 2^o (12), F. S4v.



Figure 50: So-Called Seal of Nero, Dioskourides, ca. 150–100 BCE, carnelian, Roman, Naples, Museo Archeologico Nazionale.



Figure 51: Cristoforo di Geremia, Portrait medal of Pope Paul II with “Seal of Nero” on reverse; cast bronze, Rome, 1464–71. The British Museum, London.



Figure 52: Bertoldo di Giovanni, Detail: Quies, from the Palazzo Medici courtyard frieze.



Figure 53: Upper Cover, Gotha, Landesbibliothek, Mon. Typ. 1477, 2° (13).



Figure 54: Lower Cover, Landesbibliothek, Mon. Typ. 1477, 2° (13).



Figure 55: Upper cover, Gotha, Landesbibliothek, Mon. Typ. 1477, 2° (12).



Figure 56: Lower Cover, Gotha, Landesbibliothek, Mon. Typ. 1477, 2° (12).



Figure 57: Detail with illuminated coin of Nero, Suetonius, *Lives of the Caesars* (*Vitae XII Caesarum*), Nicholas Jenson, Venice, 1471. Milan, Biblioteca Trivulziana, B.87.

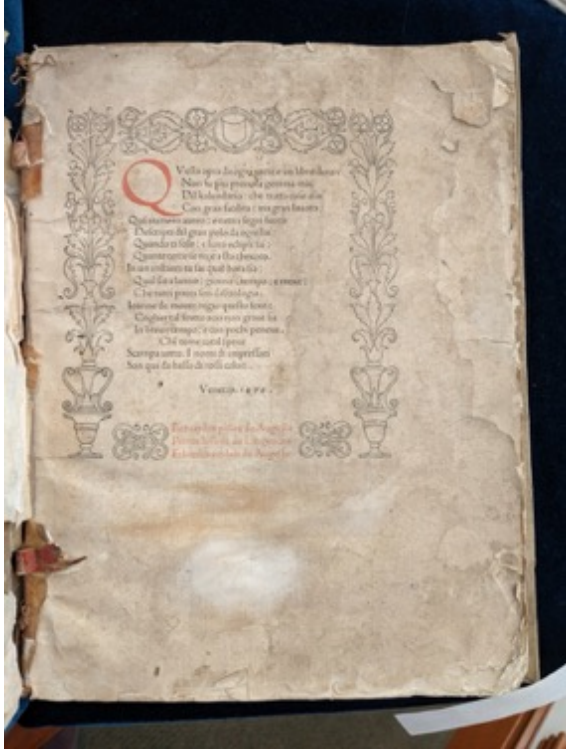


Figure 58: Johannes Regiomontanus (Johann Müller of Königsberg), *Kalendarium* [Italian edition: *Calendario*], Venice: Bernhard Maler (Pictor), Erhard Ratdolt, and Peter Löslein, 1476. ISTC No. ir00103000, GW M37479, Image from Huntington Library, San Marino, California, 105405.

1497	1700	1701
Eclipsis del Sole	Eclipsis de la Luna	Eclipsis de la Luna
20 1 2	7 14 2	2 17 40
Luna	Novembrio	Mayo
Meja duracion	Meja duracion	Meja duracion
0 36	1 37	1 32
Puncti tre	Puncti dece	
1702	1703	1704
Eclipsis del Sole	Eclipsis de la Luna	Eclipsis de la Luna
30 12 45	17 12 20	20 11 35
Septembrio	Octobrio	Februaro
Meja duracion	Meja duracion	Meja duracion
1 7	1 1	1 45
Puncti dece	Puncti tre	

Figure 59: Johannes Regiomontanus (Johann Müller of Königsberg), *Kalendarium* [Italian edition: *Calendario*], Venice: Bernhard Maler (Pictor), Erhard Ratdolt, and Peter Löslein, 1476. ISTC No. ir00103000, GW M37479, Calendar with Eclipse tables, Image Bayerische Staatsbibliothek BSB-Ink R-77



Figure 60: Johannes Regiomontanus (Johann Müller of Königsberg), Kalendarium, Venice: Erhard Ratdolt, 9 August 1482. ISTC No. ir00094000, GW M37456, London, British Library IA.20519, containing eclipse tables with overlapping color printing.




1479	1479	1480
Finster der Svnnen	Finster des mondes	Finster des mondes
12 23 47	28 12 50	21 21 40
Des Cristmondes	Des Cristmondes	Des Brachmondes
Halbe werung	Halbe werung	Halbe werung
1 2	1 44	1 31
oben punct		Acht punct
		
1481	1482	1482
Finster der Svnnen	Finster der Svnnen	Finster des mondes
6 23	17 7 42	26 5 57
Des Maien	Des Maien	Des Weinmondes
Halbe werung	Halbe werung	Halbe werung
0 43	0 55	1 39

Figure 61: Johannes Regiomontanus (Johann Müller of Königsberg) Kalendarium [German edition: Kalender], Venice: Bernhard Maler (Pictor) and Erhard Ratdolt, 1478. ISTC No. ir00100500, GW M37475, London, Image: British Library IB 20497, folio containing Bull's head watermark in printed eclipse table.



Figure 62: Ptolemy, *Almagest*, translated by Gerard of Cremona, France, 1297, parchment, 226 x 319 mm, belonged to Pier Leoni (d.1492), physician to Lorenzo de' Medici, Huntington Library, San Marino California, MssHM 65, fol. 1r, containing a prince (sometimes identified as Abu l'Wafa) holding an armillary sphere and discoursing with a scholar.

in sphaera directa cum arcibus orbis signorum

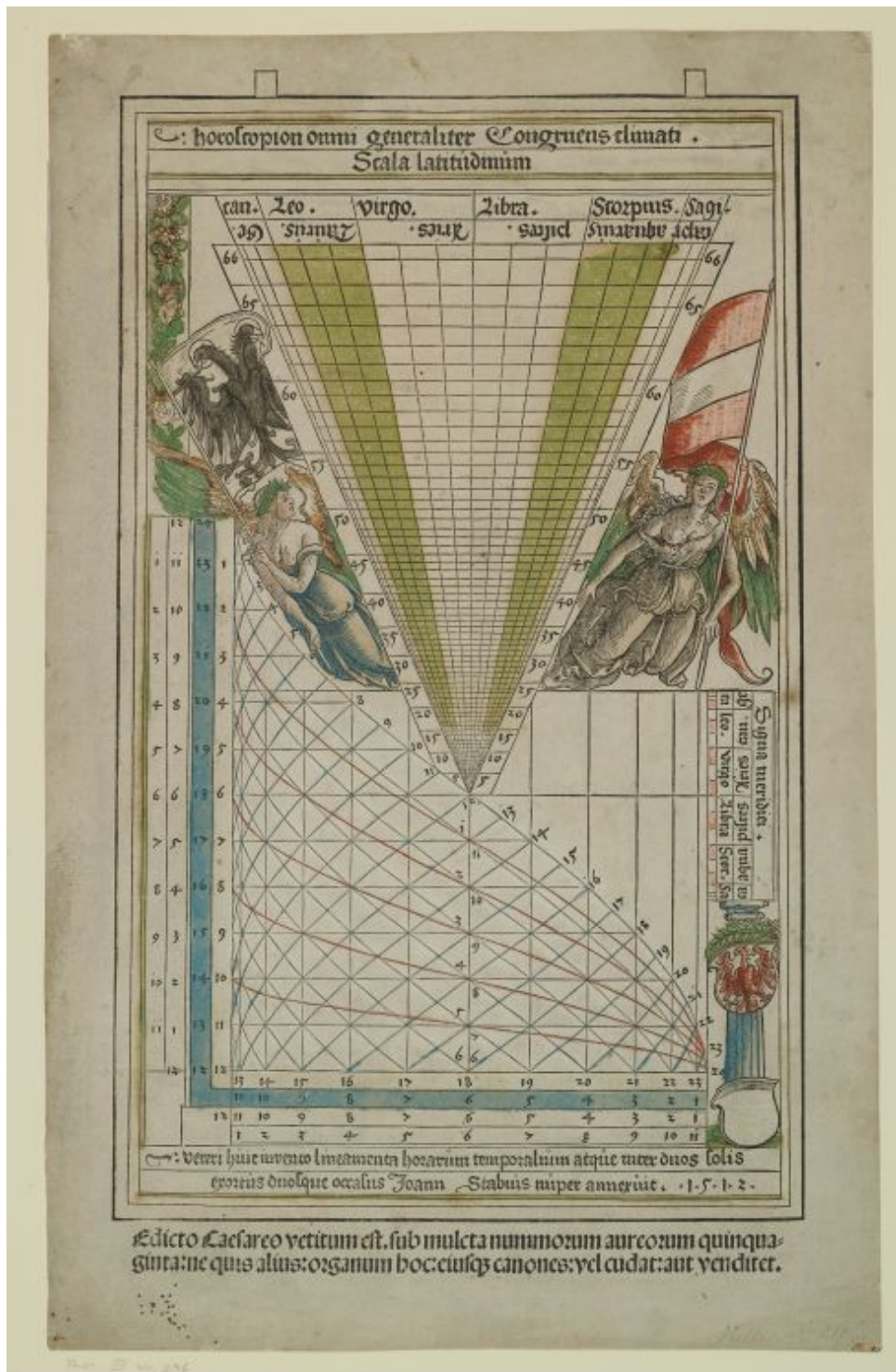
Capitulum primum De scientie huius ad alia



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conti
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nesta
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possit
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mam
scient
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na p
natio

fitiōe totius: pulchre rei: decentis forme: fm mēsurat
neq; in vilibus. ⁊ vt expendamus plurimum nostri
liva scientie magne ⁊ excelsę: ⁊ precipue que propzi

Figure 63: Ptolemy, Almagest, Venice: Petrus Liechtenstein, 10 January, 1515. USTC No. 851483, Image: Huntington Library, San Marino, California, 485907, composite woodblock initial depicting Ptolemy and Regiomontanus.



HB 25805 © Germanisches Nationalmuseum,
Foto: Monika Runge

Figure 64: Johannes Stabius, Horoscope for Jacob Bannisius, 1512, woodcut on paper, 39 x 24.6 cm, Germanisches Nationalmuseum HB25805.

**Erhardus raddoli Augustensis imprei
for Serenissimo Alinae urbis venetae
Principi Joanni Mocenico .S.**

Solebam antea Serenissime Princeps mecum ipse cogitare admi-
rari quid causae esset: quod in hac tua praesepotenti et sancta urbe cum varia
auctorum veterum novorumque volumina quotidie imprimerent. In
hoc mathematica facultate vel reliquarum disciplinarum nobilissima
aut nihil aut parva quaedam et frivola in tanta impressorum copia qui
in tua urbe agunt viderent impressa. Haec cum mecum saepius dicitur
serenissimam illi difficultate operis accidisse. Non enim ad hoc
quo pacto schemata geometrica quibus mathematica volumina sca-
tent: ac sine quibus nihil in his disciplinis fere intelligi optime potest
excogitaverant. Itaque cum hoc ipsum tantummodo communi omnium
utilitati quae ex his percipitur obstarer: mea industria non sine maximo
labore effecti. ut qua facilitate litterarum elementa imprimantur. ea
etiam geometricae figurae conficerent. Quamobrem ut spero hoc
nostro invento hae disciplinae quas mathematica graeci appellant
voluminum copia sicut reliquae scientiae brevi illustrabunt. De quarum
laudibus et utilitate possem multa impraesens adducere ab illustribus
collecta auctoribus: nisi studiosis iam omnibus haec nota essent. Illud
etiam plane cognitum est caeteras scientias sine mathematicis imper-
fectas ac veluti mancas esse. Neque hoc profecto negabunt Dialectici
neque Philosophi abnuent: in quorum libris multa reperiunt: quae si-
ne mathematica ratione minime intelligi possunt. Quam diu enim ille
Plato moere veritatis arcanum. ut adipisceretur cyrenas ad Theo-
dorum summum eo tempore mathematicus et ad aegyptios sacerdotes
enavigavit. Quid quod sine hac una facultate vivendi ratio non perfecte
constat. Nam ut de musica taceam: quae nobis maneri ab ipsa natu-
ra ad perferendos facilius labores necessaria videtur: ut astrologiam prae-
teream quae exaltat caelum ipsum veluti scalis machinisque quibusdam
conscendentes verum ipsius naturae argumentum cognoscimus: sine
arithmetica et geometria: quarum altera numeros altera mensuras do-
cet: civiliter comodeque vivere qui possumus? Sed quid ego in his mo-
ror quae iam omnibus ut dixi: notiora sunt quam ut a me dicantur. Eu-
clides igitur megarensis serenissime princeps qui xv. libris omnem
geometriae rationem summamque complexus est: quem ego sum-
ma et cura et diligentia nullo praetermisso schemate imprimendum cu-
ravi: sub tuo nomine tutus sociisque prodeat.

Figure 65: Euclid, Elementa geometriae (Elements), translated by Adelard of Bath (Adelardus Bathoniensis), edited by Johannes Campanus, 25 May 1482, London, British Library IB.20514, dedication copy on vellum with arms of Doge Giovanni Mocenigo and gold-printed dedicatory letter.



Figure 66: Erhard Ratdolt, Bücheranzeige (Advertisement for the edition of Euclid’s Elements), Venice, 1481–1482, Image: Munich, Bayerische Staatsbibliothek, Einbl. VIII, 5b.

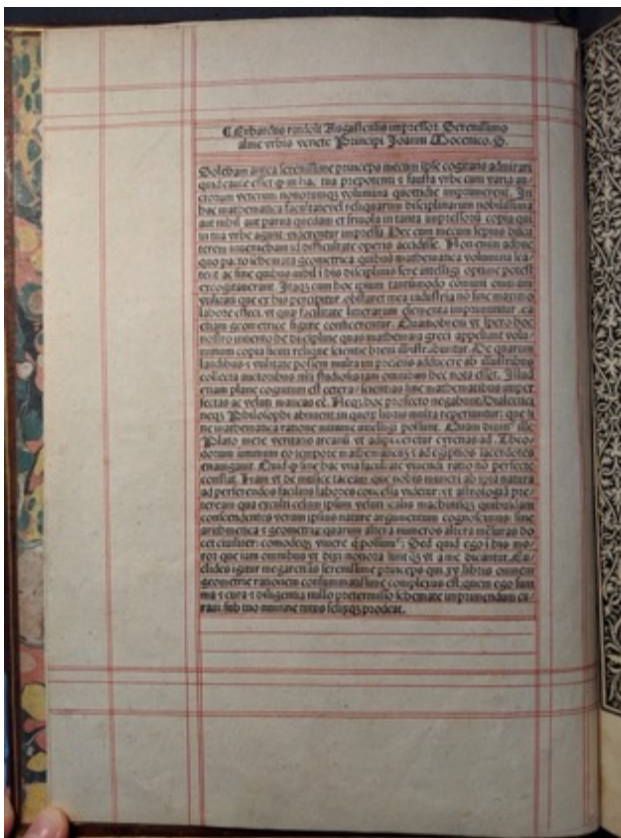


Figure 67: Euclid, Elementa geometriae (Elements), translated by Adelard of Bath (Adelardus Bathoniensis), edited by Johannes Campanus, 25 May 1482, Image: London, British Library G.7837, containing proof of dedicatory letter with red lines and pasted-down printed text.

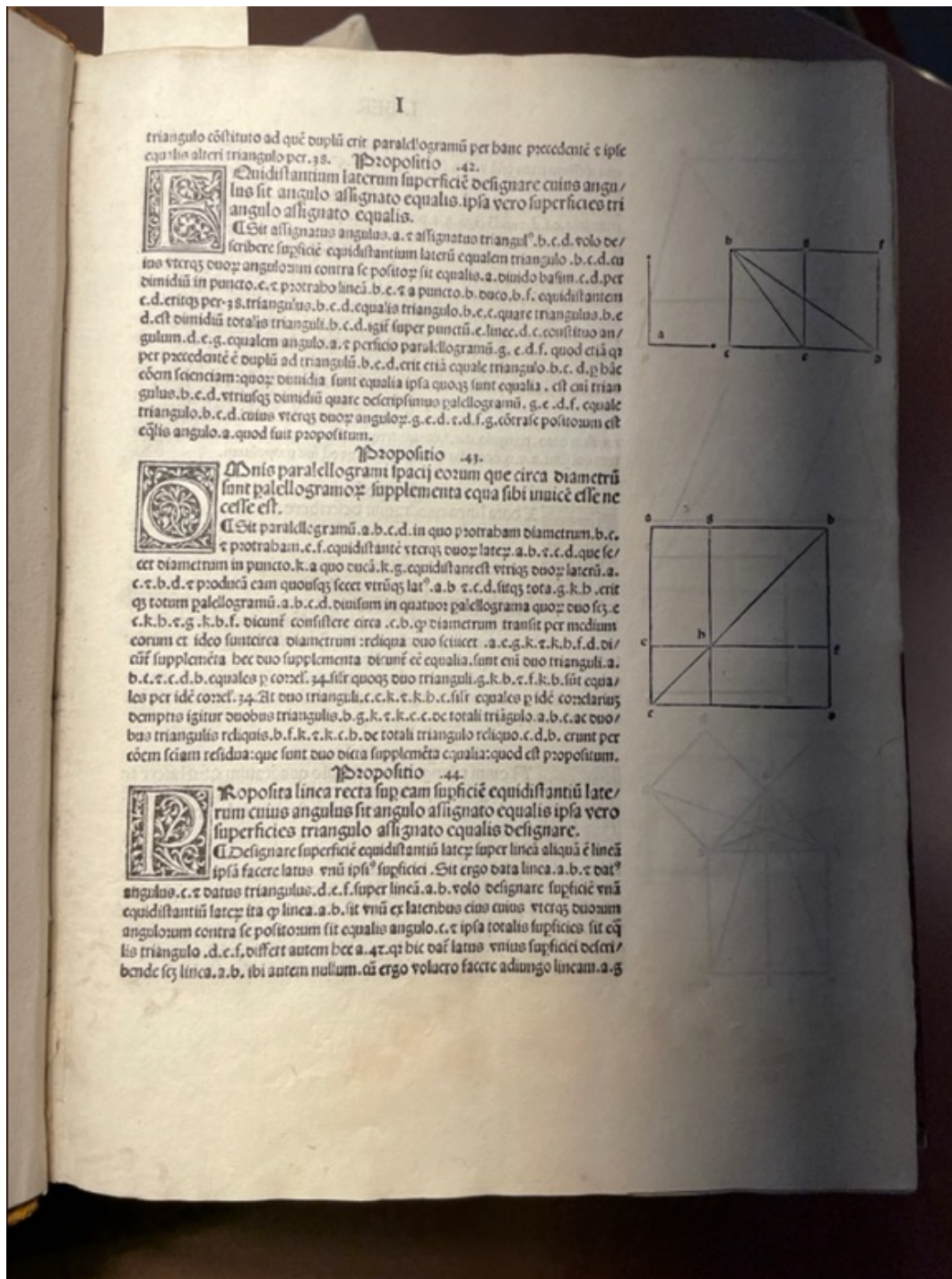
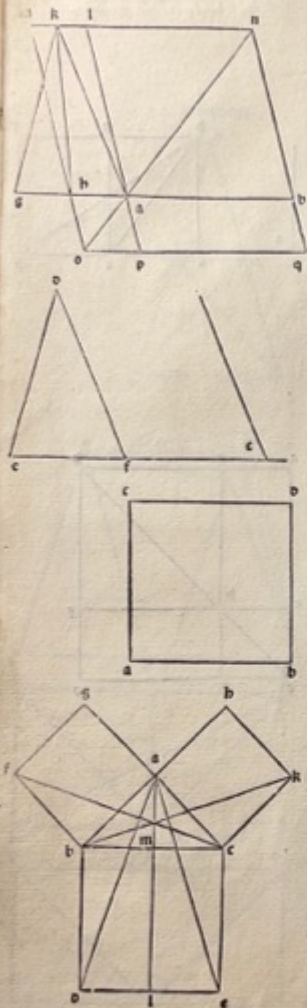


Figure 68: Euclid, *Elementa geometriae* (*Elements*), translated by Adelard of Bath (Adelardus Bathoniensis), edited by Johannes Campanus, 25 May 1482, ISTC No. ie00113000, GW 9428; Image: Library of Congress, Incun. 1482 .E8616, 2 Copy, with diagram of Book I, Proposition 43.

LIBER



linee .a. b. fm rectitudinem; quā pono equalem linee .c. f. basi trianguli dati f per
 quā cōstituo triangulū vni ei eque et equilaterū. qd hoc modo facio. Cōstituo āgu
 tum .a. g. k. equalem angulo .c. et . ngulum .g. a. k. equalem angulo .f. per .23. et quia
 g. a. posita fuerat equalis .c. f. crit per .26. triangulus .g. a. k. equalis et equilaterus
 triangulo .c. f. d. b. undā ergo .g. a. per equalia in puncto .b. et p̄trabā .k. b. et produ
 cam a puncto .k. lineā .m. k. n. equidistantē linee .g. b. critq; per .38. triangulū .a. b.
 k. equalis triangulo .g. b. k. tunc super punctū .a. lineā .g. a. faciā angulum .g. a. l. p̄
 23. equalem angulo .c. dato: et complebo sup basim .a. b. et inter lineas .g. b. et .m. n.
 equidistantes superficiem equidistantis laterum .m. l. b. a. que p. 41. dupla erit ad
 triangulū .k. b. a quare equalis totali triangulo .k. g. a. quare et triangulo .d. c. f. p̄
 posito: p̄trabam ergo .b. n. equidistantē .a. l. et producā diametrum .n. a. quā p̄
 trabā quousq; cōcurrat cū .m. b. in puncto .o. et cōplebo superficiem equidistantium
 laterum .m. o. n. q. et p̄trabam .l. a. vsq; ad .p. critq; per p̄cedentē supplementū
 a. b. p. q. equale supplemento .m. l. b. a. quare et triangulo .d. c. f. et q; per .15. angu
 lus .l. a. b. ē equalis angulo .b. a. p. et ideo angulus .b. a. p. est equalis angulo .c. p̄
 super datam lineā .a. b. descriptā esse superficiem equidist. ntiū laterum .a. b. p. q.
 equalem dato triangulo .d. c. f. cuius vterq; duorum angulorum contra se posito
 rum qui sunt .a. et .q. ē equalis dato angulo .c. quod fuit p̄positum.

Propositio 45.



Et data linea quadratum describere.
 Sit data linea .a. b. ex qua volo quadratum describere: a punctis .a
 et .b. lineā .a. b. educo p. 11. lineas .a. c. et .b. d. perpendiculares ad li
 nearum .a. b. que erūt equidistantes per vltimā p̄tem .28. et pono vtrā
 q; eaz eidem .a. b. per secā equalem et p̄trabo lineam .c. d. critq;
 ipsa equalis et equidistans linee .a. b. per .33. et quia vterq; duorum anguloꝝ .a. et
 b. est rectus. crit vterq; duoz .c. et .d. rectus per vltimā p̄tem .29. ergo per definiti
 onem .a. b. c. d. ē quadratum quod est p̄positū. Idem aliter sit .a. c. perpendica
 laris super lineam .ab. per .11. et sit ei equalis vt prius et a puncto .c. per .31. ducatur
 c. d. equidistans .a. b. et ponatur equalis ei et ducatur linea .d. b. que per .33. erit eq̄
 lis et equidistans .a. c. et omnes anguli recti per vltimā p̄tem .29. quare per definiti
 onem habemus p̄positum.

Propositio 46.



In omni triangulo rectangulo quadratum qd a latere re
 cto angulo opposito in semetipso ducto describit equū ē
 duobus quadratis que ex duob⁹ reliquis lateribus con
 scribuntur.
 Sit triangulus .a. b. c. cuius angulus .a. sit rectus dico q; quadra
 tū lateris .b. c. equū ē quadrato .a. b. et quadrato .a. c. si l sumptis. Quadrato ḡ hęc
 tria latera fm doctrinā p̄cedentis: sitq; q̄dratū .b. c. superficies .b. c. d. e. et q̄dratū .b.
 a. superficies .b. f. g. a. et q̄dratū .a. c. superficies .a. c. b. k. ab āgulo .a. recto ductā ad bas
 is .d. e. basīs maximi q̄drati tres lineas .f. a. l. equidistātē vtriusq; lateri .b. d. et .c. e. q̄ se
 cet .b. c. i puncto .m. et p̄p̄tensas .a. d. et .a. e. itōq; a duob⁹ reliq̄is āgulis triāguli q̄ sit
 b. et .c. ductā ad duos angulos duoz q̄dratoꝝ: mior; duas līcas se intersectas itra ipsū

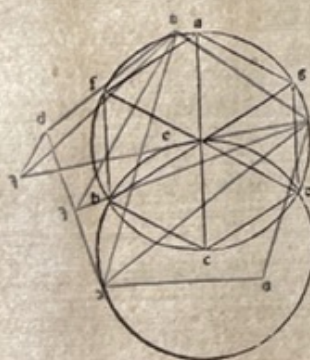
Figure 69: Euclid, Elementa geometriæ (Elements), translated by Adelard of Bath (Adelardus Bathoniensis), edited by Johannes Campanus, 25 May 1482, ISTC No. ie00113000, GW 9428; Image: Library of Congress, Incun. 1482 .E8616, 2 Copy, with diagram of Book I, Proposition 45.



Figure 70: Euclid, *Elementa geometriæ* (*Elements*), translated by Adelard of Bath (Adelardus Bathoniensis), edited by Johannes Campanus, 25 May 1482, ISTC No. ie00113000, GW 9428; Image: Library of Congress, Incun. 1482 .E8616, 2 Copy, with folio containing diagram of Book I, Proposition 43 (Recto) and Proposition 45 (Verso) in transmitted light. Viewed from verso.

duo anguli g. s. in triangulo g. f. b. sunt equalia quibus angulis b. a. b. triangulo
 d. f. b. i. a. s. b. e. e. erit per a. 6. primi. f. b. equalis. f. g. U. eodem modo probabitur
 f. b. equalis. f. i. sumpta triangulo. f. d. k. f. d. qui igitur. f. linca. f. g. f. b. f. k. f. l.
 7. f. m. sunt equalia. erit. f. i. centrum circuli. per 9. tertij. que describitur in quarta
 tera. v. i. o. o. e. r. u. m. a. s. a. n. g. e. t. o. m. n. i. a. l. a. t. e. r. a. p. e. n. t. a. g. o. n. i. p. p. t. e. r. e. q. u. a. l. i. t. a. t. e. m. l. i. n. e. a. r. u. m.
 & nullum eorum sequitur per primam geometriae. 15. tertij. itaqz constat propositum. m. b. g.
 a. n. o. g. e. d. i. q. z. i. t. u. p. d. a. l. l. 7. a. l. l. m. 7. l. m. p. l. e. n. t. o. d. i. m. g. m. d. e. d. 7. p. p. o. n. o. t. i.
 3. m. l. p. b. e. t. m. u. l. i. p. l. i. z. a. t. i. o. n. e. i. n. f. r. o. p. o. s. i. t. i. o. n. e. 14. b. c. i. n. t. r. o. d. u. c. t. o. s. i. t. m. l. a. d.

Intra datum pentagonum quod sit equilaterum. atqz equi-
 angulum circulum describere. **Propositio 14.** b. c. i. n. t. r. o. d. u. c. t. o. s. i. t. m. l. a. d.
 U. e. i. t. e. t. p. r. i. m. a. e. a. t. u. s. p. e. n. t. a. g. o. n. u. m. e. q. u. i. l. a. t. e. r. u. m. a. t. q. z. e. q. u. i. a. n. g. u. l. o. s.
 quia de alijs non est necessarium hoc esse possibile. a. b. c. d. e. s. i. c. o. l. o. q. u. o.
 ca ipsum describere circulum. hoc est q. d. i. c. t. u. m. c. o. n. v. e. r. s. a. 12. D. u. o. c. i. n. s. p.
 p. l. i. m. i. t. a. t. i. o. n. e. a. n. g. u. l. o. r. u. m. q. u. i. s. u. n. t. i. n. z. e. c. e. n. t. r. u. m. p. e. q. u. a. l. i. t. a. t. e. m. l. i. n. e. a. r. u. m. f. i. c. i. t. e. q. u. o. n. t.
 q. z. c. o. n. c. u. r. r. a. n. t. i. n. t. r. a. i. p. s. u. m. p. e. n. t. a. g. o. n. u. m. i. n. p. e. n. t. a. d. f. e. d. u. e. n. t. e. m. i. n. t. r. a. p. e. n. t. a.
 s. o. n. u. m. n. e. p. r. o. b. a. t. u. m. e. i. t. e. m. p. r. i. m. i. s. s. a. e. a. p. u. n. c. t. o. c. o. n. c. u. r. r. a. n. t. a. d. r. e. c. t. a. n. g. u. l. o. s.
 l. i. n. e. a. r. u. m. q. u. e. s. u. n. t. f. i. b. a. f. e. d. e. m. p. o. l. a. t. e. r. a. a. f. i. c. i. a. b. t. r. i. a. n. g. u. l. u. s. f. b. f. e. q. u. i. e. q. u. a. l. i. t. a.
 t. u. s. o. b. o. b. a. l. e. t. u. s. a. f. e. d. e. m. t. r. i. a. n. g. u. l. u. s. a. f. i. c. i. a. b. t. u. s. i. n. t. r. i. a. n. g. u. l. o. a. f. i. c. i. a. b. t. u. s. i. n. t. r. i. a. n. g. u. l. o. a. f. i. c. i. a. b. t. u. s.
 e. r. i. t. e. t. p. r. i. m. i. s. s. a. e. a. n. g. u. l. o. s. e. t. a. n. g. u. l. u. s. b. i. f. i. s. i. b. i. s. a. n. g. u. l. o. s. p. o. l. i. t. e. q. u. i. b. f. o. r. a.
 h. e. e. s. t. e. q. u. a. l. i. t. a. t. o. r. a. t. i. o. n. e. t. o. t. a. l. i. s. e. i. t. e. q. u. a. d. i. a. e. r. i. t. s. u. m. i. t. e. r. b. y. t. o. t. a. l. i. s. d. i. r.
 e. c. t. i. o. n. e. e. q. u. a. l. i. t. a. t. o. r. a. t. i. o. n. e. p. r. o. b. a. t. u. m. s. i. m. i. l. i. t. e. r. a. n. d. o. m. i. n. i. s. t. r. u. c. t. i. o. n. e. s. i. t. p. e. r.
 e. q. u. a. l. i. t. a. t. e. m. l. i. n. e. a. r. u. m. f. i. c. i. a. b. t. u. s. e. t. e. s. s. e. n. t. i. a. l. i. t. a. t. e. m. a. n. g. u. l. o. r. u. m. p. r. i. m. i. s. s. a. e. e. r. i. t. e. r. i. t. u. s.
 c. i. r. c. u. l. u. s. q. u. o. z. p. a. t. e. r. p. r. o. p. o. s. i. t. i. o. n. e. p. r. i. m. i. s. s. a. e. e. r. i. t. u. s. i. n. t. r. a. i. n. o. g. e. d. i. q. z. i. t. u. p. e. r. a. d. i. a. m. e. t. r. u. m.
 d. e. c. e. n. t. r. u. m. o. u. s. s. i. m. p. l. i. c. i. t. e. e. s. t. p. r. o. p. o. s. i. t. i. o. n. e. 14. b. c. i. n. t. r. o. d. u. c. t. o. s. i. t. m. l. a. d.



Intra propositum circulum. exagonum equilaterum atqz
 equiangulum describere. **Propositio 15.** b. c. i. n. t. r. o. d. u. c. t. o. s. i. t. m. l. a. d.
 U. e. i. t. e. t. p. r. i. m. a. e. a. t. u. s. p. e. n. t. a. g. o. n. u. m. e. q. u. i. l. a. t. e. r. u. m. a. t. q. z. e. q. u. i. a. n. g. u. l. o. s.
 quia de alijs non est necessarium hoc esse possibile. a. b. c. d. e. f. s. i. c. o. l. o. q. u. o. c. a. i. p. s. u. m. d. e. s. c. r. i. b. e. r. e. c. i. r. c. u. l. u. m.
 hoc est q. d. i. c. t. u. m. c. o. n. v. e. r. s. a. 12. D. u. o. c. i. n. s. p. p. l. i. m. i. t. a. t. i. o. n. e. a. n. g. u. l. o. r. u. m. q. u. i. s. u. n. t. i. n. z. e. c. e. n. t. r. u. m.
 p. e. q. u. a. l. i. t. a. t. e. m. l. i. n. e. a. r. u. m. f. i. c. i. t. e. q. u. o. n. t. q. z. c. o. n. c. u. r. r. a. n. t. i. n. t. r. a. i. p. s. u. m. p. e. n. t. a. g. o. n. u. m. i. n. p. e. n. t. a. d. f. e. d. u. e. n. t. e. m. i. n. t. r. a. p. e. n. t. a.
 s. o. n. u. m. n. e. p. r. o. b. a. t. u. m. e. i. t. e. m. p. r. i. m. i. s. s. a. e. a. p. u. n. c. t. o. c. o. n. c. u. r. r. a. n. t. a. d. r. e. c. t. a. n. g. u. l. o. s. l. i. n. e. a. r. u. m. q. u. e. s. u. n. t. f. i. b. a. f. e. d. e. m. p. o. l. a. t. e. r. a. a. f. i. c. i. a. b. t. r. i. a. n. g. u. l. u. s. f. b. f. e. q. u. i. e. q. u. a. l. i. t. a. t. u. s. o. b. o. b. a. l. e. t. u. s. a. f. e. d. e. m. t. r. i. a. n. g. u. l. u. s. a. f. i. c. i. a. b. t. u. s. i. n. t. r. i. a. n. g. u. l. o. a. f. i. c. i. a. b. t. u. s. i. n. t. r. i. a. n. g. u. l. o. a. f. i. c. i. a. b. t. u. s. i. n. t. r. i. a. n. g. u. l. o. a. f. i. c. i. a. b. t. u. s. e. r. i. t. e. t. p. r. i. m. i. s. s. a. e. a. n. g. u. l. o. s. e. t. a. n. g. u. l. u. s. b. i. f. i. s. i. b. i. s. a. n. g. u. l. o. s. p. o. l. i. t. e. q. u. i. b. f. o. r. a. h. e. e. s. t. e. q. u. a. l. i. t. a. t. o. r. a. t. i. o. n. e. t. o. t. a. l. i. s. e. i. t. e. q. u. a. d. i. a. e. r. i. t. s. u. m. i. t. e. r. b. y. t. o. t. a. l. i. s. d. i. r. e. c. t. i. o. n. e. e. q. u. a. l. i. t. a. t. o. r. a. t. i. o. n. e. p. r. o. b. a. t. u. m. s. i. m. i. l. i. t. e. r. a. n. d. o. m. i. n. i. s. t. r. u. c. t. i. o. n. e. s. i. t. p. e. r. e. q. u. a. l. i. t. a. t. e. m. l. i. n. e. a. r. u. m. f. i. c. i. a. b. t. u. s. e. t. e. s. s. e. n. t. i. a. l. i. t. a. t. e. m. a. n. g. u. l. o. r. u. m. p. r. i. m. i. s. s. a. e. e. r. i. t. e. r. i. t. u. s. c. i. r. c. u. l. u. s. q. u. o. z. p. a. t. e. r. p. r. o. p. o. s. i. t. i. o. n. e. p. r. i. m. i. s. s. a. e. e. r. i. t. u. s. i. n. t. r. a. i. n. o. g. e. d. i. q. z. i. t. u. p. e. r. a. d. i. a. m. e. t. r. u. m. d. e. c. e. n. t. r. u. m. o. u. s. s. i. m. p. l. i. c. i. t. e. e. s. t. p. r. o. p. o. s. i. t. i. o. n. e. 14. b. c. i. n. t. r. o. d. u. c. t. o. s. i. t. m. l. a. d.

Figure 71: Euclid, Elementa geometriae (Elements), translated by Adelard of Bath (Adelardus Bathoniensis), edited by Johannes Campanus, 25 May 1482, ISTC No. ie00113000, GW 9428; Image: Library of Congress, Incun. 1482 .E8616, 2 Copy, with diagram of Book III, Proposition 13 (recto) and 14 (verso) in transmitted light, viewed from verso.

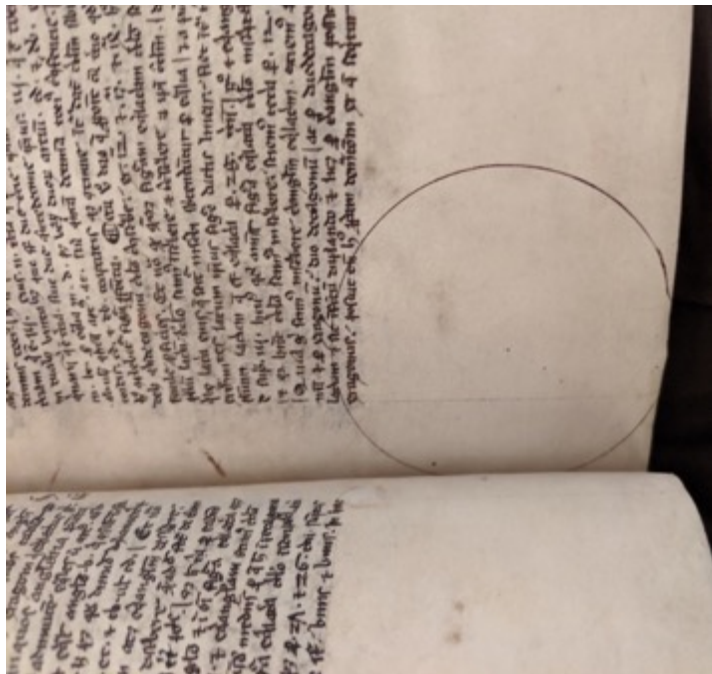


Figure 72: Euclid, translated by Adelard of Bath, Elements, written in Gothic and Gothic cursive, France, first half of the 14th century, Latin, 215 x 150mm, on parchment, London, British Library, Harley 5405, f. 36r, image of circular diagram overlapping text.

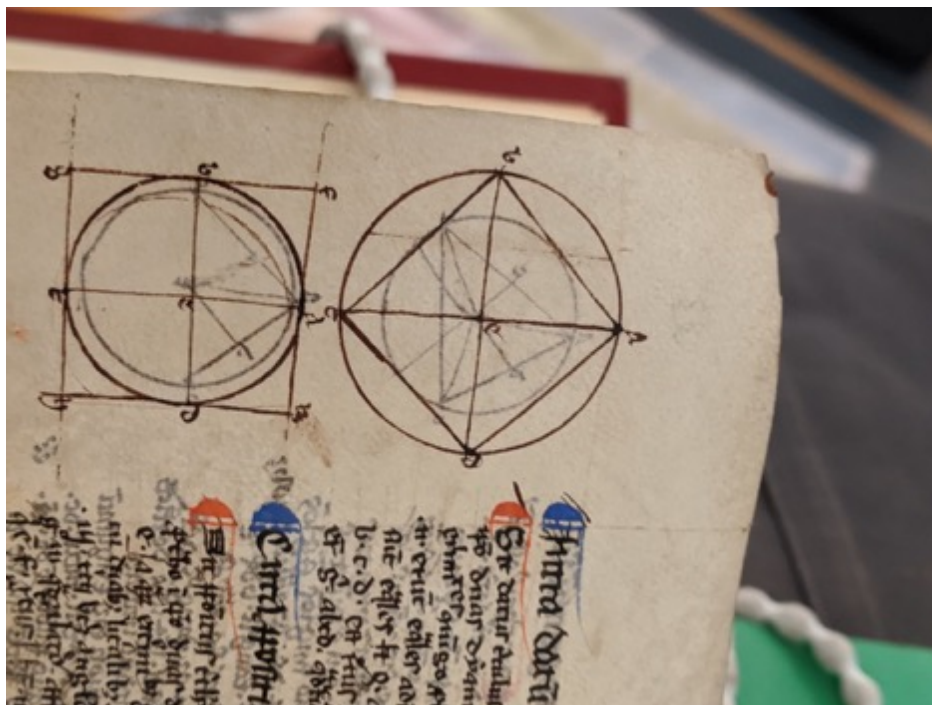


Figure 73: Euclid, translated by Adelard of Bath, Elements, written in Gothic and Gothic cursive, France, first half of the 14th century, Latin, 215 x 150mm, on parchment, London, British Library, Harley 5405, f. 33 verso, diagram with triangle circumscribed by a circle.



Figure 74: Burney MS 275, 1309–1316, Scholastic miscellany, made for Franciscus Caracciolo of Naples, chancellor of Paris, containing twenty-one treatises and works comprising the scholastic Trivium and Quadrivium, including works on grammar, rhetoric, logic, mathematics, geometry, astronomy, and music. ff. 293r-335r: Adelard of Bath's translation of Euclid's Elements. f. 327r–327v show two circular diagrams sharing a center.

IVS

introductionum Ioannis de sacrobosco
t. adiunctus. Argumentum autoris.

sphaera inuentor pro
ufas expugnaret: in
olebat. Apud autem
ductorio astronomi
quid est q̄ quale ali
idem est cognoscere
:sphaera:centr̄: axis:
tur.

culi qua (fixa diame
at. Et haec descriptio
abeatur. Sphaera est
li stanteq̄ diametro)
d solidum circunscri
endo: tangi imagina
is nihil referat.

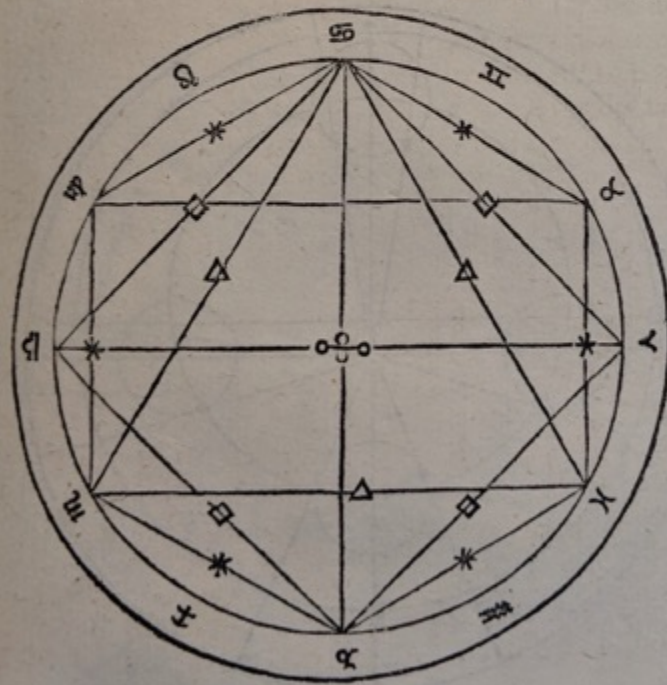
erte docet (quãtum
:sphaeram:cuius uti
ices multis auri pon
ria figuras torno ex
rcino supra quãcũq̄
usq̄ excauetur: quin
m circunferẽtiamq̄
ptus: exurget instru
is) aptissimum. Hanc

intendebat cum diceret sphaeram esse tran
im suum redeat circunducitur: abditã: ocul
bylosophi passim miro ingenio sua secreta:
puia sint.



Figure 76: Johannes de Sacrobosco, Sphaera Mundi, Comm: Cecco d'Ascoli, Franciscus Capuanus, Jacobus Faber Stapulensis. Add: Georgius Purbachius: Theoricae novae planetarum, Venice: Simon Bevilaqua, 1499, ISTC no. ij00419000, GW M14635. Image: London, British Library, IB.23996, Diagram describing sphere created from the rotation of a semi-circle.

etiā omniū eorū oppositū accidit: tunc quarto die contingit eā
 apparere. Aspectus planetarū trinus est cū p̄ tertiā ptē. Quadratus
 cum p̄ quartā. Sextilis uero cū p̄ sextam eclipticę partē eorū
 uera loca distiterint. Coniunctio media planetarū fit quādo
 lineę mediꝝ motuū eorū s̄m longitudinem zodiaci con
 iungunt. Vera autē quando lineę uerorū motuū sic conueniūt.
 Sed uisibilis quando lineę ab oculo nostro p̄ centra corporum
 suorū eductę coniungunt in unū. Similiter de oppositione me
 dia & uera dicendum. Et attendunt hęc in eisdem signo gradu
 & minuto. Ex isto p̄ sepe coniūctionē uerā esse q̄n media p̄ces
 sit aut futura ē. sepe etiā uerā eē q̄n tñ uisibilis nō est. aliqñ etiā
THEORICA ASPECTVVM ET RADIORVM.



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Figure 77: Johannes de Sacrobosco, *Sphaera mundi*, Add: Georgius Purbachius: *Theoricae novae planetarum*. Regiomontanus: *Disputationes contra Cremonensia deliramenta*, Venice: Erhard Ratdolt, before 4 November, 1485, ISTC No. ij00406000, GW M14654. Image: London, British Library, IA.20546, folio containing “Theorica aspetuum et radiorum” (Theory of Aspects diagram, zodiac).

uisibile uerā p̄cedere: q̄nq; uero sequi. Locus uerus astri ē p̄tē/
ctus firmamēti lineā a centro mūdi p̄ centrū astri p̄tentā ē p̄tē/
nās. Locus autē uisus siue apparēs p̄ lineā ab oculo p̄ centrū astri
p̄tractā determinat. Diuersitas astri ē arc⁹ circuli magni p̄ ze/
nith & uerū locū astri transeūtis inter locū astri uerū & apparen/
tem intercept⁹. Inde manifestū ē quāto uicini⁹ astrū centro mū/
di & horizonti fuerit tāto maiorē h̄re diuersitatē aspect⁹. Hāc
quoq; maximā in luna repiri. In Marte uero nō bñ p̄ceptibile
Habet nāq; semidiameter terrē sensibilē ad semidiametrū or/
bis lunę; nō multū autē p̄ceptibile ad semidiametrū orbis Mar/
**THEORICA CONIUNCTIONIS ET
OPPOSITIONIS LVMINARIVM.**

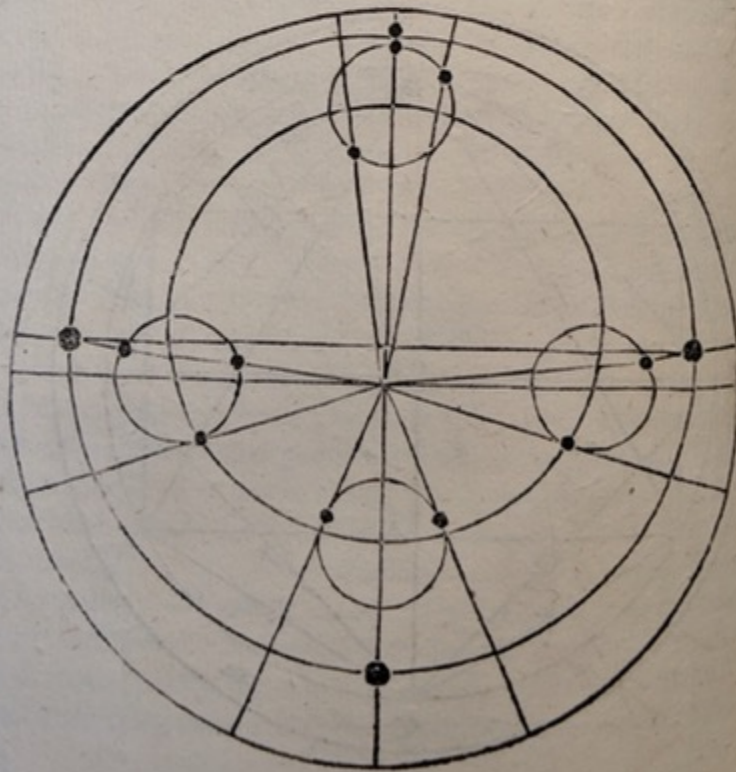


Figure 78: Johannes de Sacrobosco, *Sphaera mundi*, Add: Georgius Purbachius: *Theoricae novae planetarum*. Regiomontanus: *Disputationes contra Cremonensia deliramenta*, Venice: Erhard Ratdolt, before 4 November, 1485, ISTC No. ij00406000, GW M14654. Image: London, British Library, IA.20546, folio containing *Theorica coniunctionis et oppositionis* (Theory of conjunction and opposition [of planets]).



Figure 79: Johannes de Sacrobosco, *Sphaera mundi*, Add: Georgius Purbachius: *Theoricae novae planetarum*.
 Regiomontanus: *Disputationes contra Cremonensia deliramenta*, Venice: Erhard Ratdolt, before 4 November, 1485,
 ISTC No. ij00406000, GW M14654. Image: London, British Library, IA.20546, folio raised with both diagrams
 visible in transmitted light.



Figure 80: Johannes de Sacrobosco, Sphaera mundi, Add: Georgius Purbachius: Theoricae novae planetarum. Regiomontanus: Disputationes contra Cremonensia deliramenta, Venice: Erhard Ratdolt, before 4 November, 1485, ISTC No. ij00406000, GW M14654. Image: Library of Congress, QB144 .S643 1485, Theorica Minutorum Proportionalium Lunae.

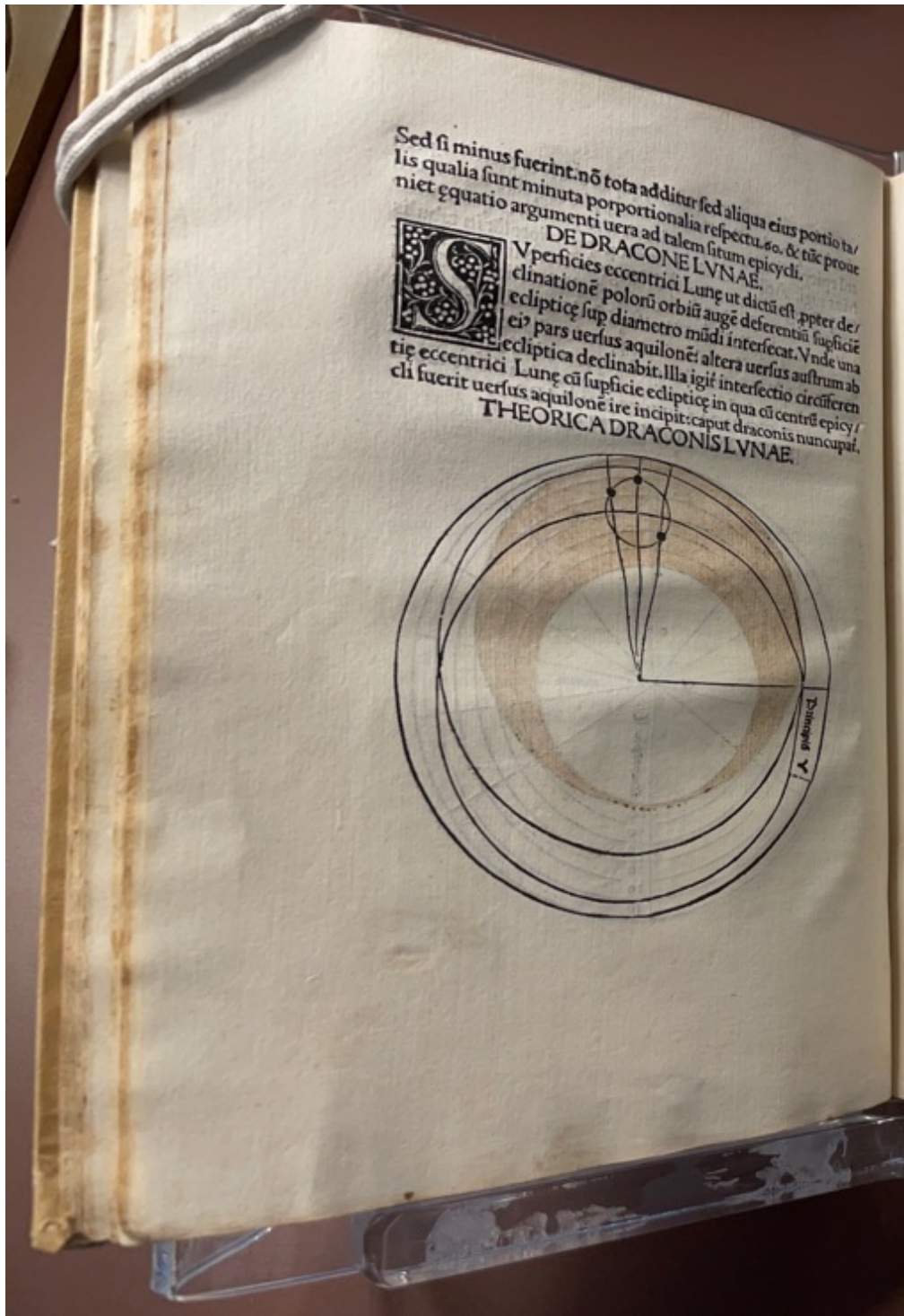


Figure 81: Johannes de Sacrobosco, Sphaera mundi, Add: Georgius Purbachius: Theoricae novae planetarum.
 Regiomontanus: Disputationes contra Cremonensia deliramenta, Venice: Erhard Ratdolt, before 4 November, 1485,
 ISTC No. ij00406000, GW M14654. Image: Library of Congress, QB144 .S643 1485, Theorica Draconis Lunae.



Figure 82: Johannes de Sacrobosco, Sphaera mundi, Add: Georgius Purbachius: Theoricae novae planetarum. Regiomontanus: Disputationes contra Cremonensia deliramenta, Venice: Erhard Ratdolt, before 4 November, 1485, ISTC No. ij00406000, GW M14654. Image: Library of Congress, QB144 .S643 1485, with Theorica Minorum Proportionalium Lunae (recto) and Theorica Draconis Lunae (verso) in transmitted light.



Figure 83: Johannes de Sacrobosco, Sphaera mundi. Add: Gerardus Cremonensis: Theorica planetarum, Venice: Franciscus Renner, de Heilbronn, 1478. ISTC No. ij00402000, GW M14655. Image: Fondazione Giorgio Cini, FOAN TES 722.

Virgo infra pedes boetis collocata capite posteriore
 partem leonis: dextra manu circulum æstiuale tan-
 git: ac inferiore partē corporis: supra coruum & hy-
 dra: caudam habere perspicit. Occidens capite pro-
 usq̄ reliquis membris. huius in capite est stella una
 obscura. in utrisq̄ humeris singula. in utrisq̄ pennis binæ: quas
 rum una stella quæ est in dextra pēna ad humerum defixa pro-
 trigot uocatur. Præterea habet in utrisq̄ manibus singulas stel-
 las: quarum una quæ est in dextra manu: maior & clarior con-
 spicitur. In ueste autem habet passim dispositas stellas septem.
 in utrisq̄ pedibus singulas. Omnino stellarū numerus. xvi

Virgo



Figure 84: Julius Hyginus, *Clarissimi viri Hyginii Poeticon astronomicum opus utilissimum foeliciter incipit*. Venice: Thomas de Blavis de Alexandria (containing woodblocks used by Erhard Ratdolt's edition of 22 Jan 1485), June 1488. ISTC No. ih00562000, GW13680. Image: San Marino, California, Huntington Library 717870, with diagram of Virgo constellation with darkened folio suggesting possible tracing.



Figure 85: Reliquary of the arm of St. George, Interior casing: Byzantine, Before 1204. Exterior: Venetian before 1325. Finial of St. George and the dragon: Venetian, 1325 and 16th century. Interior casing: silver-gilt. Exterior: silver-gilt, enamel (the original crystal lid has been replaced with a glass one). Height 519mm, width at top 117mm. Listed in the 1325 inventory: II, no. 4.



Figure 86: Beaker, Translucent calcedonio glass (vetri calcedonii), blown, Conical bowl with fire-polished rim applied to pedestal foot with infolded rim and pontil mark. Remnant of paper label of Bodenheim Collection, no. 854, glued to underside of foot. 150099, Venice, Corning Museum of Glass, 61.3.1.



Figure 87: Goblet, Calcedonio glass with mould-blown, applied and tooled features, late fifteenth century c. 1500, 18 cm x 12.1 cm, London, Wallace Collection, C513.



Figure 88: Goblet, Calcedonio glass with mould-blown, applied and tooled features, late fifteenth century c. 1500, 18 cm x 12.1 cm, London, Wallace Collection, C513, with alternate lighting conditions.



Figure 89: Glass goblet and bottle, millefiori and gold leaf; vertically ribbed, clear glass body incorporating sections of millefiori canes. Venice, c. 1500, 11.5 cm, British Museum S.796 and S. 797, glass between rosettes is opaque when objects are standing.

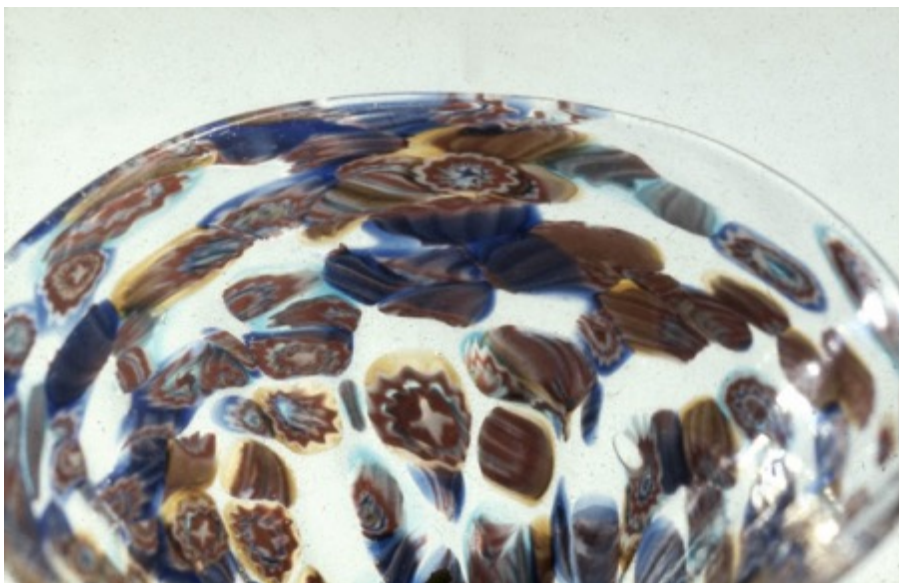


Figure 90: Alternate view of goblet, British Museum S.797, indicating glass between rosettes is transparent when object is tilted.



Figure 91: Attributed to Jacopo de' Barbari, portrait of Luca Pacioli and pupil (possibly Guidobaldo da Montefeltro?), c. 1495/1500, tempera on panel, 99cm x 120 cm, Capodimonte Museum, Naples.



Figure 92: Attributed to Jacopo de'Barbari, portrait of Luca Pacioli and pupil (possibly Guidobaldo da Montefeltro?), c. 1495-1500, tempera on panel, 99cm x 120 cm, Capodimonte Museum, Naples, with detail of glass rhombicuboctahedron.



Figure 93: Vittore Carpaccio, Vision of St. Augustine, Scuola di San Giorgio degli Schiavoni (also Scuola Dalmatia) c. 150109, tempera on panel, in artificial light.



Figure 94: Vittore Carpaccio, Vision of St. Augustine, Scuola di San Giorgio degli Schiavoni (also Scuola Dalmatia) c. 150109, tempera on panel, in artificial light. Detail with illuminated manuscript.



Figure 95: St. Jerome and the Lion, Scuola di San Giorgio degli Schiavoni (also Scuola Dalmatia), Tempera on canvas, 141 x 211 cm., c. 1502.



Figure 96: Funeral of St. Jerome, Scuola di San Giorgio degli Schiavoni (also Scuola Dalmatia), tempera on canvas, 141 x 211 cm, 1502.



Figure 97: Vittore Carpaccio, Vision of St. Augustine, Scuola di San Giorgio degli Schiavoni (also Scuola Dalmatia) c. 150109, tempera on panel, photographed with natural light entering from the nearby transom window to the right.



Figure 98: Antonello da Saliba's Virgin Annunciate (Annunciata), 1480, Painted in Venice, now in the Gallerie dell'Accademia di Venezia, Cat. #590.

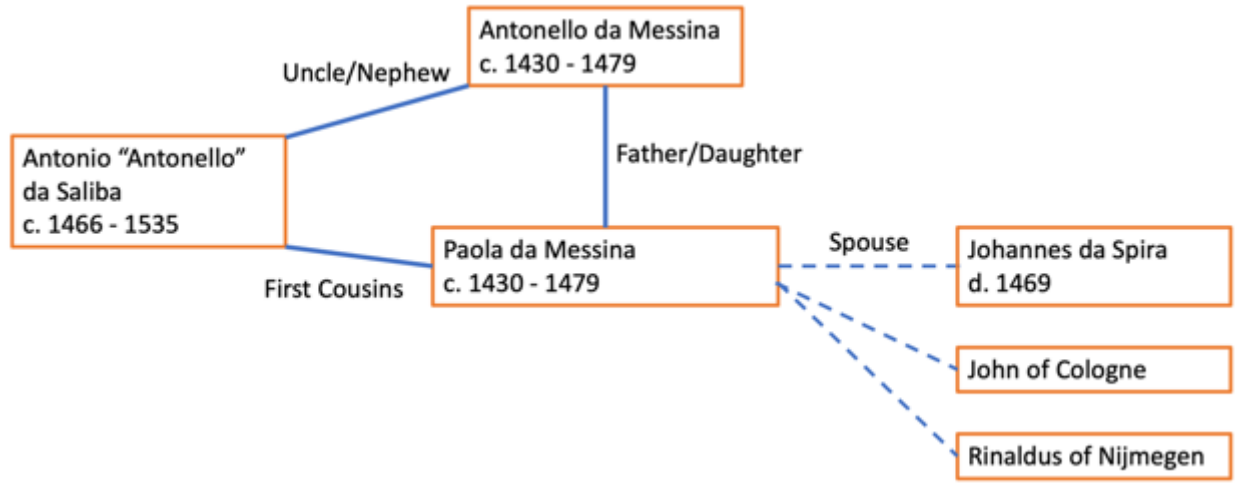


Figure 99: Diagram of Relationships between Antonello da Saliba, Paola da Messina and her printer spouses.



Figure 100: So-called “Mascoli” chapel (known as Cappella Nuova until the seventeenth century), St. Mark’s Basilica, with dark exterior (left) and light through oculus window (right), designed by Michele Giambono commissioned by Doge Francesco Foscari, dedicated 1430.



Figure 101: Erhard Ratdolt, commissioned by Friedrich von Zollern, Bishop of Augsburg, Obsequiale, Augsburg, 1 February 1487, four-color woodcut depicting the patron.



Figure 102: Albrecht Dürer, Study of a Female Nude seen from the Front with Construction Lines and Alteration to her Left Leg, 1500, pen and brown ink with green wash, British Museum, Bequeathed by Sir Hans Sloane, (SL,5218.184).

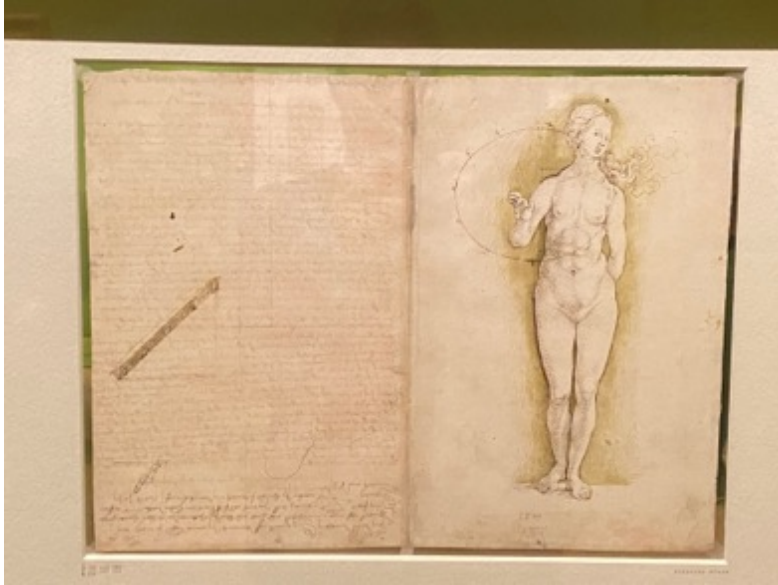


Figure 103: Albrecht Dürer, Study of a Female Nude seen from the Front with a Foreshortened Circle, 1500, pen and brown ink with green wash, British Museum, Bequeathed by Sir Hans Sloane, (SL,5218.184).

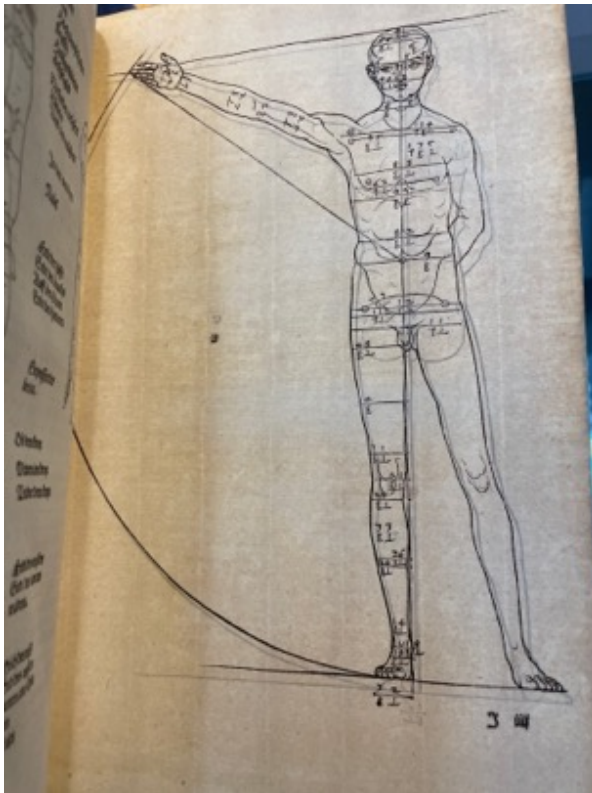


Figure 104: Albrecht Dürer, Four Books on Human Proportion (Vier Bücher von menschlicher Proportion), fol. L4r with fol. 14v visible in transmitted light, published posthumously by Willibald Pirckheimer in 1528.

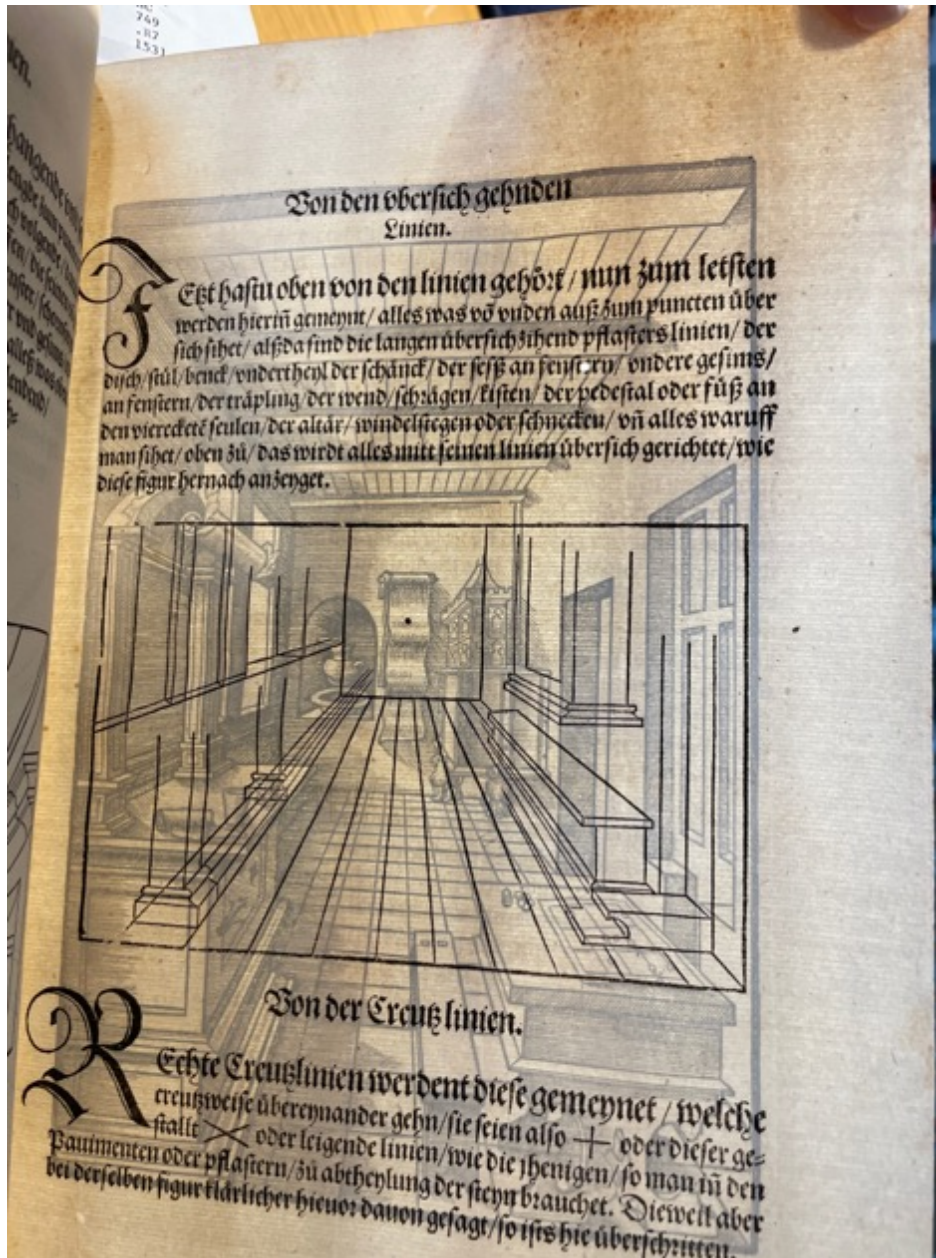


Figure 105: Hieronymus Rodler, [...] Instruction on the Art of Measuring [...] (Eyn schön nützlich büchlin und underweisung der kunst des Messens [...]), published in Simmern, 1531, transfoliate diagrams from a section describing single-point perspective.

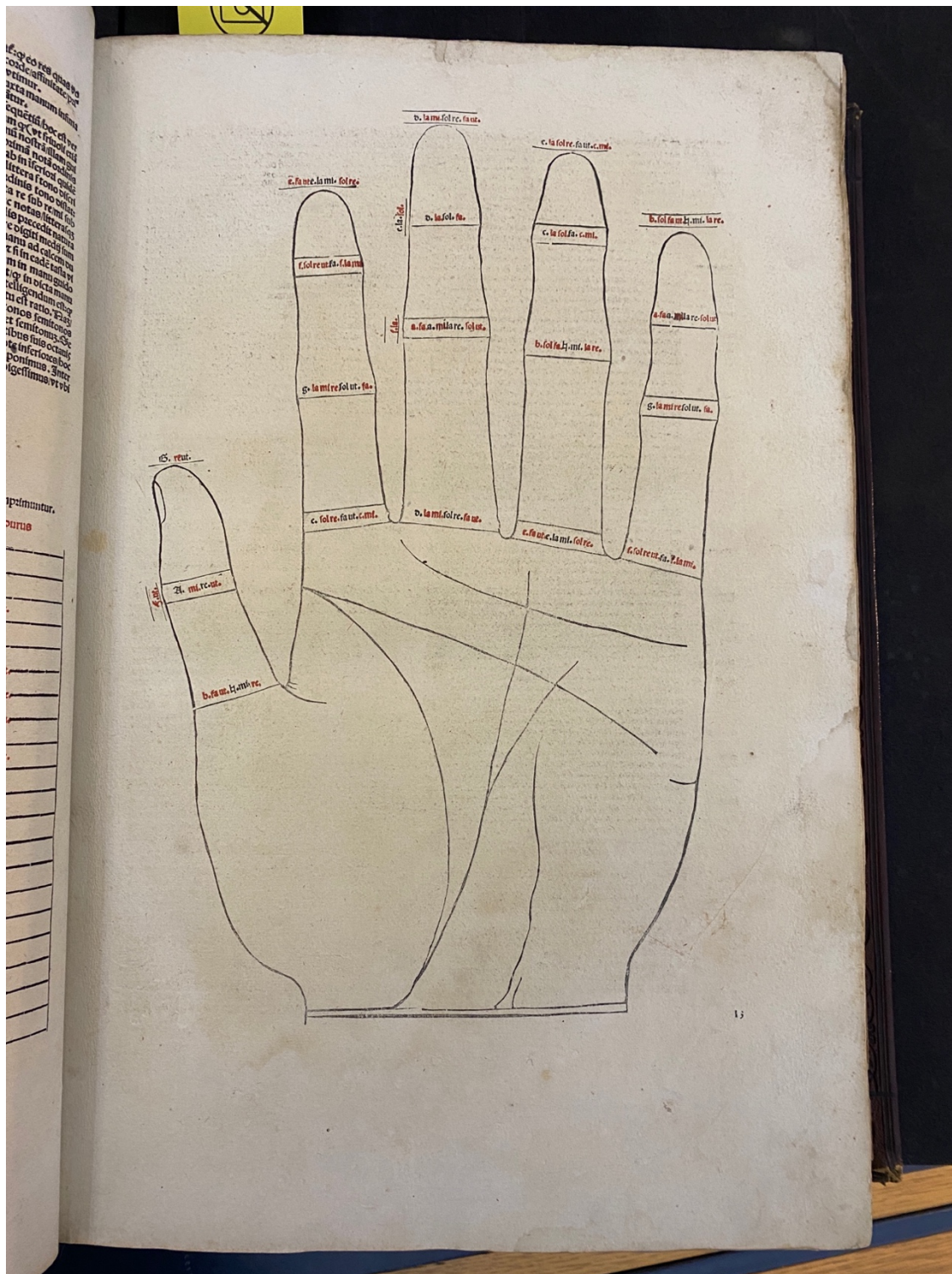


Figure 106: So-called “Guidonian Hand” from Antiphonary printed by Johann Emerich for Lucantonio Giunta in Venice, 15035(?), ISTC: IA00774000, photo of British Library, C.18.e.9, fol. 13r.



Figure 107: Giovanni Bellini, San Giobbe Altarpiece (Madonna and child enthroned with musician angels, Saints Francisco, John the Baptist, Jobe, Domenico, Sebastian and Louis of Tolouse), c. 1487, oil on panel, now in the Gallerie dell'Accademia, Venice. Cat. 38.

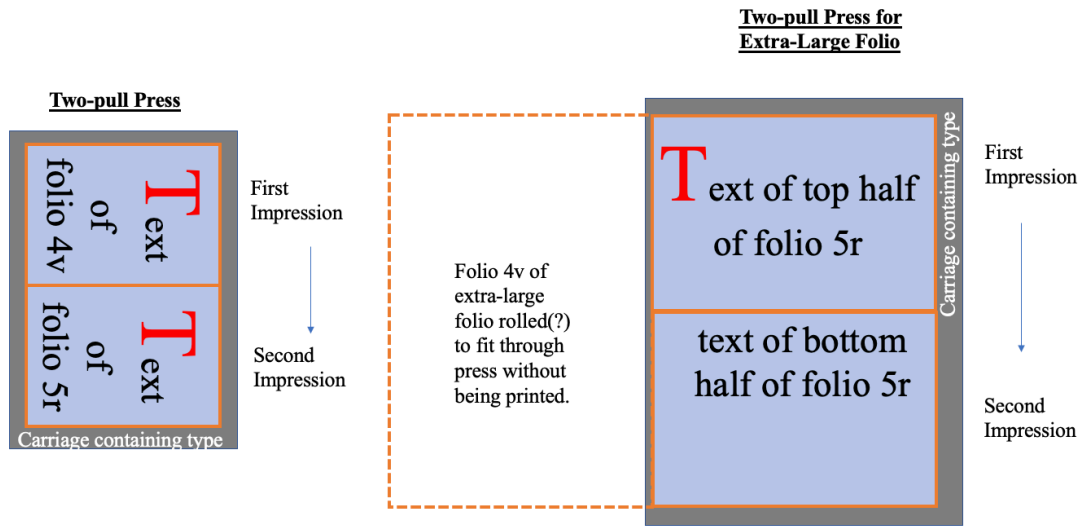


Figure 108: Proposed application of two-pull press technology for extra-large folio of Gradual and Antiphonal.



Figure 109: Graduale Romanum, edited by Franciscus de Brugis, printed by Johannes Emericus de Spira for Lucantonio Giunta in Venice, between 28 September 1499 and 1 March 1500 (m.v.), ISTC No. ig00332000, photo from Biblioteca Apostolica Vaticana, folio 26v, containing printer error Initial O.

XXXI 32

ra fui te do mino
in le tici a i trate i o spectue
ius i exultatio ne qui a do
minus ip se est de'. **A** i li
qd fecisti. **B** sic: ego z pat tu'
tolentes q'rebam' te z qd e' q' me
q'rebatis nesciebatis qa in his q'

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Figure 110: Graduale Romanum, edited by Franciscus de Brugis, printed by Johannes Emericus de Spira for Lucantonio Giunta in Venice, between 28 September 1499 and 1 March 1500 (m.v.), ISTC No. ig00332000, photo of Biblioteca Apostolica Vaticana, fol. 31r containing erroneous text printed over a rubricated initial.

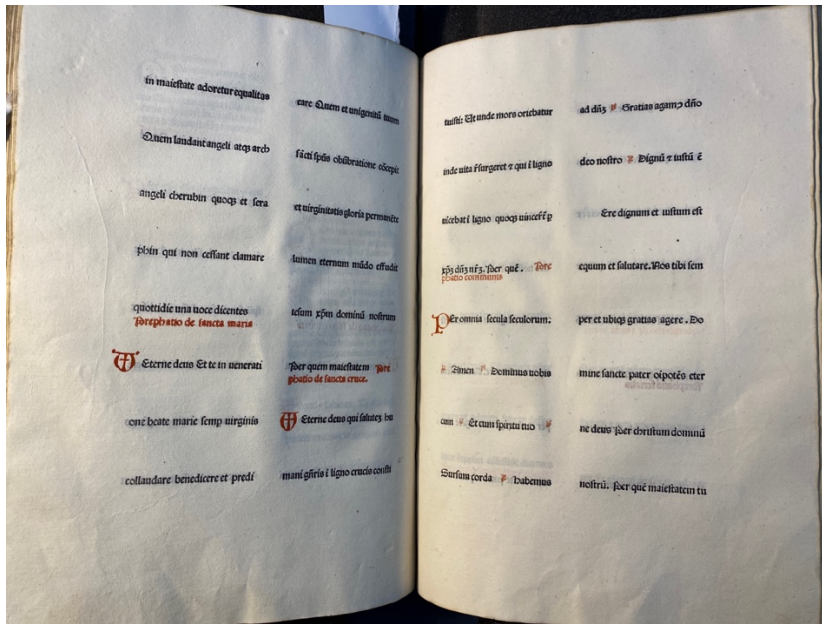


Figure 111: Space left blank for the manuscript inclusion of musical notation in the Missale Romanum published in Venice by Alvisius de Siliprandis, 20 September 1477. ISTC No. im00689100, photograph of British Library IB.20702.

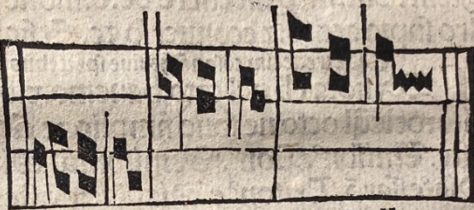


Figure 112: Lines printed for manuscript musical notation in the Missale Romanum by Phlippus de Rotingo published in Venice by Nicolaus de Frankfordia, 1487. ISTC No. im00701000, photograph of British Library IA.22043, fol. 63r.

Itē nota ch nel cāto haue mo tre specie d toni. s. toni pfecti: toni pfectissimi: e toni impfecti. Toni pfecti sono ut re: z fa sol: tā in ascēsu q̄ in descēsu. Itē toni pfectissimi sono re mi: z sol la: solū i ascēsu: i descēsu vō sono pfecti: vt s. i figura patet zc. Itē toni ipfecti siue semitoni: sono doue si troua mi fa z fa mi: vt infra patebit zc. *De semitono tertia specie. Cap. xij.*

Item nota che semitono e vna specie impfecta cōposita d̄ doue note. Et dī semitoniū a semis. i. nō plenus z ton' tono. i. nō pieno tono. Et q̄sto se troua doue e mi fa: z fa mi: vt hic.

Itē nota ch son tre specie de semitono: cioe semitono enarmonico semitōio diatonico: z semitono cromatico. vl sic semi



tonio minore. semitono mazore. z semitono eccellente zc. El semitono enarmonico: cioe minore: e p tutto doue si troua mi fa. in ascēsu. z fa mi in descēsu: vt supra patet in figura. Itē semitono diatonico siue mazore: e p tutto doue se troua fa mi. in ascēsu. z mi fa. in descēsu. e de q̄sti se ne troua doi nela mane: quo ad ordinē naturalē. s. doue sono li b. fa. b. mi. e questo semitono se troua dal pmo b. al scdo: vt hic.

Itē el semitono cromatico siue eccellente se fa per musica ficta. s. quando de tono per musica plana faciamo semitonium per ficta musica. z q̄sti tali semitoni cromatici: siue colorati se fāno in descēsu. s. q̄n de fa: vel de ut naturalis: facimus mi: accidētalis. vt hic pz.



Argo si de tono facimus semitoniū: z ecōuerso. adūq; tonus est semitoniū: qd̄ est falsus. De q̄sta declaratiōe vedi nela Cēturina nel primo libro. s. nel. xiiij. caplo: vbi dicitur de semitono zc.

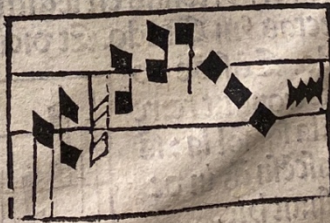


Figure 113: Bonaventura Brixianus, Regula musicae planae, printed by Jacobus Pentius de Leuco in Venice, about 1505, ISTC No. ib00973000, photo from British Library Music K.1.C.7, example of xylographic music.



Figure 114: Graduale Romanum, edited by Franciscus de Brugis, printed by Johannes Emericus de Spira for Lucantonio Giunta in Venice, between 28 September 1499 and 1 March 1500 (m.v.), ISTC No. ig00332000, photo from Biblioteca Nazionale Marciana, Venice, Rari Ven 708-709, printed on parchment with a portion of Psalm 99/100 scraped off.



Figure 115: Manuscript Graduale Romanum, dated c. 1420–30, now in the Bodleian Library, MS Add. D. 48, originally held in a northern Italian monastery dedicated to St. Peter, photo contains scraped out and re-written clef.

ni t' reple tuoz corda
 fideliu' z tui amo
 giat q' odest igne ac cede

Sequētia. Sancti spūs alit nob gra. **Df.** Q' o firma hoc de
 us qd operatus es inob a tēplo
 tu o qd est in hieru salem
 tibi of ferēt reges mune ra al.

Figure 116: Graduale Romanum, printed by Johannes Emericus de Spira for Lucantonio Giunta between 28 September and 1 March 1500 (m.v.), ISTC No. ig00332000, photo of British Library IC.24240, fol. 180r containing pastedown with manuscript chant.

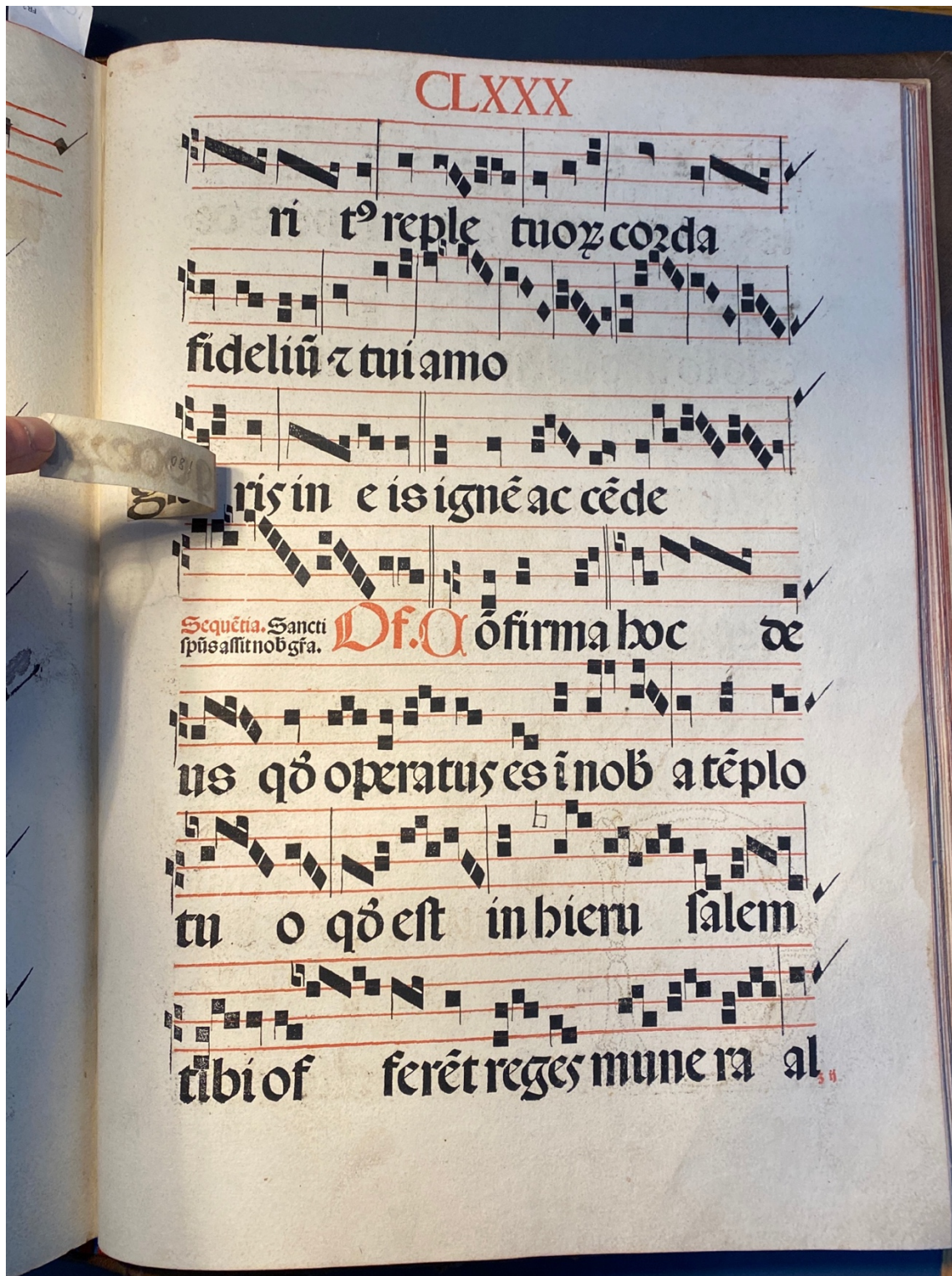


Figure 117: Graduale Romanum, printed by Johannes Emericus de Spira for Lucantonio Giunta between 28 September and 1 March 1500 (m.v.), ISTC No. ig00332000, photo of British Library IC.24240, fol. 180r containing with pastedown with manuscript chant raised to reveal printed text below.

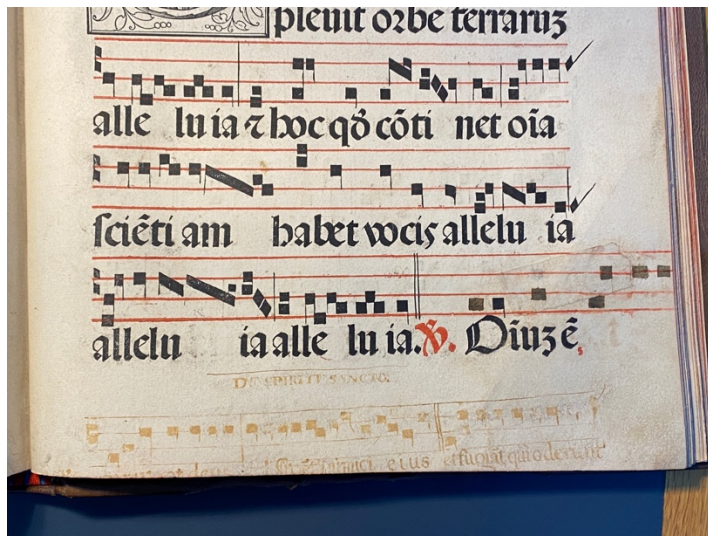


Figure 118: Graduale Romanum, printed by Johannes Emericus de Spira for Lucantonio Giunta between 28 September and 1 March 1500 (m.v.), ISTD No. ig00332000, photo of British Library IC.24240, fol. 179r and 179v, the introitus for Pentecost, with manuscript musical notation added between printed notation.

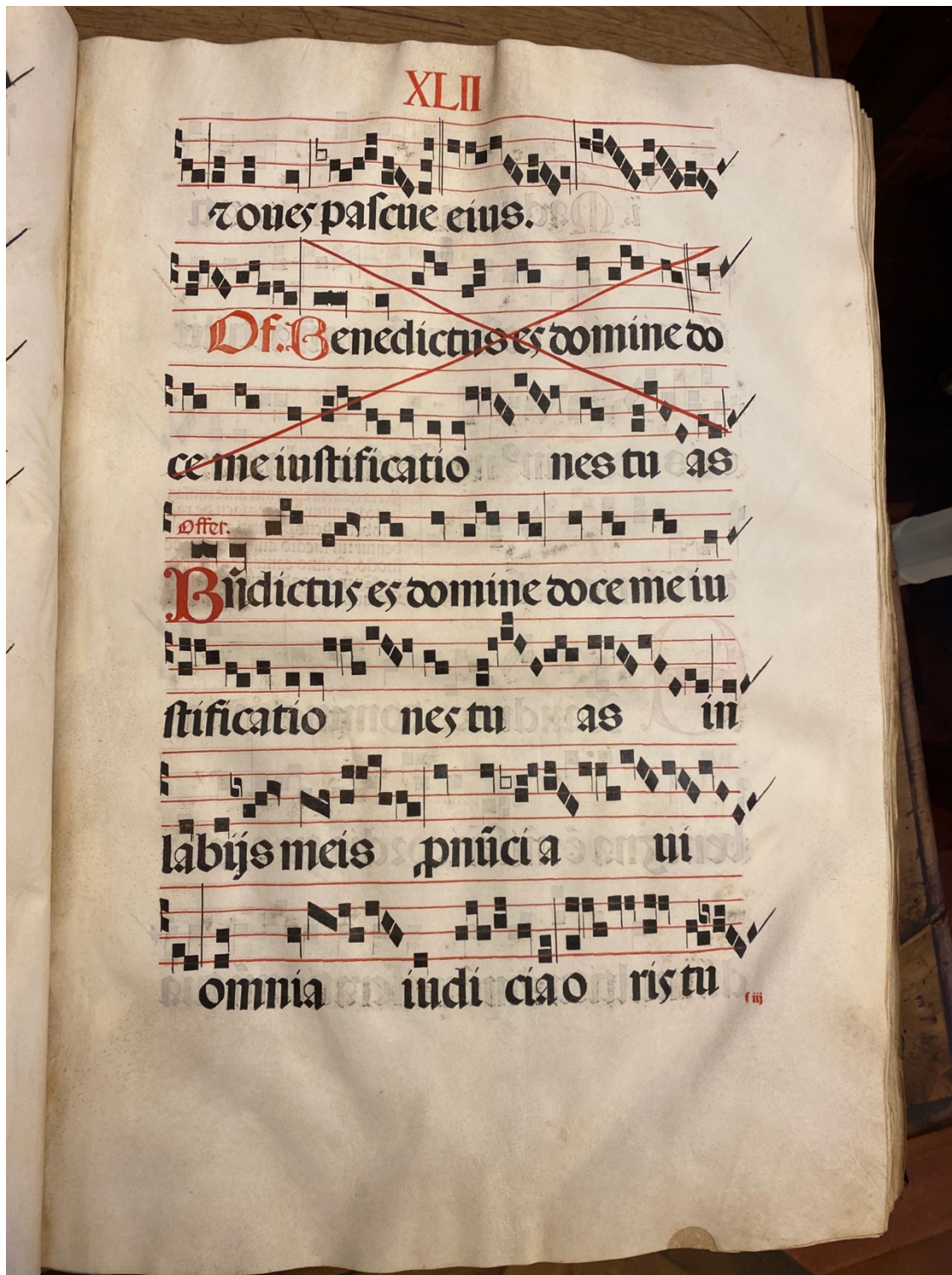


Figure 119: Graduale Romanum, printed by Johannes Emericus de Spira for Lucantonio Giunta between 28 September and 1 March 1500 (m.v.), ISTC No. ig00332000, photo of Biblioteca Nazionale Marciana Rari Ven 708, fol. 42r with red lines cancelling repeated text.

XLII

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zones pascue eius.

Of. Benedictus es domine do
ce me iustificatio nes tu as
benedictus es domine doce me iu
stificatio nes tu as in
labijs meis pnúcia ui
omnia iudi cio ristú

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Figure 120: Graduale Romanum, printed by Johannes Emericus de Spira for Lucantonio Giunta between 28 September and 1 March 1500 (m.v.), ISTC No. ig00332000, photo of Biblioteca Apostolica Vaticana Inc.S.244, fol 42r., with repeated notes scraped off.

dalla turba diabolica e deliberarono a iesu trarli fora quelle ueste e darli le sue acio fusse cognosciuto: e cossi gli fosse maggiore uergogna. E caua doli qlla ueste purpurea e coccinea sentiti itollerabili dolori renoua dose tutte le ferite: perche quello uestimento era cōgelato insieme cō il sangue & applicato al strazato corpo in modo de pelle: & denudato che fusse uillanezauano con ogni opprobrii che se potesse imaginare pareua che non potesseno faciare: o iesu quanto sei degno de compassione: iuda essendo de fora con le turbe uedendo iesu sententiato alla morte cognoscendo hauer fallito e restituendo la pecunia disse. Io ho fallito tradendo el sangue iusto e loro risposeno se hai peccato tuo sia el danno e lui desperandose senando a piccare per la gola: & crepando lanima uscite dal uentre: pero che non fu degna uscire dala bocca la quale haueua basato iesu a tradimento,

Meditatione come el nostro signore iesu porto la croce: & come fu conducto al monte caluario per esser posto in sul legno della croce: & di quelle cose che accadeteno nella uia,



A poi che d lo hebbe no tanto delezato el uestirono delle proprie uestimete. Et apparecchiata la croce alta secondo el maestro delle sententie: tre stature d homo cō quello trauerso ponderoso & iporabile. Et quelli idiauolati nō essendo permosti a nulla pietate uedendo lacera to e inclinato i

sino a terra non se poteua mouere con gran furia se la gittarno in col lo apogiata alle fracassate spale. E lo mansueto agnello inclinando lo nspinato capo: lo qual capo mai nō pote leuare da quella hora che gli

Figure 121: Saint Bonaventura, *Meditationes vitae Christi* (Le deuote meditatione sopra la passione del nostro signore), printed by Matteo Capasca (di Codeca) in Venice, 26 April, 1490, ISTC No. ib00906000, photograph from Biblioteca Corsiniana, Rome, 51.A.2 (unpaginated).

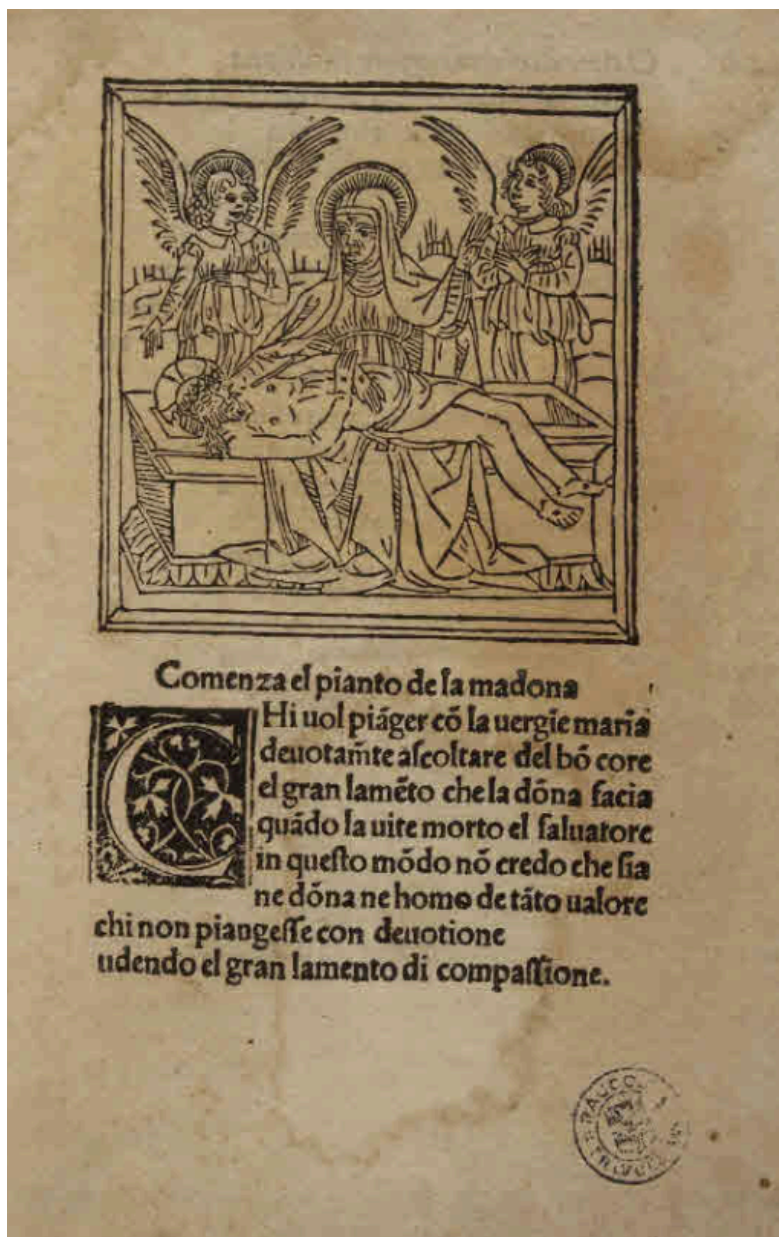


Figure 122: Lamento della Vergine Maria, published by Matteo Capasca (di Codeca) about 1490, in Venice, ISTC No. il00029200, photo from Biblioteca Trivulziana, Milan, 5638 (Indice generale degli incunaboli delle biblioteche d'Italia), fol. 1r.



Figure 123: Epistole et Evangelii, printed in Florence by Lorenzo Morgiani and Johannes Petri for Piero Pacini in 1495, fol. G4v: the Fall of Manna (exodus 15), Christ's Entry into Jerusalem, and Saint Matthew (Matthew 21); fol. G5r. ISTC No. ie00094000, photo from Washington D.C., Library of Congress, Lessing J. Rosenwald Collection (Rosenwald 298/Dyson Perrins 106).



Figure 124: Biblia (in Italian), translated by Niccolò Malermi (or Malerbi), printed by Giovanni Ragazzo for Lucantonio Giunta in Venice, 15 October, 1490, ISTC No. ib00644000, photo of Bayerische Staatsbibliothek, Munich, 2 Inc.c.a.2387 1/2, fol. 4v – 5r.



Figure 125: Graduale Romanum, edited by Franciscus de Brugis, printed by Johannes Emericus de Spira for Lucantonio Giunta in Venice, between 28 September 1499 and 1 March 1500 (m.v.), ISTC No. ig00332000, photo from Biblioteca Nazionale Marciana, Venice, Rari Ven 708-709, printed on parchment, fol. 160r with initial R with the resurrected Christ.



Figure 126: Woodblock possibly designed by Benedetto Bordon and likely cut by Jacob of Strassburg with the Circumcision of Christ appearing in the Giuntine Antiphonal printed in 150102 (ISTC No. ia00774000, photo from British Library C.18.E.9, fol. 23r) and reused as a full-page illustration in a Giuntine in Book of Hours printed in 1501 (USTC No. 819824, photo from Biblioteca Giorgio Cini, Inv. 9598, fol. 48v)



Figure 127: Andrea Mantegna, St. Sebastian, 1456/1459, oil on panel, now in the Kunsthistorisches Museum, Vienna, Gemäldegalerie, 301, 60 x 30 cm.



Figure 128: Albrecht Dürer, Saint Veronica between Saints Peter and Paul, from “The Small Passion,” Woodcut, 1510, Metropolitan Museum, 19.73.192, 12.8 x 9.8 cm.



Figure 129: Albrecht Dürer, The Sudarium Held by One Angel, 1516, Etching, Metropolitan Museum of Art, 17.72.14.



Figure 130: Officium beate Marie secundum usum Romanum (Book of Hours), printed in Venice for Lucantonio Giunta, 1501, Annunciation to the Shepherds, USTC No. 819824, photo from Biblioteca Giorgio Cini, Inv. 9598, F. 42v.

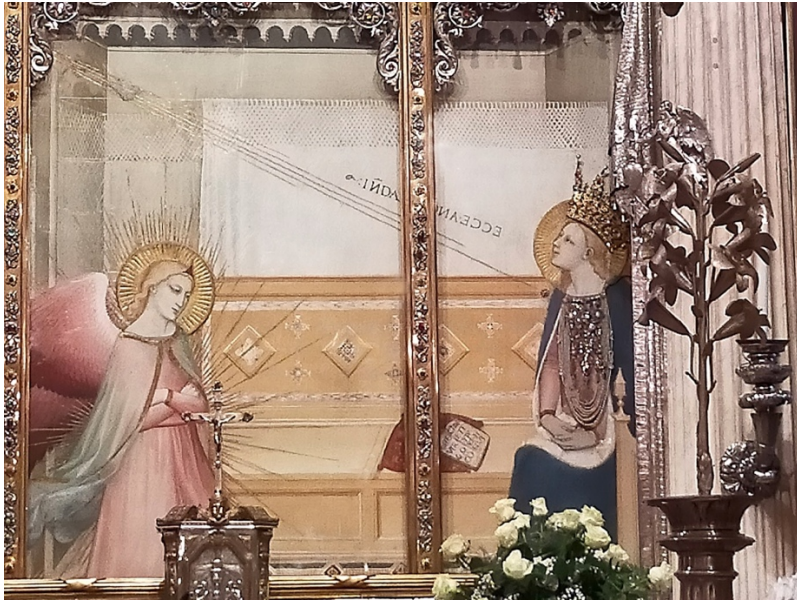


Figure 131: Fresco of the Annunciation, Florence, painted 1252 on the inner side of the façade wall of the Basilica Santissima Annunziata, image after 2020 cleaning campaign.



Figure 132: Francesco Petrarca, *De viris illustribus*/Libro degli uomini famosi, translated by Donato degli Albanzani, printed by Felix Antiquarius and Innocens Ziletus in Pojano on 1 October 1476. ISTD No. ip00415000, photo of British Library IB.32901, folio depicting Fabius Maximus.



Figure 133: Missale Romanum, published for Lucantonio Giunta in Venice, 1508, USTC No. 820083, Photo from Biblioteca Civica Angelo Mai, Bergamo, M6-26/337, fol. 148v, within the modular printed monumental frame, the text of the banderole is partially reversed.

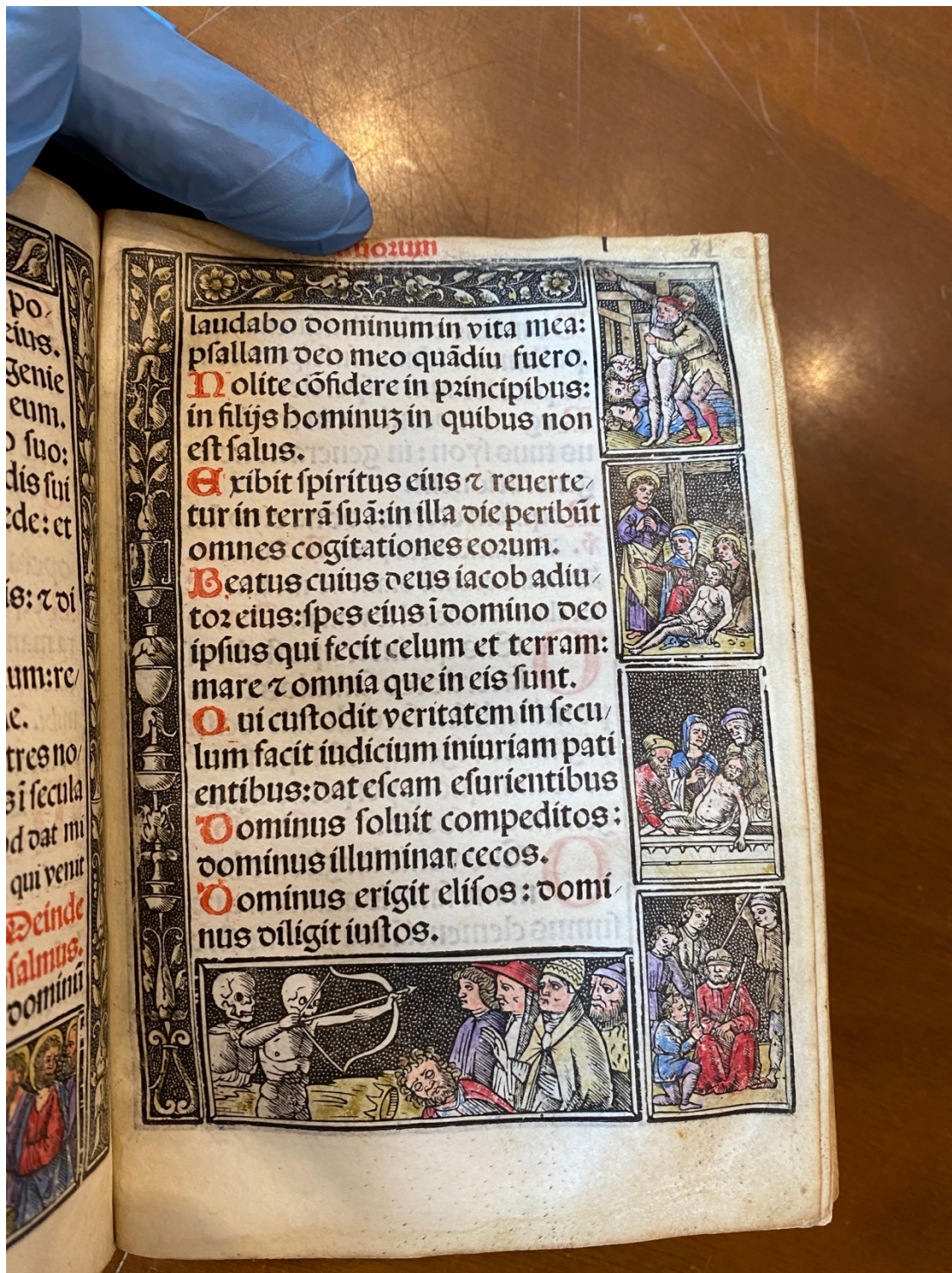


Figure 134: Officium beate Marie secundum usum Romanum (Book of Hours), printed in Venice for Lucantonio Giunta, 1501, USTC No. 819824, Photo from Biblioteca Civica Angelo Mai, Bergamo, Cassaforte 3, 6, fol. 81r, Unpainted woodblock illustration of Death, despite hand coloring throughout, this unadorned image of death also occurs on fols. 89, 96, 101, 102, 105, 105v, 116v, and 122.

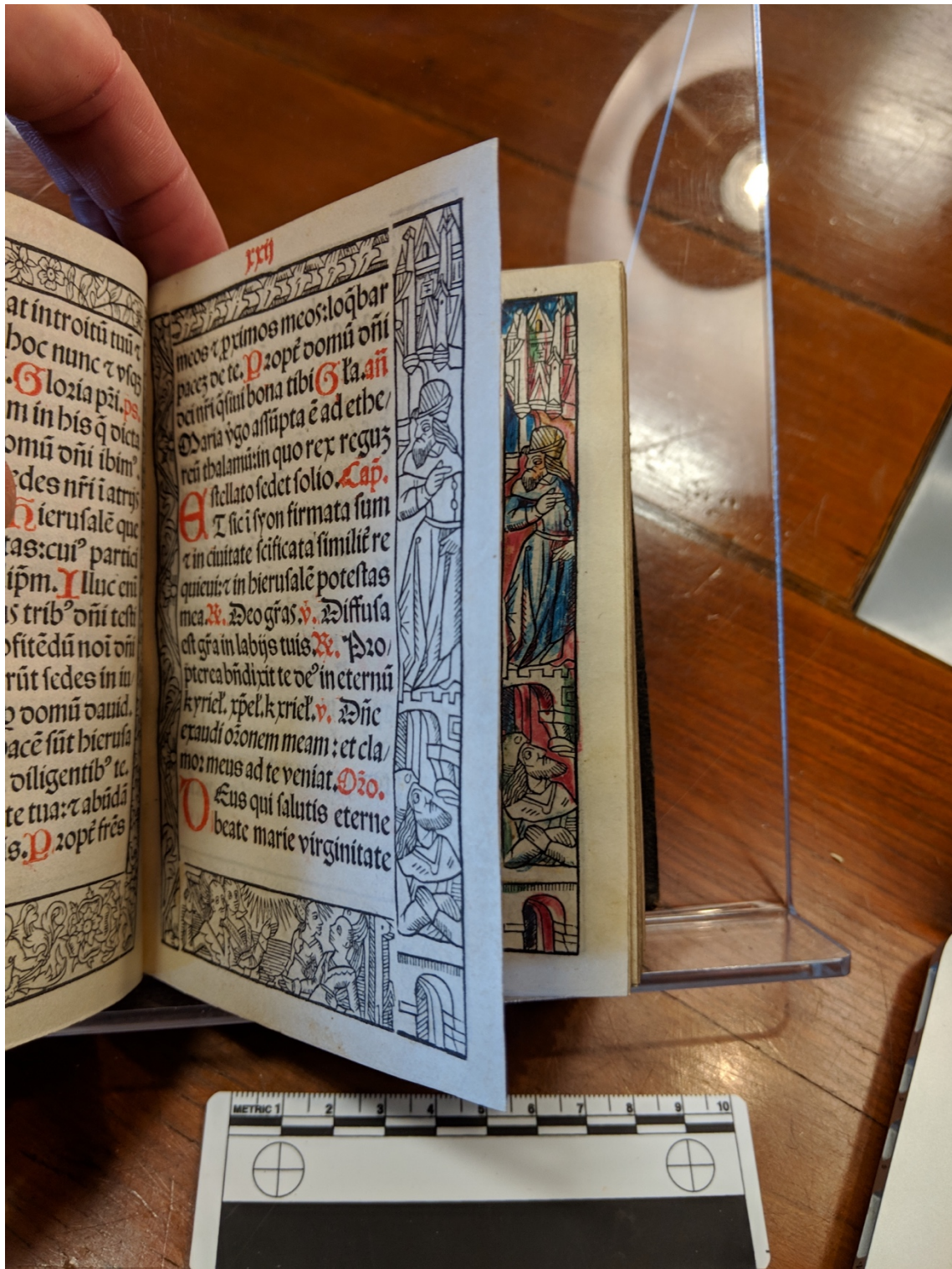


Figure 135: Officium beate Marie secundum usum Romanum (Book of Hours), printed in Venice by Johann Hamman Book of Hours, ISTC No. ih00366400, photo from Biblioteca del Museo Correr, Inc. L002, fol. 22r and 23r, containing printed and painted borders.

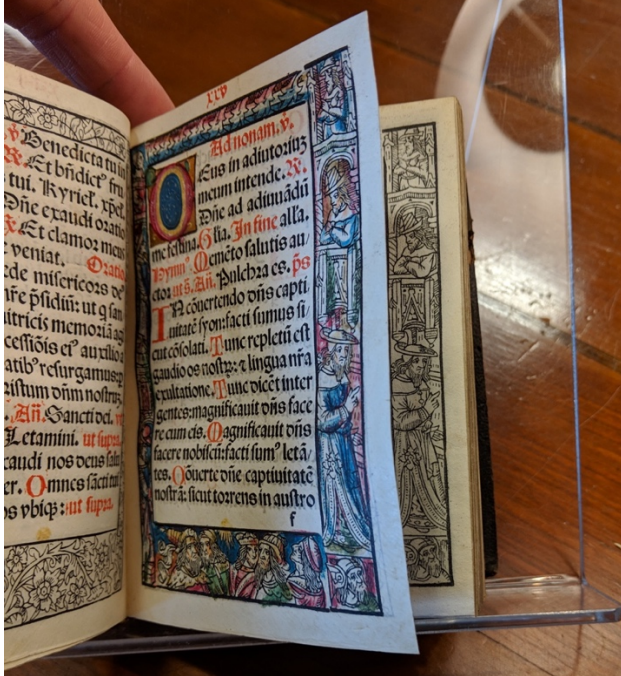


Figure 136: Officium beate Marie secundum usum Romanum (Book of Hours), printed in Venice by Johann Hamman Book of Hours, ISTC No. ih00366400, photo from Biblioteca del Museo Correr, Inc. L002, fol. 22r and 23r, containing printed and painted borders.

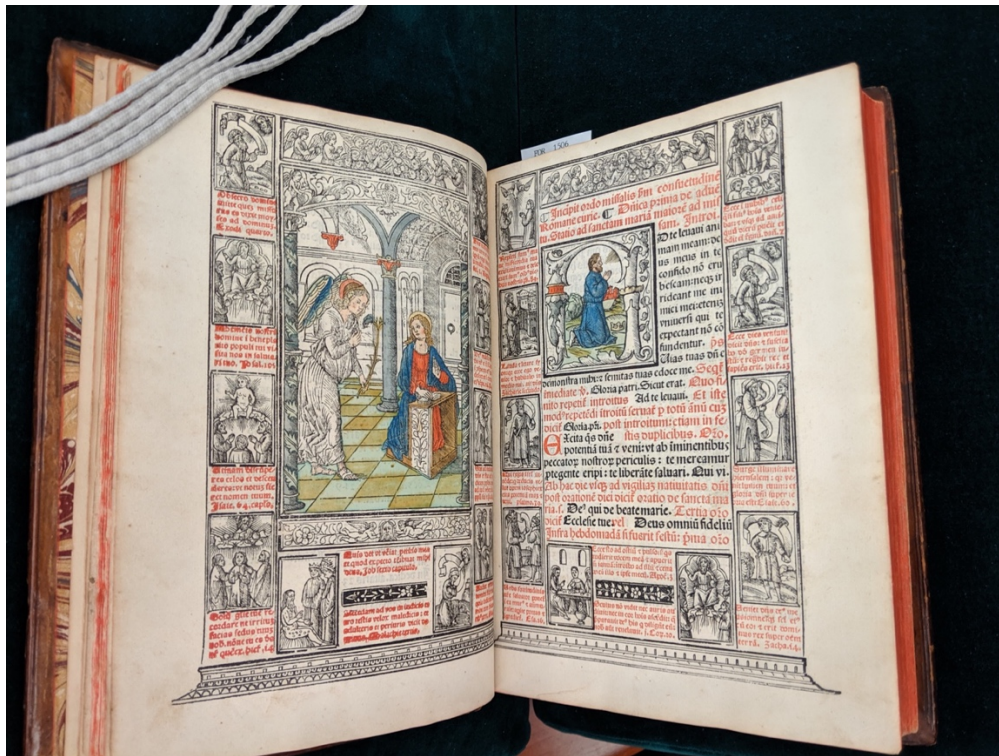


Figure 137: Missale Romanum, printed for Lucantonio Giunta in Venice, 1506. USTC No. 820072, photo from Huntington Library 441423, (errors in foliation and misbound folios), woodcut depicting the Annunciation with hand coloring.



Figure 138: Jacopo dei' Barbari, View of Venice, published by Anton Kolb in Venice, 1500, woodcut from six blocks on six sheets of paper, overall size 132.7 x 277.5 cm, Cleveland Museum of Art 1949.565.

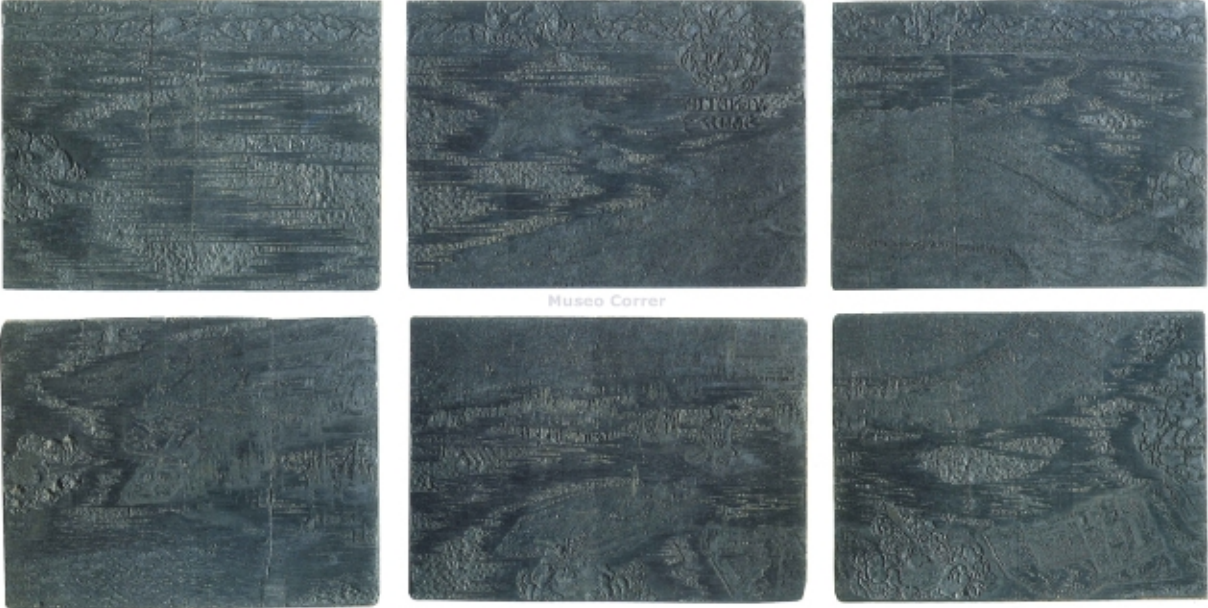


Figure 139: Six woodblock matrices for View of Venice, Jacopo dei' Barbari and assistants, before 1500, woodblocks now in the Museo Correr, Venice.



Figure 140: Biblia (in Italian), translated by Niccolò Malermi (or Malerbi), printed by Giovanni Ragazzo for Lucantonio Giunta in Venice, 15 October, 1490, ISTC No. ib00644000, photo of Bayerische Staatsbibliothek, Munich, 2 Inc.c.a.2387 vol. 2, fol. 1r, introduction to the book of Proverbs with King Solomon.



Figure 141: Franchino Gaffurio, *Theorica Musicae*, published in Naples by Francesco di Dino, 8 October 1480, ISTC No. ig00005000, photo from British Library IA.29495a, woodcuts showing musical, geometrical, and arithmetical proportions.



Figure 143: Graduale Romanum, edited by Franciscus de Brugis, printed by Johannes Emericus de Spira for Lucantonio Giunta in Venice, between 28 September 1499 and 1 March 1500 (m.v.), ISTC No. ig00332000, photo from British Library, IC.24240, woodblock depicting *The Assumption of Christ*.



Figure 144: Psalterium secundum morem et consuetudinem sancta Romane ecclesie, printed for Lucantonio Giunta in Venice, 1507, USTC No. 820078, photo from Modena, Biblioteca Universaria Estense, Inventario: A28335, Collocazione E 091 L 019, fol. 2r., woodblock originally depicting *The Assumption of Christ* has been partially masked to depict singers at the beginning of the Psalter.



Figure 145: Anonymous printmaker after Titian, St. Roch, as early as 1516 (1523), commissioned by the Scuola Grande di San Rocco, Venice, woodcut on paper, 563 x 404 mm, British Museum, 1860,0414.140.

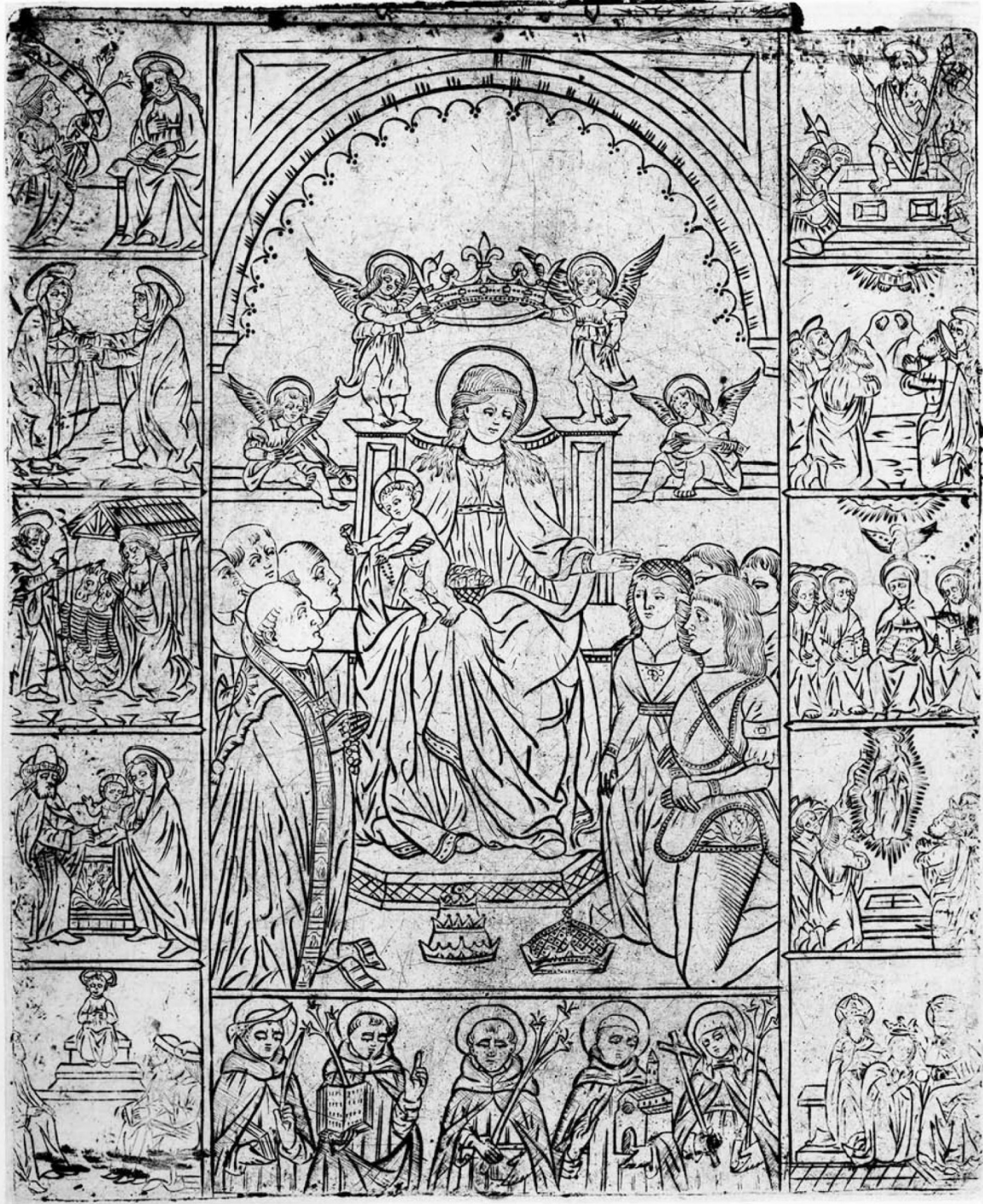


Figure 146: Virgin and Child Enthroned Surrounded by Six Scenes of the Life of the Virgin, printed to celebrate the marriage of the Emperor Maximilian I and Bianca Maria, 30 November 1493. As published in Gisèle Lambert, *Les Premières gravures italiennes— quattrocento—début du cinquecento*, Paris, 1999, no. 385: “La Vierge et l’Enfant sur un trône, entourés de dix scènes de la vie de la Vierge,” Milan (?), after 1490.”



Figure 147: Officium beate Marie secundum usum Romanum (Book of Hours), printed in Venice for Lucantonio Giunta, 1501, USTC No. 819824, photo from Biblioteca Giorgio Cini, Inv. 9598, woodblock possibly designed by Benedetto Bordon and likely cut by Jacob of Strassburg with the *Annunciation*.



Figure 148: Missale Romanum, published for Lucantonio Giunta in Venice, 1508, USTC No. 820083, Photo from Biblioteca Civica Angelo Mai, Bergamo, M6-26/337, fol. 6v7r, Crucifixion with scenes of The Annunciation within modular woodblocks of the architectural frontispiece.



Figure 149: The Submersion of Pharaoh's Army in the Red Sea, 1514/1515, reprinted 1549, Titian, printed by Domenico dalle Greche, published by Bernardino Benalio in Venice, woodcut on twelve pieces of paper, overall dimensions: 1210 x 2210 mm. British Museum, 1980, U.9.



Figure 150: Details of woodcuts with additional borders, woodcuts designed by Benedetto Bordon and cut by Jacob of Strassburg, printed by Johann Emerich da Spira for Lucantonio Giunta.



Figure 151: Titian, Assumption of the Virgin, 1516/1518, Basilica di Santa Maria Gloriosa dei Frari, Venice.



Figure 152: Andrea Mantegna, San Zeno Altarpiece, 1457/1460, Basilica di San Zeno, Verona.



Figure 153: Giovanni Bellini and workshop, Organ shutters depicting The Annunciation, originally for Santa Maria dei Miracoli, now in the Gallerie dell'Accademia, Venice, c. 1500.



Figure 154: Albrecht Dürer, A Pastoral Landscape with Shepherds Playing a Viola and Panpipes, 1496/1497, watercolor and gouache heightened with pen and ink and gold, pasted into: Theocritus, Idylls (and other texts), Venice: Aldo Manuzio, February 1496. National Gallery of Art, Washington, D.C. 2005.1.1.a



Figure 155: Breviarium Romanum, Venice: Nicolas Jenson, before 6 May 1478. Now in the Huntington Library, San Marino, California, Call Number 85663.



Detail

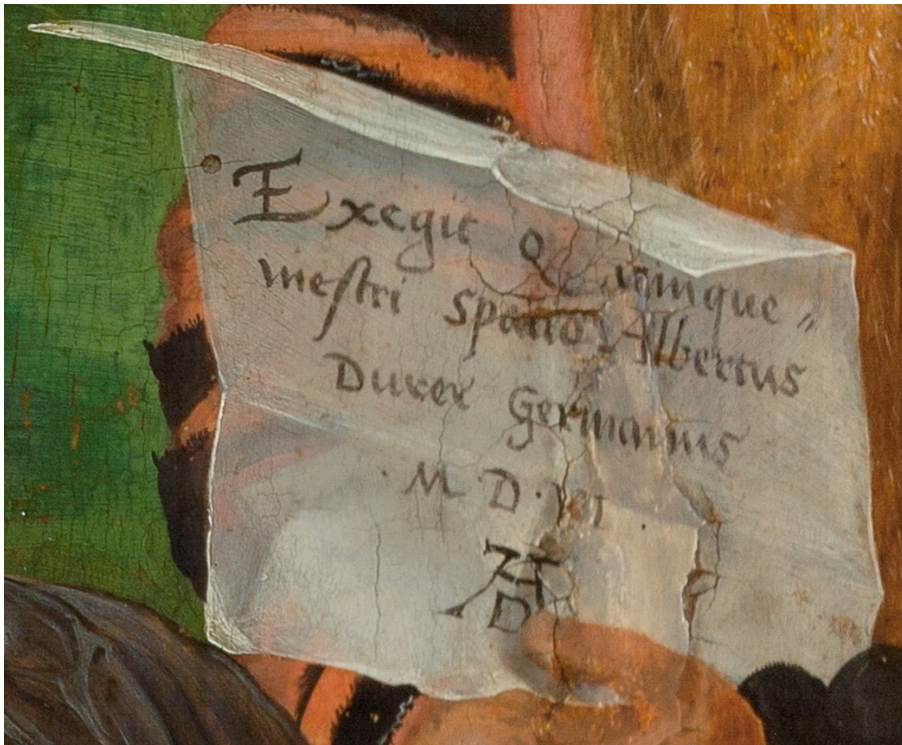
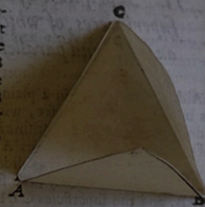


Figure 156: Albrecht Dürer, The Feast of the Rosary, 1506, oil on panel, 161.5 cm x 192 cm, National Gallery Prague, O.1552.

ward narrower and narrower, at length ende their angles (at the heigh
 or to ppe therof) in one point. So all their angles there ioyned toge-
 ther, make a folide angle. And for the better light thereof, I have fet
 here a figure wherby ye shall more easily conceiue it, the base of the
 figure is a triangle, namely, A B C, if on euery side of the triangle A B
 C, ye raise vp a triangle, as vpon the side A B, ye raise vp the triangle A B
 F, and vpon the side A C the triangle A F C, and vpon the side B
 C, the triangle B F C, and so bowing the triangles raised vp, that their
 toppes, namely, the pointes F meete and ioyne together in one point,
 ye shall easily and plainly see how these three superficiall angles A F B
 B F C, C F A, iojne and close together, touching the one the other in
 the point F, and so make a folide angle.



10 A Pyramis is a folide figure contained vnder many playne superficieses
 set vpon one playne superficies, and gathered together to one point.

Tenth defini-
 tion.

Two superficieses rayfed vpon any ground can not make a Pyramis, forthat two superficiall angles
 ioyned together in the toppes, cannot (as before is sayd) make a folide angle. Wherefore whé three, foure,
 and euer ascéding diminish their breadth, till at the légh all their angles cöcurre in one point, making
 there a folide angle: the folide inclosed, bounded, and terminated by these superficieses is called a Py-
 ramis, as ye see in a taper of foure sides, and in a spire of a towre which containeth many sides, either of
 which is a Pyramis.

And because that all the superficieses of euery Pyramis ascend from one playne superficies as from
 the base, and tend to one poynt, it muft of necessitie come to passe, that all the superficieses of a Pyra-
 mis are triangular, except the base, which may be of any forme or figure except a circle. For if the base
 be a circle, then it ascendeth not with sides, or diuers superficieses, but with one round superficies, and
 hath not the name of a Pyramis, but is called (as hereafter shall appeare) a Cone.

Of Pyramids, there are diuers kindes. For according to the varietie of the base is brought forth the
 varietie and diuersitie of kindes of Pyramids. If the base of a Pyramis be a triangle, then is it called
 a triangled Pyramis. If the base be a figure of foure angles, it is called a quadrangled Pyramis.
 If the base be a Pentagon, then is it a Pentagonall or fizeangled Pyramis. And so forth according
 to the increase of the angles of the base infinitely.

Although the figure of a Pyramis can not be well expressed in a playne superficies,
 yet may ye sufficiently conceaue of it both by the figure before fet in
 the definition of a folide angle, and by the figure here fet, if ye ima-
 gine the point A together with the lines A B, A C, and A D, to be
 cleaued on high. And yet that the reader may more clerely see the
 forme of a Pyramis, I haue here fet two sundry Pyramids which will
 appeare bodilike, if ye erecte the papers wherin are drawn the trian-
 gular sides of eche Pyramis, in such sort that the pointes of the angles
 F of ech triangle may in euery Pyramis concurre in one point, and
 make a folide angle: one of which hath to his base a foure sided fi-
 gure, and the other a fize sided figure. The forme of a triangled Pyra-
 mis ye may before beholde in the example of a folide angle. And by
 these may ye conceaue of all other kindes of Pyramids.

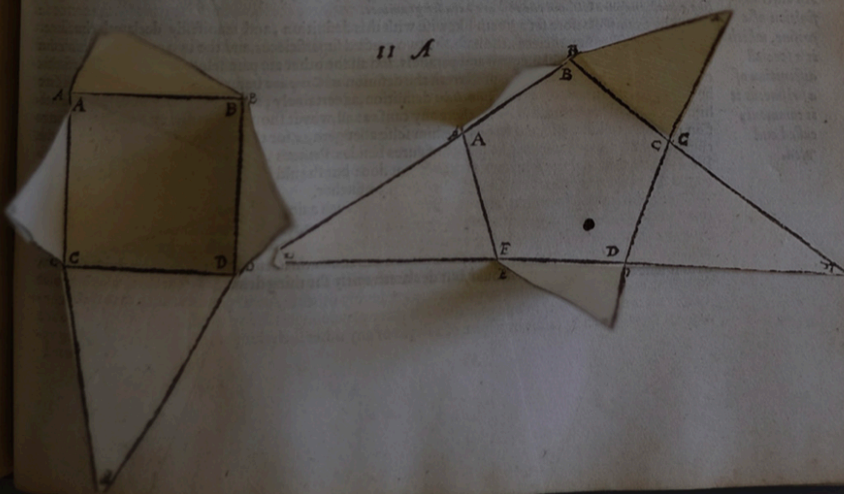
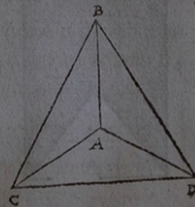


Figure 157: Pop-up diagrams in the First English Translation of Euclid's Elements, translated by Sir Henry Billingsley and published in London by John Day (Dee) in 1570. Diagram for Tenth Definition (XI.12), photo published by Eunsoo Lee, courtesy of the Department of Special Collections, Stanford University Library.



Figure 158: Habitat for Humanity's first 3D printed house owned by April Stringfield. Detail with house texture compared to stone veneer.

Missale Romanum

[See detailed information](#)

RESOURCE

Missale Romanum

Location
München, Bayerische Staatsbibliothek -- Inc.c.a. 41

Title
Missale Romanum

By
Hrsg. von Philippus de Rotingo

Other
Philippus de Rotingo -- (GND: [103147020](#))

Creation
Venedig : Nikolaus von Frankfort
1487

Extent
272 Bl.

Dimensions
8

Language
Latin

Note
Bibliogr. Nachweis:
Hain/Copinger 11389. Weale-Bohatta 900. Meyer-Baer 137. M. K. Duggan: Italian music incunabula. Berkeley 1992. Nr. 74. Pol 2732. BMC V, 335 (IA).



Figure 159: Missale Romanum, ed. Philippus de Rotingo (Venice: Nikolaus de Frankfordia, 1487), ISTC No. im00701000, held in the Bayerische Staatsbibliothek BSB-Ink M-469. Digitized at the Münchener Digitalisierungszentrum, viewed in the Digitale Bibliothek (Digital Library) using International Image Interoperability Framework and an Application Programming Interface.

Appendix A: The Known Extant Library of Peter Ugelheimer

For each title, the general edition is given first, followed by the location of the specific copy owned by Peter Ugelheimer. Entries are listed chronologically. Entries with an asterisk (*) indicate bindings informed by Islamic design.

Manuscript:

Vatican City, Biblioteca Apostolica Vaticana, Pal. Lat. 697, *Supplementum pisanelle*, on parchment, 1470.*

Print:

Plinius Secundus, Gaius (Pliny, the Elder). *Historia naturalis*. Venice: Johannes de Spira, before 18 September 1469. ISTC No. ip00786000. <https://data.cerl.org/istc/ip00786000>.

Ugelheimer copy: Paris, Bibliothèque nationale de France, Vélins 493-494.

Cicero, Marcus Tullius. *Epistolae ad familiares*. Venice: Nicolas Jenson, 1475. ISTC No. ic00513500. <https://data.cerl.org/istc/ic00513500>.

Ugelheimer copy: Paris, Bibliothèque nationale de France, Vélins 1149.*

Vergilius Maro, Publius (Virgil). *Opera [Bucolica, Georgica, Aeneis, with argumenta]*. With additional texts. Venice: Nicolas Jenson, 1475. ISTC No. iv00158000. <https://data.cerl.org/istc/iv00158000>.

Ugelheimer copy: Darmstadt, Germany, Landesbibliothek, ULB, Inc. IV 25.*

Gratianus (Gratian). *Decretum cum apparatu Bartholomaei Brixiensis*. Venice: Nicolas Jenson, 1477. ISTC No. ig00366000. <https://data.cerl.org/istc/ig00366000>.

Ugelheimer copy: Gotha, Germany, Forschungsbibliothek der Universität Erfurt, Mon. Typ. 1477, 2° 12, illuminations by Girolamo da Cremona and the Master of the Seven Virtues.*

Justinianus (Justinian). *Digestum novum with the Glossa ordinaria of Accursius*. Venice: Nicolas Jenson, 1477. ISTC No. ij00566000. <https://data.cerl.org/istc/ij00566000>.

Ugelheimer copy: Gotha, Germany, Forshungsbibliothek der Universität Erfurt, Mon. Typ. 1477, 2° 13, Illuminations signed by Benedetto Padovano [Bordon].*

Plutarchus. *Vitae illustrium virorum with Sextus Rufus: De historia Romana*. Venice: Nicolas Jenson, 2 January 1478. ISTC No. ip00832000. <https://data.cerl.org/istc/ip00832000>.

Ugelheimer copy: Wolfenbüttel, Germany, Herzog August Bibliothek, segnato: 8.11. Hist. 20.

de Spathariis, Georgius. *Breviarium Romanum*. Venice: Nicolas Jenson, before 6 May 1478. ISTC No. ib01112000. <https://data.cerl.org/istc/ib01112000>.

Ugelheimer copy: Dresden, Germany, Sächsische Landesbibliothek, Ink. 2872 (2°)*

Gregorius IX, Pontifex Maximus. (formerly Ugolino, Count of Segni). *Decretales cum glossa Bernardi Parmensis*. Ed. Franciscus Moneliensis. Rev. Alexander de Nevo. Venice: Nicolas Jenson, 8 May 1479. ISTC No. ig00452000. <https://data.cerl.org/istc/ig00452000>.

Ugelheimer copy: Gotha, Germany, Forshungsbibliothek der Universität Erfurt, Mon. Typ. 1479, 2° 4, Gregorius IX, *Decretales*, Nicolas Jenson, 1479, illuminations signed by Benedetto Padovano [Bordon].*

Biblia Latina. Venice: Nicolas Jenson, 1479. ISTC No. ib00563000. <https://data.cerl.org/istc/ib00563000>.

Ugelheimer copy: Dresden, Germany, Sächsische Landesbibliothek, Ink. 2876 (2°)

Innocentius IV, Pontifex Maximus (Sinibaldo Fieschi). *Apparatus super libros Decretalium*. Ed. Franciscus Moneliensis. Venice: Nicolas Jenson, et Socii, 15 June 1481. ISTC No. ii00096000. <https://data.cerl.org/istc/ii00096000>.

Ugelheimer copy: Gotha, Germany, Forshungsbibliothek der Universität Erfurt, Mon. Typ. 1481, 2° 10, illumination by Master of the Seven Virtues.*

Burlaeus, Gualtherus. *Expositio in Artem veterem Porphyrii et Aristotelis*. Venice: Johannes Herbort, de Seligenstadt, 10 December 1481. ISTC No. ib01308000. <https://data.cerl.org/istc/ib01308000>.

Ugelheimer copy: The Hague, Netherlands, Koninklijke Bibliotheek, 169 D 1, illumination by Master of the Seven Virtues.

Aristoteles (Aristotle). *Problemata* (Text beginning: Propter quid superabundantiae), trans. Bartholomaeus de Messana with commentary of Petrus de Abano. Venice: Johannes Herbort, de Seligenstadt, 25 February, 1482. ISTC No. ia01044400. <https://data.cerl.org/istc/ia01044400>.

Ugelheimer copy: The Hague, Netherlands, Koninklijke Bibliotheek, 169 D 2, illumination by Girolamo da Cremona and the Pico Master.

De Abano, Petrus. *Conciliator differentiarum philosophorum et medicorum*. Ed. Franciscus Argilagnes. Venice: Johannes Herbort, de Seligenstadt, 5 February 1483. ISTC No. ip00433000. <https://data.cerl.org/istc/ip00433000>.

Ugelheimer copy: The Hague, Netherlands, Koninklijke Bibliotheek, 169 D 3, illumination by Benedetto Bordon.

Aristoteles (Aristotle). *Opera* [Latin] with commentary of Averroes. Ed. Nicoletus Vernia. Venice: Andreas Torresanus, de Asula and Bartholomaeus de Blavis, de Alexandria (in part for Johannes de Colonia), 1483. ISTC No. ia000962000. <https://data.cerl.org/istc/ia000962000>.

Ugelheimer copy: New York, The Morgan Library, PML 21194-95, illumination by Girolamo da Cremona and Antonio Maria da Villafora.

Appendix B: The Known Extant Library of Pietro and Alvise Agostini

For each title, the general edition is given first, followed by the location of the specific copy owned by the Agostini. Entries are listed chronologically.

Manuscript:

Alberti, Leon Battista. *Descriptio Urbis Romae* (ca. 1450), Venice, Marciana, Ms. Lat. X, 231 (3731).

Print:

Cicero, Marcus Tullius. *De Oratore*. Venice: Christophorus Valdarfer, 1470. ISTC No. ic00658000. <https://data.cerl.org/istc/ic00658000>.

Agostini copy: Manchester, John Rylands Research Institute and Library, no. 3260.

Plinius Secundus, Gaius (Pliny, the Elder). *Historia naturalis*. Ed. Johannes Andreas, Bishop of Aleria. Venice: Nicolas Jenson, 1472. ISTC No. ip00788000. <https://data.cerl.org/istc/ip00788000>.

Agostini copy: Vatican City, Biblioteca Apostolica Vaticana, Stamp.Barb.A.A.A.IV.1., with pen-and-ink drawings.

Cato, Marcus Porcius, and others. *Scriptores rei rusticae*. Venice: Nicolas Jenson, 1472. ISTC No. is00346000. <https://data.cerl.org/istc/is00346000>.

Agostini copy: Florence, Biblioteca Medicea Laurenziana, D'Elci 749.

Solinus, Gaius Julius. *Polyhistor, sive De mirabilibus mundi, sive Collectanea rerum memorabilium*. Venice: Nicolas Jenson, 1473. ISTC No. is00615000. <https://data.cerl.org/istc/is00615000>.

Agostini copy: London, British Library, IB.19672, on vellum.

Sallustius Crispus, Gaius. *Opera*. Venice: Johannes de Colonia and Johannes Manthen, 23 March 1474. ISTC No. is00056000. <https://data.cerl.org/istc/is00056000>.

Agostini copy: Manchester, John Rylands Research Institute and Library, Inc. No. 10547.

Gratianus (Gratian). *Decretum cum apparatu Bartholomaei Brixiensis*. Ed. Alexander de Nevo and Petrus Albinianus Trecius. (with Johannes Diaconus: *Summarium, seu Flos decreti*). Venice: Nicolas Jenson, 28 June 1474. ISTC No. ig00363000. <https://data.cerl.org/istc/ig00363000>.

Agostini copy: London, British Library, IC.19678, on parchment with illumination.

Vergilius Maro, Publius (Virgil). *Opera [Bucolica, Georgica, Aeneis, with argumenta and commentary of Servius and additional texts]*. Venice: Antonio di Bartolommeo Miscomini, Oct. "1486" [i.e. 1476]. ISTC No. iv00167000. <https://data.cerl.org/istc/iv00167000>.

Agostini copy: London, British Library, C.19.e.14 [IB.20448].

Biblia Latina. Venice: Nicolas Jenson, 1476. ISTC No. ib00547000. <https://data.cerl.org/istc/ib00547000>.

Agostini copy: Ravenna Classense, Ravenna C Inc. 31.

Clemens V, Pontifex Maximus (formerly Raimundus Bertrandi del Goth). *Constitutiones cum apparatu Joannis Andreae with Decretales extravagantes Johannis XXII*. Venice: Nicolas Jenson, 1476. ISTC No. ic00728000. <https://data.cerl.org/istc/ic00728000>.

Agostini copy: Paris, Bibliothèque Nationale, Vélins 390.

Plutarchus. *Vitae illustrium virorum with Sextus Rufus: De Historia Romana*. Venice: Nicolas Jenson, 2 January 1478. ISTC No. ip00832000. <https://data.cerl.org/istc/ip00832000>

Agostini copy: Dublin, Trinity College, Fagg. GG.2.1, 2 On parchment.

Plutarchus. *Vitae illustrium virorum with Sextus Rufus: De historia Romana*. Venice: Nicolas Jenson, 2 January 1478. ISTC No. ip00832000. <https://data.cerl.org/istc/ip00832000>.

Agostini copy: Paris, Bibliothèque nationale de France, Vélins, 700.

Plutarchus. *Vitae illustrium virorum with Sextus Rufus: De historia Romana*. Venice: Nicolas Jenson, 2 January 1478. ISTC No. ip00832000. <https://data.cerl.org/istc/ip00832000>.

Agostini copy: New York, Pierpont Morgan Library, ChL ff 767a, no. 77565.

Bibliography

Primary Sources (listed chronologically):

Archivio di Stato di Venezia (ASV):

- Privilege granted to: Johannes da Spira on 18 September 1469:
In the ASV: Collegio Notatorio (CN), Registro (Reg.) 14, Folio (Fol.) 55r
Published: Fulin, Rinaldo. "Documenti per servire alla storia della tipografia Veneziana, raccolti dal prof. R. Fulin: Nuovi documenti." *Bollettino Bibliografico dell'Archivio Veneto* XXIII, no. 1 (1882): 99–100, No. 1.
Available online: <https://emobooktrade.unimi.it/db/privileges/10>
- Privilege granted to: Pietro Tomasi on 3 January 1492
In the ASV: Collegio Notatorio (CN), Registro (Reg.) 14, Folio (Fol.) 53r
Published: Fulin, Rinaldo. "Documenti per servire alla storia della tipografia Veneziana, raccolti dal prof. R. Fulin: Nuovi documenti." *Bollettino Bibliografico dell'Archivio Veneto* XXIII, no. 1 (1882):102, No. 4.
Available online: <https://emobooktrade.unimi.it/db/privileges/15>
- Privilege granted to: Andrea de' Torresani on 17 August 1492:
In the ASV: CN, Reg. 14, Fol. 99r
Published: Fulin, 103, No. 6.
Available online: <https://emobooktrade.unimi.it/db/privileges/26>
- Privilege granted to: Alessandro Calcedonio on 18 January 1493
In the ASV: CN, Reg. 14, Fol. 79r
Published: Fulin, 106–107, No. 12.
Available online: <https://emobooktrade.unimi.it/db/privileges/71>
- Privilege granted to: Bernardinus de Benalis on 27 February 1494:
In the ASV: CN, Reg. 14, Fol. 70r
Published: Fulin, 111–112, No. 23.
Available online: <https://emobooktrade.unimi.it/db/privileges/68>
- Privilege granted to: Lazaro Soardi on 2 May 1494:
In the ASV: CN, Reg. 14, Fol. 103v
Published: Fulin, 112–113, No. 25.
Available online: <https://emobooktrade.unimi.it/db/privileges/34>

- Privilege granted to: Aldo Manuzio on 25 February 1496:
In the ASV: CN, Reg. 14, Fol. 137v
Published: Fulin, 120, No. 41
Available online: <https://emobooktrade.unimi.it/db/privileges/2101>
- Privilege granted to: Boneto Locatello on 22 September 1496:
In the ASV: CN, Reg. 14, Fol. 148r
Published: Fulin, 125, No. 55.
Available online: <https://emobooktrade.unimi.it/db/privileges/2003>
- Privilege granted to: Bernardino Stagnino on 24 December 1496:
In the ASV: CN, Reg. 14, Fol. 150v
Published: Fulin, 126, No. 58.
Available online: <https://emobooktrade.unimi.it/db/privileges/41>
- Privilege granted to: Barnardino Stagnino on 31 January 1497:
In the ASV: Collegio Notatorio (CN), Registro (Reg.) 14, Folio (Fol.) 150v
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In the ASV: CN, Reg. 14, Fol. 153v
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- Privilege granted to: Democrito Terracina on 15 July 1498
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- Privilege granted to: Nicola Vlastò on 21 September 1498
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- Privilege granted to: Bernardino de Benalii on 1 February 1500:
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- Privilege granted to: Maseo Berto Marchian on 12 March 1500:
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- Privilege granted to: Aldo Manuzio on 23 July 1500:
In the ASV: CN, Reg. 15, Fol. 25v
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- Privilege granted to: Carlo Bembo di Ser Bernardo on 26 June 1501:
In the ASV: CN, Reg. 15, Fol. 142r
Published: Fulin, 146, No. 115.
Available online: <https://emobooktrade.unimi.it/db/privileges/332>
- Privilege granted to: Andrea Torresano on 30 November 1502:
In the ASV: CN, Reg. 15, Fol. 83v
Published: Fulin, 150, No. 128.
Available online: <https://emobooktrade.unimi.it/db/privileges/489>
- Privilege granted to: Giacomo di Penzi on 20 November 1505
In the ASV: CN, Reg. 15, Fol. 162v
Published: Fulin, 158, No. 151.
Available online: <https://emobooktrade.unimi.it/db/privileges/376>
- Privilege granted to: Paganino Paganini on 16 June 1507:
In the ASV: CN, Reg. 16, Fol. 8r
Published: Fulin, 166, No. 162.
Available online: <https://emobooktrade.unimi.it/db/privileges/592>
- Privilege granted to: Giacomo Ungaro on 26 September 1513
In the ASV: CN, Reg. 17, Fol. 80r
Published: Fulin, 178, No. 189.
Available online: <https://emobooktrade.unimi.it/db/privileges/376>
- Privilege granted to: Ugo da Carpi on 24 July 1516:
In the ASV: CN, Reg. 18, Fol. 39v
Published: Fulin, 189, No. 209
Available online: <https://emobooktrade.unimi.it/db/privileges/694>
- Privilege granted to: Lucantonio Giunta on 3 April 1522:
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- Suetonius Tranquillus, Gaius. *Vitae XII Caesarum* [with] *Ausonius: Versus*. Venice: Nicolas Jenson, before July 1471. ISTC No. is00817000. <https://data.cerl.org/istc/is00817000>, copy in the *Biblioteca Trivulziana*, Milan, B.87.
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