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The Versions of Vincenzo Viviani's Library

Shortly before his death, natural philosopher and mathematician Vincenzo Viviani (1622-1703) added a note at the end of a 234-page inventory of books.[1] The handwriting betrays his advanced age and stands in contrast to the otherwise clear, steady script of the manuscript: «Io Vincenzio di Jacopo Viviani ho sottoscritto questo presente inventario di tutta la mia liberaria che consiste in queste dugento trenta quattro fascie et in fede mano propria».[2] The document is rich with details about titles, edition information, book formats, numbers of volumes in sets, and the multiple works bound in a single volume as *Sammelband*. Many pages of the manuscript also bear traces of later readers this document. Given the remarkable

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1 Viviani 1702.

2 *Ivi*, p. 234. Translation: «I, Vincenzio [son] of Jacopo Viviani underwrote this present inventory of all of my library, which consists of these 234 pages and [are], in faith, my own hand». All translations are the authors' unless otherwise indicated.

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description of the collection, Viviani's catalog was used in the late-nineteenth century as a source for re-identifying editions of books in the library of Galileo Galilei (1564-1643).[3] Viviani had described himself as Galileo's final student and Galileo's books were presumed to have passed to him.[4]

Both digital representations of the primary source material and computational tools for analysis provide an opportunity for a more comprehensive understanding of this collection. To study the library computationally and quantitatively in relation to Galileo's collection, the lead author of this article began transcribing the manuscript and entering the bibliographic information into a spreadsheet in 2021.[5] Then, in 2023 Viviani's collection of books was given a curated, digital library presence hosted by the Museo Galileo in Florence.[6] The manuscript has also been digitized and the scans are accessible through the Museo Galileo Digiteca.[7] This article juxtaposes the information about the library, as represented by the manuscript, with both its organization as a digital collection and its representation as a spreadsheet in order to provide an overview of the library and explore the strengths of each type of source for learning more about Viviani's books.

As methods expand for studying collections as data, there is ongoing need for comparative analysis of the technological medium through which the data is represented. Each technology for representing Viviani's library, from the manuscript (now scanned) to the digital library, to the spreadsheet, affords different opportunities for understanding Viviani as both an intellectual and bibliophile. We argue that the comparative approach offers a way to access features of the collection that are not revealed by any representation in isolation, and we advocate for future web-based projects to integrate digital sur-

3 Favaro 1886b; Favaro 1887; Favaro 1992.
4 On the possible fate of Galileo's books see Hall 2026.
5 Hall 2025.
6 Casati - Pocci 2023.
7 Museo Galileo 2025.

rogates of the primary source material and make the underlying data available to facilitate this kind of research.

After using Viviani's correspondence to describe his relationship with late-seventeenth century book culture, we will address in turn the manuscript, the digital library, and the spreadsheet. We conclude with an example of an analysis that unites the correspondence and the three types of representations to investigate the library's connections to Galileo. To assess the methodological value of comparing digital representations, this article asks three primary questions. First, how does the manuscript reveal Viviani's priorities for representing his collection? Next, what affordances of the digital library provide new readings of the manuscript? Finally, what quantitative features revealed by the spreadsheet offer a new understanding of the manuscript or the digital library catalog? The highlighted features of each representation provide an aggregated view of Viviani's library and a way to assess a mixed-methods approach to collections as data.

Viviani as Book Collector, Intellectual, and Memorializer

Viviani was active for his entire adult life in Florentine educational, engineering, and intellectual societies.[8] His library served as the foundation for publications and unfinished works in geometry and mathematics as well as the decades that he dedicated to solving civil engineering problems ranging from containing river beds to road construction.[9] While Viviani was a mathematician, engineer, and natural philosopher in his own right, much of his life's work was also oriented towards preservation and continuation of Galileo's intellectual legacy. Although Viviani was not precisely Galileo's last disciple as he claimed, he was intertwined with the activities of Galileo's final years and the twilight of the direct Galilei descendants.[10]

8 Primbault 2020.
9 Barreca 2023.
10 Righini Bonelli 1972.

Viviani began living and working with Galileo in 1639, staying in the villa in Arcetri until Galileo's death and then supporting the Galilei family until the death of elder grandson Carlo Galilei in 1675. Viviani devoted significant time and financial resources to memorializing his famous instructor through a biography, advocacy for the printing of Galileo's works, establishing plans for what would become Galileo's memorial tomb in Florence's Basilica of Santa Croce, and turning his own home into a monument now known as the Palazzo dei Cartelloni.[11] From his incomplete efforts to gather and print the collected works of Evangelista Torricelli (also a final resident in Arcetri), to the labor of retrieving as many of Galileo's letters as possible from correspondents as a complementary project to the collected edition of Galileo's works, much of this labor focused on producing print materials.

The Galilean influence on Viviani's library lasted for decades. For as much attention has been given to Viviani's role as custodian of the Galilei family collection of books and papers, less has been said about his reliance on members of the Galilei family to help build his own library. This included Galileo's grandson Carlo, the middle son of Vincenzo Galilei, Jr., who Viviani asked about the availability of certain books in Venice in late January 1654.[12] A letter from the Danish physician Rasmus Bartholin (1625-1698) about receipt of the shipment of instruments in early 1656 reveals that the intermediary in the shipment was «Carolo Galilei», likely the same Carlo.[13] Viviani also acted as a book distributor for fellow student of Galileo, Vincenzo Renieri (1606-1647).[14]

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11 Gattei 2019.

12 Galluzzi - Torrini 1975, Vol. 2, p. 127-129.

13 *Ivi*, p. 300.

14 In summer of 1647, Vincenzo Renieri wrote to Viviani with a book distribution request related to a recent title printed by Amadore Massi in Florence: «Scrivo a Messer Amadore che consegni a V.S. una dozzina de' miei libri, quali potrà farmi grazia di dar a qualche libraro per veder d'esitarli a uno scudo l'uno; ne ho anco ordinato che ne dia uno legato a V.S., quale goderà per amor mio e se più ne vorrà sarà sempre padrone e, non essendo questa per altro, affettuosissimamente le bacio

Although Viviani's collection was deeply embedded in Florentine culture and history, the library contents were the result of exchanges within a broader Italian and European network of booksellers and colleagues. For example, Viviani's correspondence with Bartholin that mentioned Galileo's grandson was due to a shared interest in natural philosophy. Bartholin worked with glass makers in Murano to supply Viviani with «cristalli», likely lenses for more scopes like the two *thermoscopii* and three *liquidoscopii* that Viviani had already sent to him.[15] Yet, in an early 1656 letter Viviani had asked for news of the shipment and also requested information about twelve different books.[16] Several were on Venetian booksellers' lists, copies of which had arrived in Florence, others were a repetition of earlier inquiries to Bartholin. Viviani seemed very interested in the biographies written by philosopher Pierre Gassendi (1592-1655), a book by theologian Fra Fulgenzio Micanzio (1570-1654), and selected works by mathematician Blaise Pascal (1623-1662) and philosopher René Descartes (1596-1650). Half of the titles that Viviani requested from Bartholin appear in the final inventory of Viviani's library. Bartholin in turn asked for news of books being printed or reprinted by Evangelista Torricelli, Galileo's longtime opponent Scipione Chiaramonti (1565-1652), and student of Galileo's student, Bonaventura Cavalieri (1598-1647).[17] Similarly, Viviani's correspondence with the French polymath Melchisedec Thévenot (c. 1620-1692) frequently touched upon the book trade, including the buying and selling of private libraries.[18]

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le mani» (Galluzzi - Torrini 1975, Vol. 1, p. 398-399). Viviani's book list would seem to only include Renieri's book on Etruscan antiquities, printed by Massi in 1637 (Viviani 1702, p. 91). See also Galluzzi - Torrini 1975, Vol. 1, p. 410.

15 *Ivi*, p. 295, 300, 318.

16 *Ivi*, p. 295-6.

17 *Ivi*, p. 300, 318.

18 *Ivi*, p. 128: «M'hanno avvisato qui che fosse stata venduta a Fiorenza una Beln lissima libreria et che l'habbia comprata un libraro. Supplico V.S. di darmi un poco di lista de' più rari libri che si sieno di mathematiche, d'historia, comme anche d'avvisarmi se si sieno manuscritti et scritture di cose di stato».

In terms of knowledge of book production, Viviani was attentive to every detail in his requests. In a letter to the printer and editor Carlo Manolessi in Venice, Viviani pointed out several defects in books that he had received. The first sentence of the letter begins without formalities or pleasantries, immediately listing problems with the figures in one of the volumes:

> Al libro detto *Syntagma perspectivae* si è veduto che assolutamente mancano almeno 5 fogli di figure, che una è quella che viene citata nella prefazione alla faccia del registro A 2 che non si trova, e l'altre sono le segnate G I, G II, H V, H VI, di più le segnate I non passano tre figure, che tutte l'altre arrivano a 6, e non par possibile che il libro non habbia da avere alcuna dichiarazione in discorso e che cominci e finisca così *ex abrupto*.[19]

With this comment, Viviani reveals the attentiveness of his examination of the books that he received. The emphasis on these details in correspondence with Manolessi and others aligns with the descriptive notes that accompany some entries in the inventory, described in more detail in the next section. In the same letter, Viviani goes on with his critique: «Il libro del Ceulen *De circulo et adscriptis* cammina bene col registro sino all'Ee che è un mezzo foglio, del quale l'ultima faccia è segnata da capo col numero 220, ma in piede vi è un richiamo così L V, che è indizio che il libro passa più avanti; però V.S. ce ne assicuri».[20] Of the three digitized copies in Google Books, 2 have the

[19] Galluzzi - Torrini 1975, Vol. 2, p. 155. Emphasis in the original. English translation: «In the book called *Syntagma perspectivae [Statements on perspective]* are missing completely 5 sheets of figures, since one of them is cited in preface on the face of the register A2 that cannot be found, and the others are signaled as G I, G II, H V, H VI; what's more, those signaled as I do not amount to more than 3 figures, when all of the others come to 6, and it does not seem possible that the book did not have any statement on the subject, and that it begins and ends so, *ex abrupto* [abruptly]».

[20] *Ivi*, p. 155, November 1654. English translation: «The book by [Ludolph van] Ceulen, *De circulo et adscriptis* [On the Circle and its Pieces], goes along well with the register until Ee, which is a half sheet, of which the last face is signed at the top

LV indication, while 1 has a visible cancellation of that marking. This volume can be found in the final inventory of Viviani's library.[21] The fastidiousness of Viviani's examinations translated to a similar emphasis on completeness in his 234-page list of titles.

Moreover, the poorly assembled copy of the book on perspective had been first printed nearly 90 years prior, suggesting that both Viviani's research and his collecting habits aimed for comprehensiveness. Editors Galluzzi and Torrini speculate that the book in question might have been *Sintagma in quo varia eximiaque corporum diagrammata ex praescriptio opticae exhibentur... utile opus omnibus artis perspectivae cultoribus* (Amsterdam, 1618), a work initially published in 1568.[22] Viviani concludes the list of complaints about defects by pointing out that Manolessi's intermediary, Andrea Cecchi, was supposed to be providing complete books to him and that he ought to be more mindful of Viviani's needs.[23] Cecchi was subsequently cut out of future book purchases.[24] The work does not appear in Viviani's manuscript inventory of his library, perhaps because a complete copy could never be found.

Viviani's correspondence also describes the challenges faced in procuring books, from regional military conflicts to more local disruptions such as diseases closing borders. Letters show that Viviani's contact in Rome, Andrea Torti, was able to procure *Hemispherum dissectum* (1648) despite an outbreak of plague. Torti wrote in November 1656 describing how at least 100 people were dying each day, with perhaps as few as a quarter of those afflicted recovering. Torti described how this impacted his search for books:

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with the number 220, but at the bottom is a recall that looks like LV, which is an indication that the book goes on further; but Your Lordship may determine it for yourself».

21 Viviani 1702, p. 68.

22 *Ivi*, p. 155.

23 *Ibidem*.

24 *Ivi*, p. 157.

> Quanto a' libri che V.S. desidera, io conservo ancora la nota che mi diede quando io venni qua, et feci subito ogni diligenzia per servirla, ma non trovai altro che quel *Hemisphaerium dissectum* dell'Albio, quale presi subito sperando di tornare presto; e fu ben fatto, perché a questi giorni il libraio che solo l'aveva è morto di questi mali et la bottega serata; lo conservo però appresso di me per portarglielo e consegnarlo a chi ella ordinerà...[25]

We do not have the list of other books that Viviani desired Torti to acquire in Rome, but the letter provides valuable context for understanding the conditions under which Viviani was attempting to grow his collection.

Curiously, the library catalog only includes one note about where Viviani bought a book: in Florence. For one volume, a Latin edition of Diogenes Laertius' *Lives, Doctrines, and Sayings of the Famous Philosophers* (London, 1664), Viviani notes that he bought it from «Jacopo Carlieri, bookseller».[26] The life of Epicurus in the book was of great interest to natural philosophers. Carlieri, working in Florence, had been active in promoting the work of naturalist and diplomat Lorenzo Magalotti (1637-1712) and partnered with several local printers on different editorial projects including Viviani's *Elementi piani e solidi di Euclide* (C. e F. Bindi, 1690).[27] Viviani also owned at least two other books that Carlieri published.[28] The London edition of the *Lives*

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25 Galluzzi - Torrini 1975, Vol. 2, p. 376. English translation: «Regarding the books that Your Grace wants, I still retain the note that you gave me when I went there, and I immediately made every effort to serve you, but I found nothing other than that Hemisphaerium dissectum by Alby, which I took immediately in the hopes of soon returning; and it was well done, because during these days the only bookseller that had it has died from these ills and the shop is closed; I am keeping it however close by to bring it to you or consign it to whomever you will request... » The book is inventoried in Viviani 1702, p. 69.

26 *Ivi*, p. 43.

27 Bruni 2004, p. 351-2.

28 The first title is *Della costruzione irregolare della lingua toscana* (1679), which predates the earliest edition identified by Bruni 2004, p. 351-352. Viviani also de-

(1664) that he procured from Carlieri contained the 1594 translation and notes by the humanist Tommaso Aldobrandini (1540-1572) with notes from previous editions and a new commentary by the French linguist Gilles Ménage (1613-1692).[29] Importantly, the preface engages with an earlier translation of the tenth book of the *Lives* by Pierre Gassendi, who had translated Galileo's works into French.[30] The example provides a cautionary analytical guide: books printed at a distance might have been considered local and topics considered afield from the physical sciences were sometimes central to debates.

Finally, Viviani's catalog also includes only one note about receiving a book as a gift. For the copy of the 1691 edition of the *Vocabolario* of the Accademia della Crusca, Viviani points out: «in foglio di carta reale donatomi dal Ser.mo Principe Gio. Gastone il giorno avanti che partissi di Firenze per andare in Germania».[31] Giovanni (Gian) Gastone de' Medici (1671-1737), son of Grand Duke Cosimo III, had been part of the intellectual life of the Florentine court before being sent to Bavaria to marry in 1697. That unhappy union would lead to his becoming the final heir to the Medici lineage, but shortly before his death then-Grand Duke Gian Gastone was able to complete the monumental tomb for Galileo in Santa Croce that Viviani had partially funded through a bequest upon his own death 34 years prior.

By that point, Viviani's collection had changed dramatically from how it was presented in the manuscript catalog that he had signed in 1702. Despite the extensive detail in Palat.1195, and Viviani's request that the library remain together, the books were separated over a long process of family infighting and bureaucratic disarray in Florence.[32]

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scribes it as seidecimo, not duodecimo format that Bruni associates with Carlieri (Viviani 1702, p. 186). The second title in Viviani's collection is the second printing of *Ristretto delle cose più notabili della città di Firenze* (1698).

29 For more details on the history of Diogenes' *Lives*, see Schiavo 2018.

30 Gassendi's work is also in the collection, Viviani 1702, p. 36.

31 *Ivi*, p. 49.

32 Favaro 1886a.

The books passed directly to Viviani's nephew, and, likely after suffering losses, passed to the Santa Maria Nuova Hospital, only to be further dispersed into private hands, sold at auction, or acquired by the Magliabechiana, which then became a foundational portion of what is now the Biblioteca Nazionale Centrale di Firenze (BNCF).[33] The Museo Galileo digital library project team has been able to reidentify 238 exemplars from the collection that still bear the distinctive VV ownership mark, typically found on the title page.[34] Within the digital library catalog, using filters for the provenance of these re-identified exemplars, we learned that 120 are held by the Biblioteca Biomedica in Florence, 112 at the BNCF, and 1 at the Museo Galileo.[35] Digital methods of representation such as the Museo Galileo project and the data set that accompanies this article provide a way to reunite the titles and study the collection as a whole.

Viviani's correspondence regarding books provides a contextual frame through which to view the three representations of the library. On the one hand, his attention was hyper-local with a focus on Galilean and Florentine print culture. On the other, his inquiries were directed beyond the Alps, although perhaps in search of works printed at a distance that nonetheless connected to his immediate circle of friends and collaborators. Above all, the letters continuously emphasize Viviani's meticulous concern for the details of printed materials. His curation of the collection was oriented towards its future, and the

33 Diana 2008.

34 Eileen Reeves signaled to me via email that the Bibliothèque Municipale de Lyon appears to hold Viviani's copy of the Frankfurt edition of the *Sidereus nuncius* (1610). The verso of the title page reads «Ex libris Vincentii Viviani» but the scan lacks clear evidence of the VV. The various ex-libris markers on the guard and title pages would suggest an entirely different provenance path for this volume, and perhaps others, in contrast to the standard narrative. See Galileo 1610.

35 These numbers were established by searching for *esemplare* in the Status field and filtering by «Provenienza esemplare Viviani» on 30 May 2025. No indications are provided for the other 5 titles that would complete the total of 238 that have the status of *Esemplare identificato*.

sections will investigate the permutations of its representation.

Viviani's Library as Manuscript

First, a caveat: this article only addresses one of two known manuscripts that itemize Viviani's books. Within the collection of Galilean manuscripts at the Biblioteca Nazionale Centrale di Firenze, in a volume of documents related to Viviani's life, is an 11-sheet list of 482 titles.[36] The list lacks the bibliographic detail of the 234-page catalog, has few overlapping titles with it, and most entries include a presumed monetary value, likely as preparation for a sale. Modern scholarship has so far not addressed this shorter list, but the digitized manuscript, the digital library, and now the tabularized edition of the larger catalog might facilitate better understanding of its relationship to Viviani's library project, his intellectual endeavors, and the overlap of his books with those that had belonged to Galileo.

The longer catalog, signed in 1702, resists many elements that datafication tends to prioritize: easy segmentation into unique bibliographic entries, authorship identification, and even pagination.[37] The 234-page manuscript is titled: «Indice dei Libri nello scrittorio e prima nel 30 scaffale sopra la tavola».[38] Quire and page numbers are provided at the top of each page, apparently in the original hand. Pages 210 and 211 were mislabeled as 206 and 207. Pages 23 and 159 are blank aside from widely-spaced diagonal lines across them. *Sammelbande* of multiple titles bound or printed together are indicated by a curved line in ink to connect entries. Individual entries range from 2

36 Biblioteca Nazionale Centrale di Firenze, *Mss. Gal. 155*, cc. 43-54, https://teca.bncf.firenze.sbn.it/ImageViewer/servlet/ImageViewer?idr=BNCF0003639141.

37 A reminder that images of the manuscript pages can be viewed at the url provided in the bibliography for Museo Galileo 2025.

38 Viviani 1702, p. 1: «Index of the books in the scriptorium, and first on the third shelf over the table».

words for volumes in multivolume sets to 168 words to describe the contributions to a multi-authored collection of adages and proverbs. Entries typically include the title as it appeared on a title page, including edition information, year of publication, and format, written with occasional abbreviations. Infrequently an extra note about condition, provenance, or the contents follows the bibliographic information.

With one exception, the later hands at work on the manuscript were trying to tell a story about the collection not tied to the fame of any one author or even the collector. The sheets bear traces of several individuals working to identify, enumerate, or otherwise inventory the items in Viviani's collection. A running tally of volumes can be found on the bottom left of almost each page in a different, presumably later ink than the entries. The tallying ends at 1995 on page 233, omitting a final count of what was sometimes the number of volumes, sometimes the number of titles on the pages. A + sign can be found in ink in the margins next to nearly half of the entries across the first 137 pages. Later # marks in pencil in the left margins of the first several pages signal select entries, but skip manuscripts, duplicates, and certain titles.[39] A red pencil dot can be found next to 126 entries in the manuscript, likely made in conjunction with Antonio Favaro's research on Galileo's library in the 1880s (more on this below). The inconsistencies of these features point to the ways in which the entries resist being defined as volumes on a shelf.

The catalog only identifies 3 manuscripts; the rest of the titles are presumed to be printed works. Two of the manuscripts were written by Galileo: his treatise on mechanics and a copy of his compass manual that circulated in handwritten copies before it was printed.[40] These were clearly treated as separate kinds of manuscripts from the correspondence that would later be found in the cellar of the home of Viviani's descendants and were found among books in quarto format, suggesting they were bound. Viviani was more precise about an

39 They can be found inconsistently across p. 4-57.

40 *Ivi*, p. 58 and 61, respectively.

undated copy of the Alphonsine Tables: «manuscriptae in folio in antiquo caractere».[41] For a fourth entry, it is unclear if Viviani owned a manuscript or an incunable: the *Hypnerotomachia Poliphili*, set in 1467 (the date given in the entry), first printed in 1499.[42] Incunables in the collection included works by classical authors Lucan, Pliny, Seneca; the astronomer Johannes Müller (Regiomontanus; 1436-1476); the mathematician Luca Pacioli (d. 1517); and a work of music theory by composer Franchino Gaffurio (1451-1522).

The emphasis on print is also seen in the organization of the document. The titles are not rigidly sorted by author or topic, instead following an order dictated by format. At the same time, a sequential reading of the pages does reveal thematic groupings. For instance, pages 57-63 of the manuscript represent an intellectual nexus of overlap with Galilean natural philosophy. Nonetheless, topical information is not explicitly a part of the manuscript. The organizational features of the pages and entries anticipate a reader with sufficient knowledge of the subject matter and the landscape of printed materials to make discerning judgments about completeness and quality. If anything, Viviani de-emphasized his connections to Galileo with the details of the titles, and the physical descriptions of the books and manuscripts.

Viviani's notes that surround the entries frame his priorities for later comparison to the digital library and the data set. Unlike the later hands that attempted to count all or parts of the collection, Viviani's goal was not enumeration. In addition to title information, which often included the author's name, printer and location of printing, year, and format, Viviani provided additional visual and verbal information about many of the titles in the collection. His notes were written in Italian, Latin, and French. They amount to creating, and even correcting, a record of the contents of the library. In one instance, he noted that he was listing a publication date that differed from the title page: Christoph Scheiner's *Rosa Ursina* (1630), printed

41 *Ivi*, p. 9.
42 *Ivi*, p. 190.

with a date of 1626.[43] Galileo's conflicts with Scheiner over sunspots would have been well-known to Viviani, who felt he needed to note this discrepancy in the book list. These personal notes offer a way to glimpse more of the organizational and collecting priorities that motivate the composition of the manuscript.

The most obvious way that Viviani described the contours of the library was through signaling that titles were found in the same volume: brackets drawn in the margins to encompass the entries.[44] The largest difference in publication year for the *sammelbande* was over a century.[45] Viviani used the same visual signal for titles found in the same volume of collected works or for other subsections of a work that might have been indicated on a title page.

Multivolume sets were listed as one entry, typically with a marginal note enumerating how many volumes were in the set. In others a single title was used, like the *Giornale de letterati*, for which Viviani adds «comincia dall'Anno 1668 e termina nell'Anno 1680 in quindici tomi».[46] If Viviani only owned one volume of a multivolume set, for example the second part of Vasari's *Lives* (Florence, 1568), he indicated «Tom. 1» in the margins. Viviani later specifies that the first edition of Vasari's *Vite* was divided into three parts, but bound in two

43 *Ivi*, p. 10: «impressio aecepta An: 1626 finita vero 1630».

44 Only two entries are described as unbound (sciolto), even though they are both listed as parts of three-title *sammelbande*. See the third entry on page 6 of the manuscript and Claude Perrault's anatomical descriptions of a chameleon, beaver, and camel (Paris, 1668), but Viviani adds the detail: «assieme con L'operazioni che sono state fatte nella Biblioteca del Re sopra un pesce, sopra un lione ap. il med.o Leonard 1667 in 4o con assieme ancora La nouvelle decouverte touchant la veue a Paris chez Leonard 1667 in 4o. sciolta consistente in tre fogli» (*Ivi*, p. 84).

45 The two books also do not seem to have an immediate thematic connection: *Tyronum Literatorum colloquia, sive confabulationes Hermanno Schotternio Auctore* (Lyon, 1643) and *Lilii Gregorii Giraldi de Annis et mensibus caeterisque temporum partibus* (Basel, 1541). *Ivi*, p. 213.

46 *Ivi*, p. 103. English translation: «begins in the year 1668 and finishes in the year 1680 in 15 volumes».

volumes.[47] The least specific example in the collection seems to be «Orazioni e poesie di diversi autori raccolte e legate in sette tomi».[48] No year, publisher, or format information was included.

One collection received special treatment, in alignment with Viviani's efforts to memorialize his instructor by collecting and, unsuccessfully, attempting to produce an official edition of Galileo's works. It appears after a few of Galileo's printed works and the Bologna edition of 1655.[49] The inventory note describes a peculiar binding structure that seems to reflect Viviani's personal collection of Galileo's printed works: «Le Opere del medesimo Galileo legate con carta bianca per ciascuna faccia eccettuato il Dialogo de' Due Sistemi del Mondo, la Lettera a Madama, et il Compasso del medesimo Galileo e la lettera scritta dal medesimo al Padre Clavio. Stampate in diversi luoghi e tempi».[50] Of his copy of Galileo's *Two New Sciences*, Viviani adds the annotation: «Questo è l'esemplare studiato dal Sig. Vincenzo Viviani e dal medesimo fattovi le annotazioni ne' margini di sua mano con alcune aggiunte di fogli sciolti e in mezzo fraposti».[51] The entry is immediately followed by a copy of Torricelli's work on the sphere (Florence, 1644), for which Viviani provides a similar description of his marginalia.[52] The goal appears to have been documen-

47 The original reads: «divisa in tre parti legate in due tomi» (*Ivi*, p. 200).

48 *Ivi*, p. 194. English translation: «Orations and poems by different authors collected and bound in seven volumes».

49 Viviani owned both a complete and an incomplete set of the unofficial Bologna edition of Galileo's collected works. *Ivi*, p. 57-58.

50 *Ivi*, p. 57. English translation: «Works by the same Galileo bound with white paper on each side, except the *Dialogue on the Chief World Systems,* the *Letter to Madama [Cristina],* and the *Compass* by the same Galileo and the letter written by him to Father Clavius. Printed at different places and times».

51 *Ivi*, p. 58. English translation: «This is the exemplar studied by Sig. Vincenzo Viviani and by the same made therein the annotations in the margins by his own hand with others added on loose sheets and interspersed in between».

52 His note reads: «Legato in tre tometti e questi sono gli esemplari studiati dal Sig. Vincenzo Viviani con le Annotazioni manoscritte dal medesimo nei margini in occasione di studiarle» (*Ivi*, p. 58).

ting the scope of what, to Viviani, were the most valuable attributes of the collection.

From this overview of the annotations to the manuscript, we see that the contents took priority; the physical conditions of the volumes were rarely remarked upon. For example, Viviani only mentions binding style once. At the end of the manuscript Viviani listed his own work with the descriptor, later crossed out, «legato in bazzana» (bound in chamois).[53] In very few instances does the catalog remark on the paper size or quality. For a copy of Pascal's *Historia Trochoidis* (1658), Viviani distinguishes that the paper used was «foglio volante».[54] For the work on optics *Catoptricae et dioptricae* (Oxford, 1697) by David Gregory (1659-1708), Viviani indicates that the book is in quarto «minorem».[55] On the other hand, the Italian translation of Vitruvius (Venice, 1556) is described simply as *grande*.[56] The value of the books was not in their material, but in their contents and their completeness.

To that end, Viviani seems to have documented each instance that a volume was somehow lacking compared to an ideal copy, in line with his letter of complaints to the editor Manolessi about the quality of books the agent had been providing. 19 entries indicate that the copy in Viviani's library was, in his terms, imperfect/*imperfetto* or defective/*manchevole*.[57] A collection of poetry written at the death of Pietro Bembo is listed without publication information, but described as «di poche carte/a few pages».[58] Other works are simply listed «senza

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53 *Ivi*, p. 234, final entries.

54 *Ivi*, p. 65.

55 *Ivi*, p. 126. The note appears at the end of the entry. This detail might explain why it is listed as an ottavo in ICCU. See http://id.sbn.it/bid/UBOE007203.

56 *Ivi*, p. 56.

57 *Ivi*, p. 52. In the accompanying data set, these are identified by searching the MssNotes column for the words *senza* and *manchevole*. For example: «Delle rime fiorentine di Gio. Soranzo» (p. 212) and «Lettere di diversi nobilissimi et eccellentissimi uomini» (p. 223).

58 *Ivi*, p. 231.

frontespizio» or «senza principio».[59] Most dramatic is the description of the posthumous works of Fermat: «Domini Petri de Fermat Opera posthuma senza principio senza prefazione abbruciato in Roma e fatto raggiustare».[60] Yet, the imperfections were not reason enough to cull the book from the collection, even if a duplicate copy was present. Early in the document, Viviani adds details about the condition of a copy of *Regola delli cinque ordini d'architettura* by Jacopo Barozzio da Vignola (1503-1573): «senza intitolazione per che manca carte nel principio».[61] But, the entry for the second copy of the same work (Siena, 1635) adds the details about the contents of Vignola's treatise: «in folio con l'aggiunta delle Porte di Michelagnolo Buonarroti in tutto i rami sono no. 45».[62] The patient accounting for damaged volumes reads almost as a declaration of the value of contents: the books were worthy of preservation despite their missing pages because of what the remaining pages contained.

This attitude may also explain why Viviani left a few notes about missing and loaned volumes, creating placeholders for their return or memorials to their loss. For the *Saggi di naturali esperienze fatte nell'Accademia del Cimento* (1667) a note was added: «Questo libro Vincenzo Viviani lo diede via».[63] The next entry in the inventory is for a newer edition. Other notes document books that were lent but not returned. Of a collection of letters from French Jesuits to their coun-

59 See for instance, the entry for Verdizotto's *Cento favole* (n.d.) missing its frontispiece (*Ivi*, p. 83), and the *Orlando furioso* (Venice, 1556), missing its beginning (*Ivi,* p. 195). A *Promptuarium Catholicum* was missing both the cover and the beginning (*Ivi*, p. 202).

60 *Ivi*, p. 52. English translation: «Pierre de Fermat, posthumous work without beginning and without preface, burned in Rome, and fixed». The note for this entry in the online library omits reference to the descriptive status of the book.

61 *Ivi*, p. 14. English translation: «without the heading because it is missing the initial page».

62 *Ivi*, p. 14. English translation: «in folio with the addition of the Doors of Michelangelo Buonarroti; in total there are 45 copper plates».

63 *Ivi*, p. 52. English translation: «Vincenzo Viviani gave this book away».

terparts in other countries, the note reads: «Questo libro fu prestato da Vin. Viviano e non riavuto».[64] Under the listing for a copy of Boiardo's *Orlando innamorato* (Venice, 1545), the same hand has written another entry: «Un altro simile esemplare quale è del Sig. Gio. Battista Nelli».[65] At some point, however, the entry describing Nelli's copy was crossed out, perhaps because the volume was given back to its owner. Nelli was the architect that designed and helped to implement the Palazzo dei Cartelloni. Nelli's son would eventually come to own most of the Galilean manuscripts in Viviani's collection and several volumes with annotations in the hands of Galileo, his students, and his detractors.

Had Viviani wanted to report a total of books in a given format or the range of years that his collection covered, he or his assistants could have easily counted materials based on the contents of the manuscript. The structure and patience of the document suggests that the emphasis was on the contents of the books, insofar as they could be represented by their titles and basic bibliographic information. In only one instance does Viviani comment on rarity of a volume: the entry for Giovanni Paolo Lomazzo's *Trattato dell'arte della pittura, scultura, architettura* (Milan, 1585) includes the note: «et non si trova per esser raro».[66] All of the books were valuable enough to Viviani to be collected, stored, and described, despite their inconsistencies and unique characteristics. The deeply contextual nature of the manuscript both facilitates and challenges the reassembly of Viviani's collection in digital form.

Viviani's Books as a Digital Library

The representation of Viviani's collection as a digital library is not

64 *Ivi*, p. 78. English translation: «This book was loaned by Vin[cenzo] Viviani but not given back».
65 *Ivi*, p. 102. English translation: «another similar exemplar, which belongs to Sig. Gio. Battista Nelli».
66 *Ivi*, p. 200. English translation: «which is not findable because it is rare».

the equivalent of a searchable version of the manuscript, but instead a database of the books represented according to modern principles of discoverability and documentation. The digital library within the Museo Galileo portal *Vincenzo Viviani allievo di Galileo* is built from a combination of the information available in the manuscript, thematic understandings of the books, and a search for extant volumes from Viviani's collection.[67] As a digital representation of the books signaled by Viviani's manuscript, the portal affords a complementary way to understand the intellectual profile of one of Galileo's students, a mathematician and geometer, and a Florentine civil engineer. Edited by Stefano Casati and Adele Pocci, in collaboration with other specialists, the searchable database of Viviani's library is part of a suite of tools for better understanding Viviani as a scholar (via a database of 25 instruments that he bequeathed to the Ospedale di Santa Maria Nuova) and his efforts to memorialize Galileo (via a section dedicated to the Palazzo dei Cartelloni). The portal also provides a description of the two manuscripts that contain information about Viviani's book collection. For the books, the database organization includes topical categorization and bibliographic information that are searchable fields to make the navigation of such a large collection more manageable.

Herein lies the productive tension between the manuscript and the necessities of connecting the analog textual information to digital resources. The site required both semantic modeling for searchability, thematic ontology creation and application, as well as the reidentification of authors, editions, and digital facsimiles when available. Author, date, and language information has been extracted and standardized. For hundreds of entries for which Viviani omitted a place of publication, one has been supplied. His alternate use of Arabic and Roman numerals for publication years has been changed to all Arabic. These changes are tremendously helpful for the scholar studying the books, but the textures of the manuscript are necessarily flattened.

67 Casati-Pocci 2023.

The standardization overcomes challenges of discoverability that relate to shorthand, paraphrasing, and even local dialect, which are then revealed in comparison to the manuscript. To facilitate searching across the idiosyncrasies of the manuscript's orthography and descriptive conventions, the database relies on how titles appear on title pages or in digital library catalogs rather than how they were written in the manuscript. For example, Viviani lists a copy of *Le Machine tanto spirituali, quanto d'animale* (Machines, as many spiritual ones as animal ones; 1629) by the Roman Giovanni Branca (1571-1645).[68] Yet, the title page of the book reads *Le Maghine*, both *spiritali* and *di animale*. While Viviani's Tuscanization of the title is not captured in the digital library, the book's title is represented faithfully in the digital library entry. Further comparison between the manuscript and the representation of the books in the digital library would reveal other linguistic markers of interest.

Sometimes the title information augments what Viviani provided, drawing attention then to what he omitted. For example, Viviani truncated his entry for Lodovico delle Colombe's *Riposte piacevoli* (Pleasant Responses, 1608), a reply to the pseudonymous Alimberto Mauri, now understood to have been Galileo. The contours of the debate were well known to Viviani, and perhaps not necessary for documenting the intellectual value for future readers, particularly since Galileo had argued that there was very little value in the book to begin with. In contrast, the database title transcribes every line of the title page. Alternatively, the first entry in the manuscript is for a folio volume by Seneca, for which Viviani provides a transcription of the full title page including the names of the commentators included in the volume; only the first 7 words are part of the entry in the digital library. So, while these titles, likely drawn from their equivalents in modern digital bibliographic entries for the books, are searchable, Viviani's subtle judgments of valuable contents are only visible in the manuscript. The

68 Viviani 1702, p. 130.

two representations of his library are then complementary, but not substitutes or surrogates.

By foregrounding the books, the digital library is able to connect entries to scans of extant copies, and thus the content. For each entry, a status field indicates whether the exemplar from Viviani's library has been reidentified (238 entries), if the edition referenced in the manuscript has been identified (more than 1,400 entries), or if the information in the manuscript was too vague to attach to a specific edition (31 entries).[69] Some of the online catalog entries contain notes related to sources and scholarship; some entries have provenance information. This layer of data augments the manuscript both for larger-scale digital research and for analysis of the period that relies on close reading.

Similarly, the class field added by the editors provides a valuable overview of the breadth of subject matter in Viviani's library: 17 main topical categories and more than 40 subcategories encompass fields that range from agronomy to technology. (Table 1) The emphases on sciences and mathematics are to be expected. The fact that literary works comprise the second largest category is likely an artifact of this group of texts not being divided into forms or genres in the same way that branches of the sciences were.

Class	Number of Titles
Architettura	48
Aritmetica e Algebra	30
Arti diverse	37
Astronomia	293
Diritto, politica e storia	90
Erudizione varia	51

[69] Two other extant volumes are classified in the Galilean manuscripts at the BNCF, which might be why they are not identified during the search for books with signs of Viviani's ownership. Notes in the volumes indicate that Viviani received them from Galileo's son. See Sizi 1611; Grassi 1619.

Filosofia e pseudoscienze	132
Geografia	56
Geometria	161
Letteratura	262
Matematica	109
Medicina	81
Religione	127
Scienze e tecnologia	53
Scienze militari	30
Scienze naturali	46
Scienze fisiche	127

Table 1. Summary of the entries provided in each topic category of the digital library of Vincenzo Viviani. Class headings are those found on the project website.

There are 1,733 categorized titles.[70] The perspective provides a high-level quantitative and qualitative overview of Viviani's collection. Of note are the 81 medical texts, given that Viviani bequeathed his collection to the Santa Maria Nuova hospital library and that 120 exemplars with provenance from Viviani can now be found at the Biblioteca Biomedica in Florence. Further comparative work could begin to fill in more information about the separation of the collection in the mid-18th century and the paths of different genres through private and institutional repositories. The pencil symbols and tallies of the manuscript pages likely overlap with phases of the collection's dispersal. Each title is connected with an author and a category, which means that a different kind of representation is necessary to evaluate the extent to which Viviani owned multiple copies of works (seen in the next section).[71] The database foregrounds the unique books that

[70] The research team made this tally by expanding the entries for all authors in each category and making a count.

[71] There are also several cases in which the edition information for a book in the manuscript conflicts with the entry in the digital library. The documentation has

are represented by the manuscript, not the titles as expressed in the manuscript itself.

Thus, similarly to the tally at the bottom of each page of the manuscript, even the sum of the categorized materials in Table 1 does not consider all volumes in the many multivolume sets in the collection. Where Viviani indicated subsections of books as separate entries, he also occasionally collapsed several volumes into one entry. The digital library, representing the books, and pointing to scans, sometimes splits apart what had been one entry in the manuscript, and at times combines manuscript entries into one digital catalog entry. In that sense, the online version of the collection offers a way to see the books that Viviani otherwise expressed primarily as titles, printers, and formats. Isolating the volumes for which he provided an itemized table of contents in comparison to the accepted title of a work could bring to light further contours of Viviani's priorities for representing the library.

In sum, the digital library is a powerful research instrument given the accessibility of digital facsimiles of the volumes and the database structures to assist discoverability. The digital facsimile of Viviani's manuscript equally offers access to details about the collection, which gain new understanding when read against the digital library. The final representation investigated in this article addresses the strengths of a transcription of the manuscript when compared to the digitized manuscript and digital library.

Viviani's Library as a Spreadsheet

While thematic groupings can provide one high-level understan-

not been posted for how the editorial team handled entries in the manuscript that were thought to be erroneous. The discrepancies that we noted are documented in the Comparison column of the spreadsheet. See, for example, Giovanni Antonio Magini's *Tabulae Primi Mobilis* (Venice, 1604; Viviani 1702, p. 10). In the digital library it is listed as a 1606 edition and links to a scan for an Italian translation of the work.

ding of the collection and lists of search results of features are another, the research team was interested in searching and counting elements of the library that Viviani had curated in his own words. Admittedly, the work of creating the tabularized edition of the catalog began as a way to better understand the relationship between Viviani and Galileo, but the results point in a different direction. The data set provides an opportunity to explore quantitative summaries of the collection as represented by the manuscript, the distribution of features across the pages, and a comparison with the digital library and its underlying database. More patterns are waiting to be found in this data than we can report here.

For this reason, we are making available the tabularized transcription of the manuscript used to create the graphs and tables in this article.[72] The entries have been digitally transcribed to make them searchable and the information written on the manuscript is presented as a spreadsheet of rows and columns to allow for sorting, filtering, and counting. Search is limited to words as they appear in the transcription; they have not been generalized into a lexicon, categories, translations, or other more abstract layers. The research team is working on this future version of the dataset to facilitate comparison with Galileo's library and other collections of books from the period.

The transcription was completed in August 2021 based on images taken by the author at the BNCF in May 2018 and later compared to the scan now available through the Museo Galileo.[73] Viviani did not number the items of the manuscript, but an ID number has been added to each entry in sequential order to assist with navigating, sorting, and analyzing the data. Standardized author information has been added to match the conventions used by the Museo Galileo database to facilitate easier comparison and use of both resources. Abbreviations of names in the book descriptions in most cases have not been expanded, but Latin shorthand for suffixes have been. Printers and places of printing have been placed in separate columns, and the names

72 Hall 2025.
73 Museo Galileo 2025.

have been standardized. The page numbering irregularities have been corrected for the data analysis, but remain in the transcription. *Sammelbande* contents and the itemized sections of books that Viviani included in a single entry or labeled with a bracket are identified in the BoundWith column using the ID number. Notes in the manuscript extraneous to the bibliographic information are transcribed in the MssNotes column along with indications of where the red marks are visible. A language column indicates the language of the title, which at times may contradict the language that Viviani noted for the entry or the language(s) of the content. Blanks in the spreadsheet mean that the information was not present in the manuscript.

Every effort has been made to faithfully capture the titles and notes as written on the pages of Viviani's manuscript, as opposed to how they may have appeared on title pages or colophons. For this reason, readers of the transcription will find a few [sic] indicators of obvious errors as well as the pagination corrections mentioned earlier, but there may also be other discrepancies between the digital library and this transcription. Inserted text is addressed in line. The few instances of mostly illegible cancelled text were not reproduced.

The spreadsheet representation of the manuscript includes 1,955 entries representing more than 1,000 unique authors with dates of creation or printing encompassing the years 1467-1702.[74] The earliest year for an entry in the collection is associated with the *Hypnerotomachia Poliphili*, mentioned earlier. The latest work was Viviani's own. The year of publication was not provided in nearly 90 instances, many of which were multivolume sets or entries for titles either printed or bound with others.

As one might expect from Viviani, and as was reflected in the digital library, the level of detail in the description was precise enough that many of the entries in the manuscript could be connected to specific editions in the digital library, and nearly all to their authors. Author

[74] When doing a comparison of the entries in the manuscript to those in the digital library to align author information, we also noticed that page 134 of the manuscript had seemingly been skipped, amounting to 9 entries.

information was either provided in the description or easily inferable such that only 2 authors could not be identified based on a book's description provided in the manuscript. There are 26 anonymous works, 14 by various authors. Unsurprisingly, the authors with the most entries are Euclid (28), Galileo (20), Kepler (18), Archimedes (15), and Ptolemy (14). Interestingly, among other authors in the top 20 are several other mathematicians and natural philosophers, but also the medieval poet Petrarch (11 entries) and Galileo's favorite Renaissance poet Ludovico Ariosto (10 entries). 683 authors only appear in a single entry.

The languages of the manuscript did not always match the languages of the books. Titles in the manuscript were written in five languages: Latin (1,128), Italian (699), French (110), Spanish (8), and German (1). For the German title, *M. Pieter Wils Wis - Kostinge Wercken* (1653), a note in the manuscript says that the book is in English («in inglese»).[75] Arabic text is embedded in books with Latin titles, such as *Muhammedis Fal Ketini Ferganentis qui vulgo Alfagranus dicitur Elementa Astronomica arabice, et Latine cum notis ad res exotices, sive orientales, quae in iis recurrunt opera Jacobi Golii* (1669).[76] Admittedly, these examples immediately problematize any reading of the manuscript as a whole.

Charting the distribution of the collection across languages and years of publication or creation relies on how Viviani expressed the titles of his books and manuscripts. Using only the language of the descriptions, we can see a collection that is remarkably consistent in Italian titles across the decades 1550-1680 (see Fig. 1) Yet, the amount of Latin material dwarfs the Italian volumes in the seventeenth century, despite most modern scholarship acknowledging a decline in Latin publishing at the time. The collection of French titles, while modest, gestures towards Viviani's European connections and interests. Viviani also owned French translations of works like Seneca's letters and Aesop's fables, for which abundant Latin and Italian editions

75 Viviani 1702, p. 59.
76 *Ivi*, p. 100.

were also available.[77]

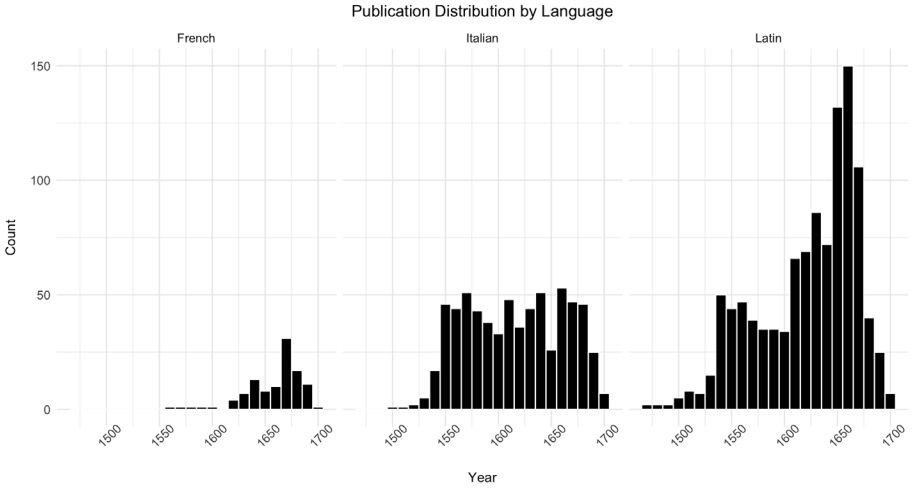

Figure 1. Quantities of titles in the three most common languages in the manuscript descriptions, organized by decade.

Far less prominent are the 8 Spanish titles, not pictured in Figure 1, likely a reflection of the continued political and military conflict and the Aragonese control of Milan, Naples, and other areas of the peninsula. The books are spread across more than a century of book production, 1548-1693. They include one mathematics text, a popular description of the Spanish war with Germany, the collected lives of saints, the sayings of King Alfonso, and a mirror for princes. There are also three Spanish translations: Ovid's *Metamorphoses*, Virgil's *Aeneid*, Paolo Giovio's *Emblems*. A final text cuts across linguistic lines, but was described in Italian: Florentine Lorenzo Franciosini's tri-lingual collection of theatrical excerpts *Rodomontate, o Bravate Spagnuole* (1627). A note in the manuscript explains that the book contained passages in French, Italian, and Spanish.[78] Perhaps because of the conflicts with Spain, or as a residue of Galileo's overtures to the Spanish court regarding the calculation of longitude, this small subcollection seems evident of someone learning the language through comparison to more familiar texts.

77 *Ivi*, p. 222.
78 *Ivi*, p. 222.

While the language information was inferred from the entries, the quantitative understanding of the geographic distribution of book production relied on the details provided or omitted by Viviani in his descriptions. The manuscript was quite consistent with listing the place of publication of the books (117 omissions), slightly more often than the printer (209 omissions). The geographic information, when extrapolated from the city-level data provided by the manuscript, shows the overwhelming number of books in the collection that were produced in Italy (see Fig. 2). Again, this is presented with the caveat that books printed in distant places could have been considered local for their connection to the author or the content.

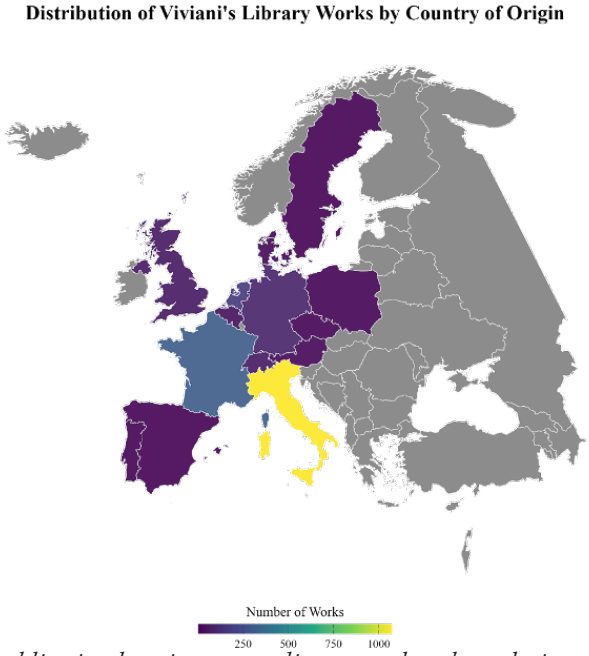

Figure 2. Map of publication locations, according to modern boundaries, of the 1,837 entries with city-level information in Viviani's 1702 catalog. Maximum is Italy (1,071 titles), minimum are Sweden and Portugal (2 titles each).

In a notable difference with Galileo's library, Viviani's collection shows more engagement with books printed in the Netherlands (170) and Denmark (14), Britain (56), and Poland (7). When mapped

against the frequency of Viviani's correspondence in these locations, we might better understand the extent to which his contacts over the Alps sent books or, like he did with the bookseller Carlieri, Viviani relied on book lists and trade networks to gain access to these titles.

Like the publication location, the format information was also nearly complete (only 91 omissions). The consistency of the formats from entry to entry also provides a sense of library organization. The manuscript had been precise about in which room and on what shelf the inventory began, so the compilers needed to move through the library space(s) as they wrote. They began with folios, moving through formats that were also typically smaller in size. On manuscript page 187 (corresponding with ID 1409 in the spreadsheet), the format organization started anew with another set of folios.

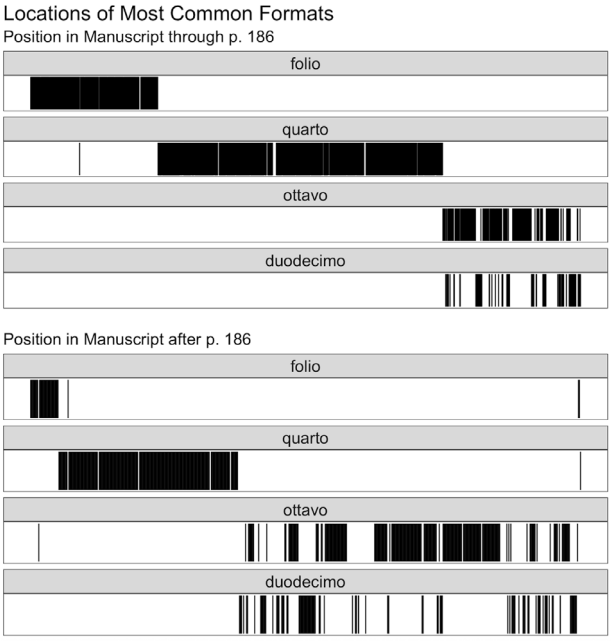

Figure 3. Dispersion plots of the occurrences of the four most common book formats in the collection. The x-axis marks the order of titles as they appear in Viviani's 1702 catalog. A black line indicates the title was identified with the format. The top half of the graph visualizes 1,307 titles on pages 1-186; the lower half visualizes 479 titles on pages 187-234. Note that white spaces can indicate that no format information was provided in the manuscript.

Viviani's works are the final entries, accounting for the folio and quarto volumes that appear at the end of the distribution plot in Figure 3. The consistency of the format organization can then perhaps give an indication of the similar sizes of some of the volumes. Some duodecimos were interspersed with the ottavos. Not pictured are 52 books in the seidecimo format, 17 in 24o, and 7 in 32o. This quantitative overview provides a high-level glimpse of the organizational logic that Viviani applied to the manuscript, if not the storage of the collection itself.

The spreadsheet representation of the manuscript also makes it easier to see the duplication and redundancies present in Viviani's library, simply by sorting by author or by title. He owned multiple editions of the same works by dozens of authors.[79] Viviani also owned more than one copy of dozens of books. Sometimes the copies appear consecutively in the manuscript and are explicitly labeled as duplicates, with a note such as «Eiusdem alterum exemplar» (another exemplar of the same) or «Altro esemplare» (another exemplar).[80] His second copy of updates from the French Royal Academy of Sciences is listed in French: «Un outre sans les figures de la meme editione».[81] It is the only descriptive note in French in the manuscript. Others, like Heron's work on machines of war, may have been inventoried twice, since there is no note acknowledging the duplication, and the two entries appear on consecutive pages.[82] At times the duplicate copies present inconsistencies in format or publication information.[83] Sometimes the

[79] *Ivi*: Schonbell's *Algebra* (p. 76, 124), Calepino's dictionary (p. 47, 53), Pietro Mengoli's *Anno* (p. 112, 139), Apollonius on conics (p. 26, 35), and Sannazzaro's *Arcadia* (p. 181, 184).

[80] See the spreadsheet IDs 1142 and 1543, respectively, for example.

[81] Viviani 1702, p. 165: «Another without the figures of the same edition».

[82] For Heron, see *Ivi*, p. 130 and 131. See also Eustacius on Saturn (Rome, Dragondelli, 1660), *Ivi*, p. 142, 143.

[83] See for example the entries for Ismael Boulliau on the nature of light (1638; *Ivi*, p. 88, 157). One is identified as ottavo, the other quarto. Torsellini's *Historiarum ab Originem Mundi* (1628) has a note «iuxta exemplar» but one is listed as

second copy is part of a *sammelband*, as was the case with Viviani's two copies of a work on holding one's breath underwater.[84] Other second copies are listed in the second section of the manuscript after the format organization started anew, which, with further analysis and comparison of the titles and contents, contextualized against phases of Viviani's development of projects may offer clues to the kinds of spaces (i.e. active or storage) in which the books were kept.[85]

Having offered a preliminary overview of the collection here, there is still more that the data set can offer. Questions remain about printers, densities of authors, depth of duplication and multiple editions of works, as well as the title information itself. When paired with information from the digital library, the topical information and edition specificities as they appear in the books offer a way to better understand omissions, truncations, and discrepancies as part of Viviani's overall intellectual project of establishing a legacy.

A Comparative Reading of Viviani›s Library: A Search for Galileo›s Books

That question of legacy motivates the final section of this analysis, a comparative reading across the correspondence, the details of the manuscript, the search features of the digital library, and the quantitative affordances of the spreadsheet. Galileo has appeared throughout this article, despite the focus on Viviani. Admittedly, part of the authors' motivation for transcribing the manuscript was to better identify overlaps between Viviani's list and other sources for

having been printed in Paris, the other in Douai (*Ivi*, p. 207 [211]).

84 Michelangelo Lapi's *Discorso sopra il tempo che si possa star sott'acqua e non morire* (1670) is listed twice *Ivi*, p. 234.

85 *Ivi*, including Vincenzo di Grazia's commentary on Galileo's *Discourse on Floating Bodies* (p. 62, 190), Vincenzo Galilei's 1581 *Dialogo della musica antica e moderna* (p. 22, 189), Christoph Scheiner's *Oculus* (p. 126, 191), Napier's *Logarithmorum* (p. 67, 206 [210]), and Carlo Dati's *Prose fiorentine* (p. 176-217).

the books owned by Galileo. This example of a comparative reading across representations builds on traces left in the margins by previous scholars: red dots that align with Antonio Favaro's late-19th century catalog of Galileo's library. These 126 marginal red dots are listed in the manuscript notes column (MssNotes) of the spreadsheet built from the manuscript, but they resist interpretation without context and comparison to documents including Favaro's research, but also Viviani's correspondence, extant volumes, and a visualization of the dots' frequency based on the spreadsheet.

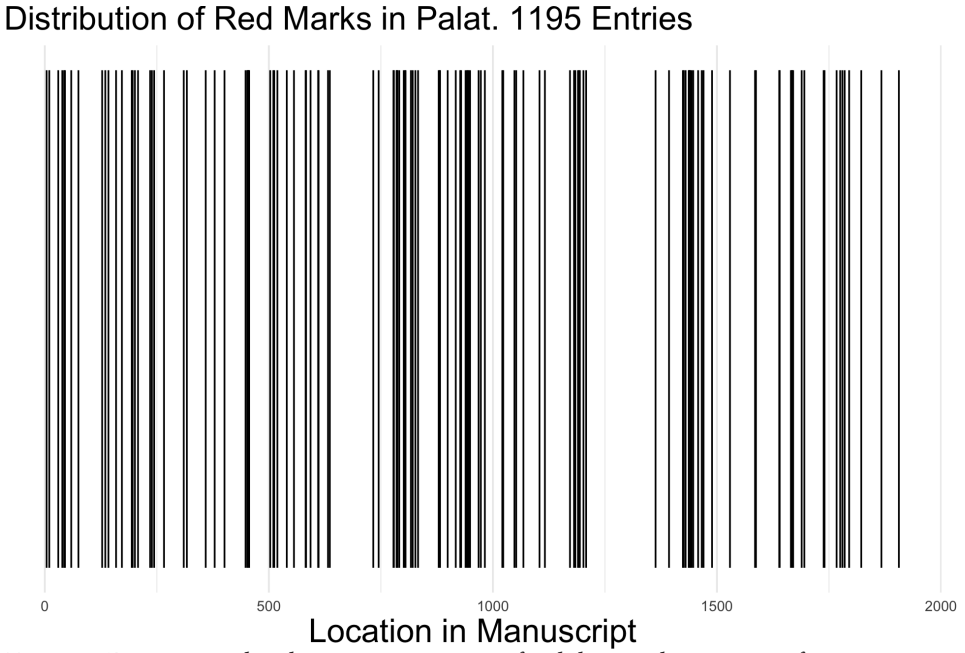

Figure 4. Dispersion plot showing occurrences of red dots in the margins of certain entries in Palat. 1195. Apparent thickness of black lines corresponds to several marks in quick succession in the manuscript.

All but two marked titles in Figure 4 directly correspond to entries in Favaro's «Libreria di Galileo» series of reports in which Favaro listed Viviani's manuscript as one or the only source for connecting

a title to Galileo's library.[86] Yet, Favaro cited Viviani's list 141 times as a source for corroborating the presence of a title in Galileo's collection. The quantitative discrepancies are multiple: 16 of the titles for which Favaro credits Viviani as the source are unfindable in the manuscript, two have different years of printing from what Favaro listed in Galileo's library, and 18 lack a corresponding red dot. The titles that lack a red dot are almost entirely written by Galileo or are on topics of astronomy; the titles unfindable in the manuscript represent a mixture of genres and subjects. These inconsistencies between the 126 red marks and Favaro's cited use of the manuscript point to an intermediary source that connected entries across the two collections. Viviani's list was almost entirely silent about explicit declarations of this sort.

The one exception in the manuscript nonetheless lacks a red dot. Only one book in Viviani's collection was explicitly labeled as having been Galileo's: one of Viviani's four copies of the 1544 Basel edition of Archimedes' collected works.[87] Viviani adds the descriptive note to the bibliographic entry: «qual è senza frontispizio, e senza fine che già era di Galileo Galilei».[88] Not only is the entry missing the red dot, an exemplar at the BNCF contains Viviani's copy of Galileo's notes, not the originals that would have presumably been in the copy that he described in the catalog.[89]

Even some of the consistent elements within both Viviani's catalog and Favaro's description of Galileo's library are problematic. For many of the titles that overlap between the two libraries, there is evidence that Viviani was looking for the volumes after Galileo's death, suggesting that these books did not pass from mentor to student.[90]

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86 The two exceptions are the miscellany *Uranologium* (1630) on *Ivi*, p. 7 and Giovanni Ferrerio's *De animorum immortalitate* (1639) on *Ivi*, p. 81.

87 *Ivi*, p. 26, 27, 35, and 36.

88 *Ivi*, p. 27.

89 Archimedes 1544.

90 Two other examples do not have red marks. One of Viviani's contacts in Veni-

Among the items with red dots, Melchisedec Thévenot sent Viviani Girolamo Sirtori's *Telescopium* (1618) from Rome in 1643.[91] In spite of Thévenot's concern that the book and a separate letter might have missed Viviani in his travels, a copy of the work did find its way into the final inventory of Viviani's library.[92] The red mark next to the title is a trace of Favaro's work to connect the manuscript to Galileo's library in the 1880s. Thévenot's 1643 letter calls into question this link.

Similarly, Elia Diodati wrote to Viviani in June 1656 with prices for books that Viviani had requested. Among the 53 titles were Jean Tarde's *Borbonia sydera* (1620) and Ismael Boulliau's *De natura lucis* (1638). Both of these books were in the Galilei family library in 1649, listed in the same section of the inventory that had once been thought to be books given to Viviani.[93] Favaro (or his research partner) placed a red mark next to each title in the manuscript. The digital library project did not recover an extant copy of Tarde's work, but Vivani's copy of Boulliau's work on light (now in the Biblioteca Biomedica) contains no obvious traces of Galilean provenance.

If the books with red dots were Galileo's books, Viviani did not indicate it. He only singled out the Archimedes volume. The comparison of representations brings to the fore the competing messages of the 1702 list and its interpretation in the context of Viviani's projects to memorialize Galileo. If Viviani owned more books that were obviously Galileo's, this list was not meant to disclose them beyond the Archimedes volume. The manuscript was instead a way to document conditions, formats, contents, and sometimes rarity of volumes in the

ce, Giovanni Bellincioni, sent Viviani the *Epitome* of Kepler (1622) in May 1654 (Galluzzi - Torrini 1975, Vol. 2, p. 145-146). Also, in early 1643 Borelli sent *Ars Sanctorii Sanctorii de Statica Medicina* (1634), another title that was in Galileo's collection (Galluzzi - Torrini 1975, Vol. 1, p. 35).

91 Galluzzi - Torrini 1975, Vol. 1, p. 72.

92 Viviani 1702, p. 126.

93 ASFi (Archivio di Stato di Firenze), Fondo notarile moderno, Notaio Pantera, Silvestro, 3483.3, 1649, c. 114r-114v.

larger context of European print history.

Conclusions

The three lenses of manuscript details, digital library features, and quantitative data all reveal the comprehensiveness of the collection. Viviani had intended for his library to have perpetual use for teaching Florentine students about the sciences and the arts when he bequeathed it to the Santa Maria Nuova Hospital. The 234-pages of the manuscript that offer testimony of that bequest hint at memorializing Galileo, but emphasize completeness and accuracy, making value claims through representation of a broad intellectual repertoire. The combined digital projects are, in a way, preserving that intent, by creating opportunities to study the collection as a whole, even if the books themselves were long ago dispersed.

Nonetheless, every later reader has imposed an interpretation on the manuscript that pushes the entries to reveal something beyond their original intent. From early readers that were tallying or tracking titles to Favaro (or his team) marking overlaps with Galileo's collection, the manuscript contains traces of reading against or despite the details offered by the descriptions of the titles. The details about completeness, composition, and format are difficult to see in the digital library, given its necessary focus on authors, subjects, and access to copies of the books. The spreadsheet emphasizes quantity in a way that Viviani explicitly did not, shows duplication that went otherwise unremarked, and separates information about publication location, printer, year of publication, format, and notes from the full entry.

Yet, alongside these tensions are also the benefits of the digital affordances. The digital library provides navigational tools for entering and consulting the materials in a way that the manuscript could not. The entries essentially fill in the blanks of the manuscript, providing details that Viviani omitted. The uniformity required by the underlying database assists in discoverability and analysis. Similarly, the

tabularized edition in the spreadsheet allows for grouping, sorting, and counting in order to describe the kind of intellectual profile that Viviani's library represented.

When taken together, these three versions of Vincenzo Viviani's library show a collector that was attentive to every detail, but also truncating, duplicating, omitting, and editing the information about his books in order to create a curated representation of Florentine intellectual life. These features would be otherwise undetectable if the representations were considered in isolation, but when compared they point to personal and institutional histories that reveal contexts and behaviors that impact what can be understood about Viviani and his cultural milieu. For this reason, we recommend that future historic library projects are designed to facilitate not just discoverability, but comparison across the primary source, the digital representation, and the underlying data.

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Abstract

In 1702 Florentine mathematician and engineer Vincenzo Viviani (1622-1703) signed the end of a 234-page manuscript that listed nearly 2000 titles of works in his library. The material spanned manuscripts, incunables, and print volumes published through 1702. Since Viviani had fashioned himself as the final student of Galileo Galilei (1564-1643), the manuscript was used in the late-nineteenth century as a source for re-identifying editions of books in Galileo's library. Using the manuscript, the digital library of Viviani's collection created by the Museo Galileo in 2021, and a tabularized edition of the manuscript, this article provides an overview of the library and explores the strengths of each type of source for learning more about Viviani's books and for understanding him as both an intellectual and bibliophile. The authors argue that the comparative approach offers a way to access features of the collection that are not revealed by any representation in isolation, and we advocate for future web-based projects to integrate digital surrogates of the primary source material and make the underlying data available to facilitate this kind of research.

Vincenzo Viviani; Galileo Galilei; Digital libraries; Digital humanities.

Nel 1702 il matematico e ingegnere fiorentino Vincenzo Viviani (1622-1703) firmò le ultime righe di un manoscritto di 234 pagine nelle quali si elencavano i titoli di quasi 2.000 opere nella sua biblioteca personale. Il materiale comprendeva manoscritti, incunaboli e volumi a stampa pubblicati fino al 1702. Dato che Viviani si presentò come l'ultimo discepolo di Galileo Galilei (1564-1643), il suo manoscritto fu consultato successivamente come fonte per identificare le edizioni dei

libri presenti nella biblioteca di Galileo. Attraverso l'analisi del manoscritto, della biblioteca digitale della collezione libraria di Viviani creata dal Museo Galileo nel 2021 e di un'edizione del manoscritto presentata in forma tabulare, questo articolo offre una sintesi della biblioteca del discente galileiano e, in modo comparativo, esplora i punti di forza di ciascun tipo di fonte per approfondire la conoscenza dei libri di Viviani e per comprendere meglio questa figura nel ruolo di intellettuale e bibliofilo. Da queste premesse si vuole mostrare come l'approccio comparativo permetta di cogliere attributi e aspetti della biblioteca di Viviani che, altrimenti, non emergerebbero dalle singole rappresentazioni della stessa prese isolatamente. Infine viene uspicata, per i futuri progetti analoghi a quello presentato, l'integrazione tra l'oggetto digitale della fonte primaria e i relativi dati costitutivi, i quali devono essere resi accessibili e disponibili.

Vincenzo Viviani; Galileo Galilei; Biblioteche digitali; Digital humanities.