

## Flaps, Volvelles, and Vellum in Pre-Modern Movable Manuscript and Print

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### ABSTRACT

Manuscripts, printed books, and stand-alone prints or broadsides with relief and intaglio illustrations are known with movable parts from throughout the history of printing, with even earlier manuscripts dating back to the twelfth century. This article seizes the opportunity of recently-digitized materials to offer a preliminary visual analysis of the ways some of the earliest medieval and early modern printers and designers conceptualized, printed, and secured these flaps and dials to contain the greatest amount of possible knowledge and to offer the greatest ease of access. Practitioners and publishers who experimented creatively with these formats include Lambert of Saint-Omer, Matthew Paris, Johannes Regiomontanus, and Georg Phillip Harsdörffer. Evidence of the popularity and frequent use of their movable books survives in the form of vellum and paper engineered components, manuscript copies, uncut sheets of components, and in the constructed books themselves.

### KEYWORDS

Interactive; manuscript; volvelle; flap; vellum

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Flexibility, timing, and survival: these vital aspects allow the study of early modern movable books today. The keynote lecture upon which this article is based likewise introduced one of the most important and tenacious conferences on paper engineering in recent history. The fact that the *Pop-App 2020 International Conference on Movable Books* (originally scheduled for February 27-28, 2020) still took place during the Covid 19 pandemic—albeit virtually, a year later—is a testament to the importance of the occasion and the topic. A few changes were made to the overall program, including the welcome inclusion of the Movable Book Society, an organization now nearing its thirtieth year. Considering these extreme circumstances, it was even more of an honor to help further this research and the new International Study Center on Interactive Books. Many thanks are due to the tireless efforts of Gianfranco Crupi and Pompeo Vagliani in persevering on this venture, and to the Fondazione Tancredi di Barolo for sponsoring this important scholarly project and the exciting new journal in which this article appears.

The history and basic components of early modern paper engineering are well known to the conference audience and to the readers of this journal. This article will focus on the origins and adaptations of early volvelles and flaps, and aspects of their materiality. In its initial form as a survey keynote, it was entitled “Medieval, Renaissance, and Baroque: The Movable Feast of European Pop-Up Books” and it served as a bookend to Jacqueline Reid-Walsh’s discussion of works of the nineteenth and twentieth century and beyond. The revised article reconsiders this topic in light of the conference and its unusual circumstances. Befitting the international origins of the books themselves, the *Pop App* conference—and the 2019 exhibition and publication that preceded it—included a wide range of new approaches, amply demonstrating that current conservation practices and studies of the signs of use are two sides of the same investigation. Both can help preserve these complicated movable publications without keeping them from being displayed and used.

Likewise, recent digital approaches to studying and creating movable books offer newfound forms of access and imagination. Ideally, movable book scholars would never do this work without touching the actual books. Nor would research proceed without using physical manipulation to discern how they were originally made, all the while searching for signs of previous use. But especially during the pandemic, the proliferation of digitized copies, with all their potential sequencing flaws and omissions, has proven more beneficial than counterproductive. In fact, two of the earliest examples of vellum engineering described below are unique autograph manuscripts that the author has not yet seen in person, yet discovered in the last year that they had been made digitally available. Understanding medieval and early modern movable books requires the study of as many copies as possible, and ideally, the ability to consult them internationally to divulge their scientific, artistic, historical, and literary significance. The following discussion of early modern interactive books focuses on concepts of chronology and permanence within the movable canon, especially the material evidence of the ways in which these fragile, yet persisting movable images were produced, and the techniques their creators used to make the books move for them. Extraordinarily hands-on by nature, interactive books have always begged for an audience.

## Manuscript or Print: The First Flaps and Dials

Some modern milestones for the beginning of the organized study of movable books include Ann Montanaro's *Pop-Up and Movable Books: A Bibliography* of 1993, which led to the Movable Book Society's founding, and Sten G. Lindberg's 1979 article on "Mobiles in Books" for *The Private Library*. Isolated studies of paper engineering for earlier material preceded these publications, going back to a spirited exchange of gentlemen collectors and book dealers in mid-1870s London in the *Notes and Queries* journal on the earliest "Movable Figures in Books" (R. C. 1875). The evergreen question remains: What was the first use of the volvelle or flap? "Paper" engineering long preceded paper, with a single intact vellum volvelle example that still turns dating from as long ago as 1250 A.D., while flaps have been present as a variety of extensions, overlays and gatefolds in use by 1121 A.D. Manuscript volvelles are still being discovered as libraries continue to digitize, and sometimes copies provide evidence of other lost volvelles, but the time is right for a reassessment of the information we already have, starting from some assumptions about the power of print, and moving backward in time.

Despite their seeming isolation within the relatively small circle of copies circulating within medieval and premodern manuscript culture, interactive devices that made it into print are not the only ones that only counted or subsequently proliferated. One frequently-cited bibliographical jumping off point was Margaret Stillwell's claim that Johannes Regiomontanus (1436–1476) authored the very first printed volvelle in a book in his German *Calendar* of 1474, which he printed at his own Nuremberg press (Stillwell 1964). A well-preserved and lavishly colored 1476 Latin printing of it as the *Kalendarium* by Erhard Ratdolt in Venice from the Art Institute of Chicago collection shows just how popular the conceit became in short order (Fig. 1).

Even though Regiomontanus died prematurely in Rome that year, it was already its third edition, and other versions of his text continued into the early sixteenth century (Bernini 2020, Chapter 5). Ratdolt's edition replicated Regiomontanus's careful use of doubled-up card stock to increase the stability of its final pages bearing the dual-dial volvelle and other functional scientific devices made of paper. Regiomontanus's famous timekeeping instruments includes his signature lunar dial, the quadrant seen opposite, and the index-string sundial with its articulated brass arm on the following page. They helped situate the book's readers respectively in terms of the phases of the moon, or in the times of day at particular latitudes. The three rivets securing the oval base for the brass arm, or bracciorum, are visible inside the quadrant; Ratdolt and subsequent printers replicated this detailed metal holder for an index string almost exactly. Without it the universal sundial would not have functioned. The book also included a static table of Easter dates valid through 1531, making the next occurrence of this so-called movable feast easier to anticipate, as its sched-



Fig. 1 | Lunar Volvelle Dial and Quadrant.  
In J. Regiomontanus, *Kalendarium*, Venice: Loslein;  
Pictor; Ratdolt, 1476.  
Art Institute of Chicago (1948.343)  
(Photo: AIC)



Fig. 2 | Easter Calendar for 1466  
Anonymous German, hand-colored woodcut with a volvelle, 1466.  
Courtesy National Gallery of Art, Washington D. C. (1944.2.1) (Photos: author)

convenient device also spanned a lengthy time frame, from 1466 to 1484, and was likewise published in multiple German and Italian iterations. Importantly, sewing holes in the National Gallery of Art, Washington D.C impression suggest it might itself have been part of a larger calendar booklet, a combination also seen in an even earlier unique incunable from 1457 now in the Herzog August Bibliothek, Wolfenbüttel. Although brightly hand colored and otherwise well preserved, this nine-folio publication is now missing its volvelle dial.<sup>1</sup>

Even though complete examples do not survive, the presence of the volvelle would make these two booklets likely precursors and possible inspirations for Regiomontanus, as the first printed volvelle, in a book or elsewhere. Yet, of course, others created manuscript versions even earlier.

The Catalan mystic Raymond Llull (c. 1235–c. 1315) circulated manuscripts of his *Great Art* and variants *Ars Brevis* and *Ars Generalis* that spawned numerous copies, the earliest of which to survive to the modern era may have been dated 1306 (R. C. 1875, 17).<sup>2</sup> Llull's work is often cited as first appearing in print with a functioning volvelle in 1514, but there was an incunable printed in 1481, and before that, it was already well known in manuscript form. The “fourth figure” movable dial that Llull developed and included in many of his books—with two

uling was erratic enough to otherwise require calendrical computation. But Stillwell didn't realize that a 1466 woodcut German calendar volvelle for determining the date of that most important Catholic feast, Easter, was published earlier than the Regiomontanus (Fig. 2). There was a trick to it (Parshall and Schoch 2003, no. 54). The angel on the dial must be positioned with its foot on the date in the current year; with this motion, the hand moves automatically forward to indicate the following Easter date. Indeed, a speech banderole notes that: “I give with the foot the past and with the finger the future Easter and the golden number.” Like the Regiomontanus *Calendar* tables and instruments, this



Fig. 3 | Fourth Figure  
In R. Llull, *Ars brevis*,  
Lyon: Baland, 1514. Bei-  
necke Rare Book and  
Manuscript Library, New  
Haven (K8 L97 d514)  
(Photo: Yale University)

<sup>1</sup> The volvelle is on folio 9r of the booklet (1189 Helmst 2): <http://diglib.hab.de/inkunabeln/1189-helmst-2/start.htm>

<sup>2</sup> The mysterious R.C. mentioned above was probably the Cincinnati book dealer and proprietor of Robert Clarke & Co. who described a now untraced 1306 manuscript of Llull's *Ars Generalis* with a volvelle then in his possession. There is also an *Ars Brevis* manuscript (CrMs245 c.1) in the Crerar Collection at the University of Chicago that is dated to 1313, but it does not contain a volvelle. Later authors have misconstrued his entry to describe the book as being located at the British Museum. (Lindberg 1979) cites and illustrates the Vadsena MS (Cod. Ups. C. 51 fol. 4 recto), which may be at the University of Stockholm. An Italian version dated 1438 is missing the volvelle dial, and is partially digitized at Oxford, Bodleian Library MS. Canon. Misc. 26: <https://digital.bodleian.ox.ac.uk/objects/848e0bc2-1ba7-4e48-a5df-c650f2a984f6/>

discs and a third set of concentric circles—was not a calendar, but rather an instrument of conversion, with symbolic concepts wedded to each rotating letter (Fig. 3). The 1481 *Ars Brevis* was printed in Barcelona, and boasts multi-color printing in red, pink, yellow, and black, another rarity along with the inclusion of the volvelle. Only four copies survive, two of which have been confirmed to retain their volvelle, and a third has had that page entirely ripped out.<sup>3</sup>

The Beinecke Rare Book and Manuscript Library copy of the Lyon 1514 *Ars Brevis* retains a well-preserved constructed volvelle secured with a paper square reinforcing the recto knot. In comparison, a 1598 Strasbourg compendium of Lull's works from the Newberry Library retains its unbroached sheet of three sets of double dials folded in at the back (Fig. 4). The first set of volvelle components is also intended for the comparatively brief *Ars Brevis*, the second, identical set is for a section on Lull's works on the Kabbala, and finally the third pair belongs in a version of the *Ars Magna*. While it bears no apparatus explaining where the dials should go, the uncut sheet offers convenient proof of the exact number of movable components that should be installed by the owner or bookbinder. Lull had ambitious plans for his device, and though it remained unadopted in his lifetime as a tool of mass religious conversion, it would prove influential to later thinkers like Pico della Mirandola (1463–1494), who must have seen the manuscript dials or 1481 incunable, and their apparatus as a form of Christian Cabala, while Girolamo Cardano (1501–1576), who included a volvelle in his own printed compendium on the natural sciences, might have read Lull in print (Karr Schmidt 2003, 106–8); (Cardano 1557, 438). Lull's manuscript and print volvelles likely appeared later, but they did so independently of other examples by Matthew Paris (c. 1200–1259), a Benedictine monk from the Abbey of Saint Albans in England (Figs. 5–7).<sup>4</sup>



Fig. 4 | Uncut sheet with six volvelle dials (for pages 8, 55, 245) In R. Lull, *Raymundi Lulli Opera*, Strasbourg: Zetzneri, 1598. Newberry Library, Chicago (Case Y 722 .L95) (Photo: author)

His self-portrait appears in the British Library's *Historia Anglorum*, a volume without the haptic qualities of his other famous work from the 1250s, the *Chronica Majora*. The only one of Paris's two volvelles to have survived is positioned early in this, Paris's magnum opus, an historical compendium manuscript comprised of several volumes. These are now digitized: one as several sections at the Parker Library of the Corpus Christi College in Cambridge, the other at the British Library. Rather than offering a static table or a rota diagram, Paris's vellum dial allowed the reader to turn it, rather than the entire book, to discover the information they sought (Fig. 7; Video 2). This famous dial, now in Parker MS 26, is approximately the same diameter as the 1466 Easter dial in Washington, though it has no concentric rings outside the central dial. As a result, this dial does not perform calculations, and lacks an index or a starting point like the angel's foot. Instead, it acts as a sort of Lazy-Susan of holy days; turning it serves up a hands-on means of accessing lists of movable feasts in a conveniently legible direction.

<sup>3</sup> The Morgan Library and [State Public Library in Palma de Mallorca](#) retain their volvelles; [the University of Barcelona copy](#) is missing most of the relevant page; the Staatsbibliothek in Berlin has confirmed that they own a copy, but its volvelle lacks its dials.

<sup>4</sup> Parker Library MS 26: <https://parker.stanford.edu/parker/catalog/rf352tc5448>



**Fig. 5** | Calendar Volvelle  
In M. Paris, *Chronica majora* [ca. 1250], Ms. 26 (f. Vr). Parker Library, Corpus Christi College, Cambridge University. (Photo: Cambridge University)



**Fig. 6** | Calendar Volvelle. Verso of volvelle leaf  
In M. Paris, *Chronica majora* [ca. 1250], Ms. 26 (f. Vv). Parker Library, Corpus Christi College, Cambridge University. (Photo: Cambridge University)

Paris dedicates a significant amount of space to the dial, with decorative spandrels fitting it into its square frame. Taking up half the page, the complete, framed volvelle measures about 150 mm, or six inches square, with the dial itself a mere half inch smaller. Lightened text on the outer circle, as well as stains on the dial and the oddly empty lower half of the page (perhaps adhesive from a removed image) suggest periodic use over long periods, and possibly the incomplete execution of the space below (Fig. 5). The wind rose chart on the verso seems to bear the mark of a drawing compass (Fig. 6). The verso knot for the volvelle at the top of this page is reinforced with a vellum oval of indeterminate age; about 5.8 x 5.5 mm (a quarter of an inch), and partially obscures the gridded text behind it. This security measure would see its own development over the years with a variety of increasingly specialized printed elements designed for securing either side. The reds, blues and greens used to decorate the dial



**Fig. 7** | Detail of volvelle  
In M. Paris, *Chronica majora* [ca. 1250], Ms. 26 (f. Vr). Parker Library, Corpus Christi College, Cambridge University. (Photo: Cambridge University)

are themselves a revelation, at one with the jewel tones of the rest of Paris's manuscript. Not quite as garish as the stencils used on later prints, these carefully drafted, concentric rings are evenly balanced and organized. The dial in the digitized manuscript cannot be seen in rotation, but it appears to have been quite evenly excised in its circle for easier turning. The first surviving volvelle, necessarily made of vellum in the era before paper, it solves a relatively simple spatial problem rather than attempting the combinatorics of Llull's device. Yet his experiment with a now-lost fortune-telling dial would also extend Paris's range and influence.

Paris's maps, on the other hand, demonstrate an early, (but not the earliest) use of flaps. They function as extensions of geography, and wayfinding that would become increasingly more common. Paris used a vertical and a horizontal gatefold very similarly in two versions of the maps in the British Library and Parker Library volumes of the *Chronica Majora* (Figs. 8a-b). This chart, which consists of multiple continuous folios, followed the route of a pilgrim from London to Jerusalem. The vertical extension flap appears similarly in both, with access to Sicily on the interior side via Apulia, and Acre on the other side of the page. Readers can make a bonus stop in Rome on the extended flap at far right, with the Tiber River intersecting the letters of its name in both manuscripts. In the first version, in Cambridge (f. iiii<sup>r</sup>), Rome's rectangular crenellated walls perch at the top of a wide flap full of text that extends for the full height of the page (Fig. 8a).



**Figs. 8a -b** | Rome and Acre gatefolds raised and open (a), f. III<sup>r</sup>; raised and open, seen from behind (b), f. III<sup>v</sup>  
In M. Paris, *Chronica majora* [ca. 1250], Ms. 26. Parker Library, Corpus Christi College, Cambridge University. (Photo: Cambridge University)

The British Library version retains this fortified image and the extension effect of placing Rome near the top, but gives it its own isolated flap (f. 4r), while it shifts the remaining text to the following page.<sup>5</sup>

As Daniel K. Connolly persuasively argues, the reader's movement of the flaps on these two linked folios evokes both their haptic journey toward Jerusalem, and the ever-present threat of the Apocalypse (Connolly 1999, 602-606).

An earlier, and perhaps even the very earliest surviving use of the extending flap or gatefold can still be seen in an encyclopedic manuscript compilation completed in 1121 AD, now in the Ghent University Library, the mysterious Canon Lambert of Saint-Omer's *Liber Floridus* (Figs. 9-10). Ellen G. K. Rubin kindly suggested this addition to the present paper during discussions at the *Pop-App* conference, and happily this manuscript too has been fully digitized for remote research.<sup>6</sup> Like Matthew Paris, the author, Lambert, whose personal history evades firm dates, contributed his own self-portrait to the book, confirming its autograph status among many copies. As the *Liber Floridus* expert Albert Derolez notes, "folding leaves are a rarity in the manuscript book in general; when occurring, they are normally used for illustrations too large to fit into the regular pages." Indeed, there are several vellum sections sewn on that extend the images, or more often, the text of the *Liber Floridus*. Derolez sees this as part of the book's rushed character given Lambert's "apparent lack of materials, assistance and time." Indeed, these adaptations do not appear to be adopted in the carefully-planned out copies that followed the autograph manuscript (Derolez 1998, 18).<sup>7</sup> Yet the effect is still meaningful, as when the volume extends the page width on ff 64v-65r to the right with a gatefold that lengthens the page by a half (Figs. 9a-b). Within this new real estate, it offers an extended section of text on the celestial city of Jerusalem, one



Figs. 9 a-b | City of Jerusalem gatefold horizontale gatefold closed (a) and open (b), ff. 64v-65r.

Lambert of Omer, *Liber Floridus*, 1121. Ghent University Library, Ghent (BHSL.HS.0092). (Photo: Ghent University)



<sup>5</sup> [http://www.bl.uk/manuscripts/Viewer.aspx?ref=royal\\_ms\\_14\\_c\\_vii\\_f004r](http://www.bl.uk/manuscripts/Viewer.aspx?ref=royal_ms_14_c_vii_f004r)

<sup>6</sup> <https://lib.ugent.be/en/catalog/rug01:000763774>

<sup>7</sup> The Herzog August Bibliothek, Wolfenbüttel copy has been digitized, but it does not replicate any of these interactive elements. <http://diglib.hab.de/mss/1-gud-lat/start.htm>





**Figs. 10 a-b** | World map, vertical gatefold closed (a) and open (b), ff. 92v-93r.  
Lambert of Omer, *Liber Floridus*, 1121. Ghent University Library, Ghent (BHSL.HS.0092).  
(Photo: Ghent University)

that should be read from the inside out. Ending with a description of the twelve foundation gemstones for that city on the verso of the flap, the text continues with an itemized list on the next page.

Even more dramatically, the circular-shaped upper half of an image of the earth and cosmos lifts up and out of the book block in the world map on ff. 92v-93r. Lambert used both sides of the vellum sheet by inscribing the lowered half of the flap with text as well (**Figs. 10 a-b**).

Despite the resulting spherical shape, this construction is not a volvelle, but it requires staggered readings, first of the text at the versos, and then of the complete image. While his *Liber Floridus* also includes several intricate circular diagrams and visual and textual labyrinths reminiscent of one of his sources, Rabanus Maurus (780-856), Lambert of Saint-Omer did not develop any movable dials, while Raymond Lull similarly does not seem to have worked the humble flap into his interactive repertoire. And so, Matthew Paris still appears to be one of the first to engage with paper, or in this case, with vellum engineering in both formats.

Relatively few manuscripts from the thirteenth century survive, and even fewer with volvelles. Paris also used a volvelle as a lottery dial in a *Book of Fate*, suggesting that he found his invention to be a malleable and productive addition to his writings (Connolly 2009, 611-12, fn. 89). That manuscript, the Bodleian's Ashmole 304, has been digitized as well, and although there are user instructions added two centuries later for its use, the volvelle has disappeared. As it may have been embedded in the front cover of the book, this could have occurred during rebinding. As Connolly notes, the Bodleian's fourteenth-century MS Digby 46 (which repeats the rest of Paris's *Book of Fate*) has a similar mechanism built directly into the front boards, confirming by association that Ashmole 304 also possessed one once<sup>8</sup>. At least two fifteenth-century instances of this type of built-in lottery dial are also known (Karr Schmidt 2004, 111-12). One of these still bears an angel dial similar to the Easter Calendar for 1466 discussed above (Fig. 2).

But neither Paris's *Chronica* nor Lambert's *Liber Floridus* manuscripts inspired an early modern printed edition. Even though they were not technically the first printed book with a volvelle, Regiomontanus's calendars became the most well-known incunables featuring them. The many editions of Jacobus Publicius's *Ars Memorativa* from the 1480s that included a fanciful worm-like dial to aid memorization may have run a close second. Many copies are now lacking this serpentine device, but one remains in the Newberry Library 1482 Ratdolt edition (**Video 1**). This delicate pointer rotates between the letter indicating the main concepts and refers back to a pictorial alphabet displayed earlier in the book. Ongoing research

<sup>8</sup> <https://digital.bodleian.ox.ac.uk/objects/10288d68-b9fb-4707-a420-2bf157c368b0>



**Video 1** || J. Publicius, *Artes orandi, epistolandi, memorandi*, Venice: Ratdolt, 1482, f. 62v.  
|| Newberry Library, Chicago (Inc. 4388). (Video: Alex Teller, Newberry Library)

on Publicius by Sarah Griffin at Winchester College suggest that much like the following of the *Chronica Majora* and the *Liber Floridus*, there was a strong response and reimagining of the concept in a number of manuscripts that adopted interactive variations on Publicius's mechanism.

This playfulness was not exclusive to manuscript however. A copy of the 1483 Cologne Guldenshafft *Ars Memorativa* at the New York Public Library Rare Book Room is an incunable, but innovatively each letter of the pictorial alphabet has been configured into rough woodcut volvelles. This was a memorable but possibly impractical approach as it seems not to have been repeated in later editions, and few if any other exempla (Karr Schmidt 2004, 111-12). In the era of print, handwritten and drawn copies still circulated, even well into the seventeenth century. An undated, sixteenth-century English astrology and astronomy manuscript at the Beinecke Rare Book and Manuscript Library for instance, leans heavily on Peter Apian's *Cosmography*. Two movable pages recreate elements of his printed lunar and zenith volvelles, with the work done entirely by hand, perhaps because copies were unavailable.<sup>9</sup>

### Other Interactive Innovations: Keeping Things Together

While he never investigated the use of volvelles, in 1543, Andreas Vesalius would explicitly recommend the use of vellum to reinforce the do-it-yourself flap mannikins for medical students in his *Epitome* and the broadsheet with a set of cut-out organs in the *De Humani Corporis Fabrica* (Karr Schmidt 2018, 127-30). While directing users to remove the excess paper from the eight sets of delicate veins and organs on folio m3 of the *Fabrica* before gluing the three-dimensional mannikin together, Vesalius also suggested that they glue vellum or parchment to the verso before cutting them out: “primum praeferensi chartae mem-

<sup>9</sup> <https://collections.library.yale.edu/catalog/2055070>

branam sub glutinibus” (Fig. 11). When printed waste was closer at hand, that would also suffice, as the New York Academy of Medicine *Epitome* confirms. Gianfranco Crupi has recently identified a manuscript precursor to both Vesalius and Henrich Vogther’s anatomical flaps, but these fifteenth-century illustrations to Mondino de’ Liuzzi’s text appear to have been carried out on paper and do not seem to have been further reinforced from the outset (Crupi 2019/20, Chapter 1).

Interestingly, Matthew Paris’s dial, itself already made of evidently durable vellum, consists of two incomplete vellum dials, whose point of overlap may be visible on the lower right along the central crease (Fig. 7).<sup>10</sup> While this may have been the dial’s original format, the practice of reinforcing flaps advocated by Vesalius also expanded and continued for volvelles, often with the help of recycled vellum. A startling example identified at the British Library by Karl Galle is the 1551 posthumous compendium of scientific instrument publications of German mathematician Johannes Schöner, who lived in Nuremberg for much of his life. All nine astrolabe-like volvelles in the volume, (which bear a passing resemblance to Peter Apian’s *Astronomicum Caesareum* on a smaller scale), consist of black and white dials, but turn unexpectedly colorful on the reverse.<sup>11</sup> The material used to reinforce the volvelles is widely-spaced and brightly-illuminated vellum replete with multi-line penwork initials, and devotional text in red, black, and blue. At least one Apian *Cosmography* at the Newberry Library, published by Arnold Birckman in Antwerp in 1533, also employed tiny snippets of manuscript waste to help secure its volvelle knots (Fig. 12). While functionally invisible to the average early modern reader when originally installed,



Fig. 11 Organ flap broadside discussing vellum reinforcement. In A. Vesalius, *De humani corporis fabrica*. Basel: Oporinus, 1543, f. m2. Newberry Library, Chicago (Case 6A 156). (Photo: author)

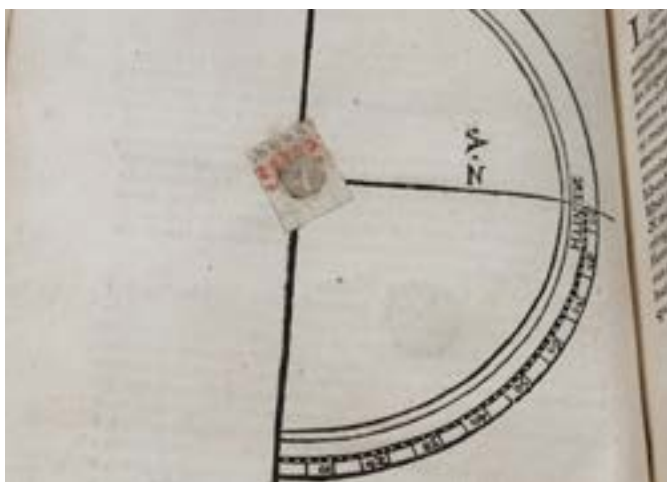


Fig. 12 Manuscript waste reinforcing volvelle (dial lacking) In *Cosmographicus liber Petri Apiani mathematici, iam denuo integritati restitutus per Gemmam Phrysius*, Antwerp: Birckman, 1533, f.12v. Newberry Library, Chicago (Ayer 7 .A7 1533a). (Photo: author)

the density of vellum made it an ideal material for the purpose. This was especially true for the Schöner text in Lutheran Nuremberg, which may well have found itself with a glut of binding waste from disused or confiscated Catholic devotional manuscripts.

Early modern publishers were increasingly aware of both the benefits and the failings of books with interactive components, and worked towards standardizing them in other ways beyond reinforcing them with manuscript or printed waste (Karr Schmidt 2020). Prolific Swiss author, professor, and publisher Sebastian Münster spelled out these fears in a 1528 pamphlet accompanying his new *Sun Instrument*, a wall map now only surviving in the University of Basel. Very clearly, he stated what this instrument needs: “First lay the glue-saturated instrument on a paper or a cloth...so the circular outlines are continuous.

<sup>10</sup> Correspondence with Sara Oberg Stradal, who inspected the Matthew Paris dial in Cambridge, UK on November 12, 2021.

<sup>11</sup> <https://twitter.com/GalleKarl/status/1382693523431043073>

I have particularly decided that I did not want to use movable dials or wheels which one can turn around, because they are unreliable, but in their place, you must use an iron circle about a (hand) span. But if you don't have one, make do with a thread, as you please" (Münster 1528).

One of the best ways of keeping those unreliable dials in their place was a set of modest woodcut squares measuring about a centimeter and a half per side that were found in a book at the Herzog August Bibliothek in Wolfenbüttel (Fig. 13). Slightly more elaborate than the vellum oval now present behind Matthew Paris's manuscript volvelle, they are in fact covers for the verso of the knots for volvelles, and a very much integral part of the book they came from. These particular examples belong to a thick astronomical text, Giovanni Paolo Gallucci's 1605 *Coelestium corporum*, in which they were found as loose sheets in 2011. They were meant to go inside the blank squares reserved within the text on the versos of over fifty volvelles and similar dials requiring threads. Comprising an incomplete subset of forty-two covers, they were never used. As Valentina Sestini notes in her 2019 *Pop-App* catalogue article, Gallucci was extremely specific about the silk thread (rather than linen) to be used in assembling the volvelles, and the way the squares were to be glued on top of the thread so as to avoid the unsightliness of too many dangling threads (Sestini 2019/20, Chapter 11); (De Pasquale 2019/20, Chapter 10).<sup>12</sup> But how well did the properly-installed knot-covers hold up?



Fig. 13 Volvelle knot caps (42 woodcut squares on two uncut sheets).  
 In G. P. Gallucci, *Coelestium corporum, et rerum ab ipsis pendentium accurata explicatio*, Venice: Somaschus, 1605. Herzog August Bibliothek, Wolfenbüttel, (11.2 Astron. (3)).  
 (Photo: Christoph Boveland)

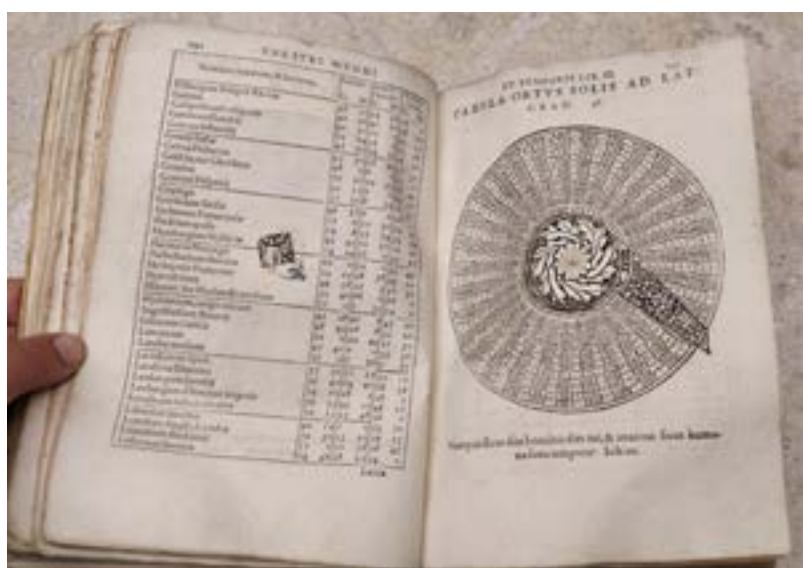


Fig. 14 Woodcut knot cap in situ  
 In G. P. Gallucci, *Theatrum mundi, et temporis, in quo non solum precipvae horvm partes describuntur*, Venice: Somaschus, 1588, pp. 142-43. Newberry Library, Chicago (Ayer 7. G17 1588).  
 (Photo: author)

In the Newberry's 1588 edition of the related *Theatrum Mundi*, only three woodcut square caps remain in situ, with pieces of vellum added as a buffer underneath the knot instead of the woodcuts (Fig. 14). One was mistakenly installed (or replaced) with its geometric design facing the page, and a second is too much obscured by the vellum and library stamp to identify. Yet one of the survivors in the 1588 edition is quite recognizable as the snowflake-like design in the middle of

<sup>12</sup> Valentina Sestini illustrates Gallucci's 1603 *Coelestium corporum explicatio* from a different Venetian publisher, Roberto Meietti, but the same (or very similar) cap to the top right-hand square in the smaller strip at Wolfenbüttel. Gallucci notes: "Avertiscasi oltre acciaio, che quelle piccole figure quadre si deono tagliare tutte separatamente, et mettere con colla sopra il filo, co'l quale hai puntata la figura, et questo dietro alla figura, ove sono le lettere, et il spacio da metterle acciaio che si levi la bruttezza che farebbe al libro tanti fili." As Andrea De Pasquale discusses, very similar language appears in Gallucci's 1588 notice to the booksellers who will bind the book.



the second row from the top of the rectangular group of squares, confirming that the same woodblock was used for both editions, at the same Venetian publisher, Giovanni Battista Somasco, nearly 20 years apart. Yet this specialized interactive printmaking technology did not start out at such a vast scale for dozens of volvelles, but more gradually.



The protective measure of the square knot caps or covers may have been inspired by a well-known sixteenth-century figure in interactive books, Peter Apian. Although his *Astronomicum Caesareum* of 1540 did not include caps, later Antwerp editions of his famous 1524 *Cosmographia* at the Newberry Library not only have surviving knot covers, but the movable sundial shown in a 1550 Bontius imprint even includes a rare instance of the original lead weight on the other end of the index string (Fig. 15). A detail of the verso of the same

Fig. 15 Woodcut rosette cap and corresponding volvelle. In P. Apian and G. Frisius, *Cosmographia*, Antwerp: Bontius, 1550, f. 11r-11v. Newberry Library, Chicago (Ayer 7. A7 1550b).

page appears above, which in leaving a wide berth for the knot, also anticipates the addition of the woodcut cover in a way Gallucci would have appreciated.

By adding this internal margin, the page manages to avoid concealing text even while it hides the dangling ends of the thread. The rosette may be applied in any direction, much like the string that it helps permanently affix. More refined than the Gallucci woodcut caps, the Antwerp Apian editions tended toward grotesque faces and masks, though at least one face of Christ was included, perhaps as an additional apotropaic safeguard (Karr Schmidt 2020, 29-30).

### Both Flaps and Dials

Once the technologies of the volvelle and the flap became more consistent and easier for buyers (or their trusted bookbinders) to construct, some adaptations became more lighthearted. While the Venetian courtesans with flap skirts by Pietro Bertelli never came with a modernized version of Paris's lottery dials, they were being sold across Europe by the 1590s, and other publishers and authors would continue to experiment with both techniques. Indeed, well into the next century, flaps and dials would provide entertainment and education at the same time. A highly active member of a literary



Fig. 16 Self-portrait flap (closed and open) In G. P. Harsdörffer, *Frauenzimmer Gesprächspiels*, vol. 4, Nuremberg: Endtern, 1644, frontispiece. Newberry Library, Chicago (Case minus VM 1500.S776s). (Photo: author)

group intent on standardizing the German vernacular, the so-called Fruchtbringenden, or Fruitbearing Society, Georg Philipp Harsdörffer (1607–1658), adopted the flap in an act of pure self-promotion. He was very much in keeping with his society’s love of emblematic imagery when he used a secret flap to open his *Frauenzimmer Gesprächspiele* (Fig. 16). None of the first three volumes of this clever periodical had included paper engineering when he set the stage on Mount Olympus. Unbeknownst to the viewer, a portrait of Harsdörffer himself hides under a rich tapestry flap. His society nickname, Der Spielende, or the Player, flanked by the date of the volume, 1644, at his feet completes the introduction. The fact that he positioned himself under this movable flap suggests Harsdörffer took the title and role quite seriously, and he seeded the volumes with music, poetry, and other visual jokes. Although not admitted as society members, these playful anthologies were in fact read by the women or Frauen of the *Frauenzimmer*, and well-to-do ladies frequently appear in images throughout the varied texts.

Encyclopedic as his efforts were to reach female audiences, it was Harsdörffer’s publication of the multi-volume work by the professor, mathematician and linguist, Daniel Schwenter, that further suggested Der Spielende’s interactive ingenuity (Figs. 17-18). His “Fünffacher Denkring der Teutschen Sprache” was a multi-layer dial meant to teach



Fig. 17 | Double-printed engraving for cutting out the “Fünffacher Denkring der Teutschen Sprache” In D. Schwenter, G. Ph. Hardörffer, *Delitiae philosophicae et mathematicae*, vol. 2, Nuremberg: Endters, 1651, f. Tt2r and p. 517. Newberry Library, Chicago (Case V 22.802). (Photo: author)



Fig. 18 | Constructed “Fünffacher Denkring der Teutschen Sprache” In D. Schwenter, G. Ph. Hardörffer *Delitiae philosophicae et mathematicae*, vol. 2, Nuremberg: Endters, 1651, p. 517. Beinecke Rare Book and Manuscript Library, New Haven (Zg17 H25 651). (Photo: Yale University)

readers about the beauty of the German language by reconstructing the words, syllable by syllable. In the uncut Newberry copy there are two consecutive impressions of the engraving bound in, both branded with GPH, Harsdörffer’s initials at the center (Fig. 17).

The instructions below the first, unnumbered page, labeled “To the Bookbinder” explicitly mention that the image “must be cut out and divided into five rings, and affixed to five paper dials of the corresponding size, then attached to each other so that one can turn each ring individually, and when this has come to pass, strengthen the entire object with cardboard.” Vellum being decreasingly common as a writing material by the seventeenth century, in the Beinecke Rare Book and Manuscript Library copy, the dial was constructed in precisely this manner, with cardboard, and contemporary marginal notes suggest the resulting dial was indeed used (Fig. 18).

In the process, the outer frame of four hands has however been pasted in upside down. This mishap does not affect the functionality of the device, but further emphasizes the mobility of its internal parts, as does the hand with a compass drawing a circle in what was originally the upper left. The vignette labeled “Durch den Fleiss” or “With

diligence” of a hand holding a peacock-feather quill pen, underscores the hands-on nature of the exercise, whether constructing the dials, turning them into customarily composite German words from a whopping forty-eight fore-syllables, sixty beginning and rhyming letters, twelve middle and 120 end letters, and twenty-four after-syllables. Finally, the hand holding the peacock pen would presumably write the completed words down. The concluding vignette, in which the hand holds a victory wreath, literally brings the prize of understanding the device and the vagaries of German. From this paper instrument alone, it is clear Harsdörffer believed in the power of language to convince, as well as to entertain. In this he is perhaps not immune to the calendar dials of Regiomontanus and Paris, or even the musings of Raymond Lull 400 years earlier, who thought his *Great Art* could, and would, systematize conversion of all unbelievers to Catholicism simply via the machinations of his versatile volvelle.

### Beyond the Premodern Interactive—Posthumus Print

To conclude, the novelty and ingenuity of early modern interactive printmaking left an indelible impression on publishing that has never entirely vanished, even as audiences eventually expanded to include children. Lull experienced a modest revival in the eighteenth century, when a luxurious history of his life and reprints of his work was conceived around 1721 as a massive set of eight folio volumes color-printed in black, blue, green, red, and yellow. Yet only a few of the volumes were ever brought to completion (Fig. 19). And despite all the care taken with the color printing, the “Quarta Figura” volvelle was never included in this edition. Yet in its grandiosity the book includes the adoption, at long last, of the triangular tables that overflowed the text block as flaps. They do this very much in the way Lambert of Omer and Matthew Paris’s manuscript cosmographies and road maps extended the page back in the twelfth and mid-thirteenth centuries, whether by design or by accident of printing or binding. So, while Paris had two kinds of manuscript volvelles and extending flaps to his credit, Lull too was eventually connected to both printed volvelles and flaps. Truth in publishing, like any other arena, was malleable, and regardless of their scale, Lull’s objective truth-calculators may not have convinced his eighteenth-century readers of their power, if in fact, they ever convinced his previous readers. The legacy of his self-titled *Great Art*, however, remained in its insistence that the reader turn the dial and repeatedly attempt for themselves the acts of revolutionary conversion, memorization, and remembrance. Lull’s *Art* made the reader of any movable book an artist, especially if they had managed to construct the diagrams themselves.

But this was hardly the last rethinking of the medieval origins of the volvelle (Video 2). Matthew Paris’s movable device from the *Chronica Majora* was recreated in 2004 by modern-day paper engineer Robert Sabuda as part of the Movable Book Society tenth-anniversary celebration pop-up book. This working, nearly to-scale reproduction (it measures only six-tenths of an inch smaller) may mark Paris’s first functional foray into print. While the monk himself was far too modest to create an interactive selfie along the lines of Georg Philipp Harsdörffer, by rethinking Paris’s self-portrait as the artist turning his own volvelle, the 2004 facsimile offers Paris a deserving tribute from a modern master almost 800 years later. For the Movable Book Society, this publication emphasizes the choice of Paris over Lull as the originator of the movable book, and looks forward, as do all of those involved in the new Study Center for Interactive Books, to the exuberant survival of the paper engineering of today and tomorrow.

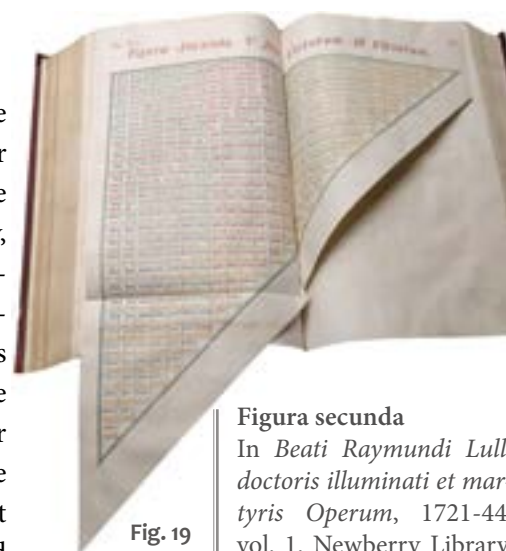


Fig. 19

Figura secunda  
In *Beati Raymundi Lulli  
doctoris illuminati et mar-  
tyris Operum*, 1721-44,  
vol. 1. Newberry Library,  
Chicago (Case oversize  
B765.L8 1721). (Photo:  
author)



Video 2 | R. Sabuda, “Matthew Paris Volvelle”  
In *A celebration of pop-up and movable books*. New Brunswick, N.J.: Movable Book Society, 2003, on front cover. Newberry Library, Chicago (Case folio Z1033.T68 C38 2004).  
(Video: author).

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