# GALILÆANA

Studies in Renaissance and Early Modern Science

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## and Early Modern Science

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# GALILÆANA
## Studies in Renaissance and Early Modern Science

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# THE ART OF MEMORY AND SCIENCES IN THE EARLY MODERN AGE

edited by Tommaso Ghezzani and Clément Poupard

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**Abstract**
This focus concerns the relation between the tradition of the art of memory and the sciences during the Early Modern Age in Europe. Seven essays: from anatomy to mathematics.

The aim of this focus is to investigate a particular aspect relating to the tradition of the art of memory, during the Early Modern Age in Europe: the relationships between mnemonics and scientific development. The art of memory encompasses techniques for memorization that have been passed down from classical culture, particularly within the context of rhetorical training. For centuries, mnemonics were part of the *trivium* and only became an independent discipline during the Renaissance. This was due in part to the radical changes of the time, ranging from the invention of the printing press to the Scientific Revolution, which led to an unprecedented production and dissemination of knowledge. In his book *Clavis Universalis* (1960), Paolo Rossi emphasized the importance of mnemonic knowledge in the development of modern science. Using this work as a cornerstone for the history of philosophical and scientific ideas, we aim to expand Rossi's analysis by studying scholars he neglected or to examine more precisely the position of major figures in the early-modern natural philosophy. Furthermore, this focus aims to broaden Rossi's perspective by questioning the rise of experimental sciences and the mathematization of the world from a social and cognitive point of view.

The contributions collected here have the advantage of bringing together these topics within very broad and varied fields, thus allowing the reader to immediately get a clear idea of the important connection between mnemonics and sciences. In particular, the essay of Tommaso Ghezzani inquires how mnemonic and hermetic propaedeutics affected the visual tools and experimental habitus of early modern anatomy, and vice-versa. The essays of Annarita Angelini, Lucia Delaini, Koji Kuwakino and Ute Frietsch inquire the use of mnemonic tools by authors who focused in the methodology for structuring a renewed *encyclopedia* of knowledge, ranging among France, Italy, and England. At the end, the essays of Marco Matteoli and Clément Poupard inquire the evolution of the classical art of memory relating to the creation of new techniques to memorize kinds of information that were neglected up to that point, in particular in the mathematical fields.

Despite the exceptional breadth of disciplinary fields taken into account in this collection of studies, there is still a lot of work to be done in this direction and, through this focus, we hope to have at least sparked historiographical interest for further investigations in this sense. Study this topic remains fundamental to better understand at which degree both scientists and humanists continue to share the same "*outillage mental*" (Febvre, *Le problème de l'incroyance au XVIe siècle*, 1947).

# Theatres of memory and anatomical theatres: Notes on Giulio Camillo, rhetoric, magic and anatomy between 16<sup>th</sup> and 17<sup>th</sup> century

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**Abstract**
The aim of this study is to highlight the links between rhetorical-mnemotechnical, magical-alchemical and anatomical investigation, starting with the works of Giulio Camillo Delminio (c. 1480-1544). Through this reconstruction, it is possible to observe how for Camillo and for others in his milieu, especially the Venetian academies of the 16<sup>th</sup> century, these *arts* were conceived in terms of profound interdisciplinarity, thereby moving towards a new *encyclopedia* of knowledge. The key to this knowledge was memory and its *ars*, through which the *homo loquens* was able to dominate both the natural and transcendental worlds by rediscovering the innate traces of knowledge dormant in their soul. We will also observe the profound links between this cultural paradigm and the parallel birth of new tools used in anatomical investigation, including anatomical tables and, above all, anatomical theatres, paying particular attention to the case of the Anatomical Theatre of Bologna.

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## Introduction

Scholarship is now in agreement on the cultural centrality of Giulio Camillo Delminio (c. 1480-1544). A rhetorician, philosopher, kabbalist, magician, and alchemist, his vision both of the world and the human being was integral to one of the most flourishing cultural trends of the European Renaissance: the consolidation of the Platonic tradition which, through the fundamental mediation of Marsilio Ficino and Giovanni Pico della Mirandola, had been conjoined with the ambiguous tradition of the Hermetic writings and the Jewish Kabbalah. The result was a single sapiential chain, reputed to be the philosophical image of Christian Revelation.[1] From this well-researched cultural ground, this study seeks to explore more deeply certain aspects which the historiography has undeservedly neglected: the influence of the nascent anatomical investigations of the sixteenth century on Camillo and, conversely, the influence of the cultural experiences described by Camillo on anatomy and its material *tools*.

By setting Camillo's rhetorical-mnemotechnical investigation against the background of his alchemical research and anatomical reflections, we will observe what anatomy meant for the philosopher and his milieux (especially the Venetian academies of the 16th century). Anatomy eroded the surface of the individual body in order to grasp its universal laws, just as the rhetoricians tried to move beyond a given speech to understand the universal knowledge that lay behind the structures of discourse. For Camillo, one aspect of such investigation was alchemical research, conceived as the extraction of the divine essence from the lowest matter: going beyond the surface of reality meant grasping its true providential design. Through this process, the wise man was able to become both a rhetorician and an alchemist, an anatomist and a divine being. The faculty of memory and the *ars* to control it became the means through which the *homo loquens* was able to dominate both the natural world and the transcendental world through *visuality*, rediscovering the innate keys of knowledge that lay dormant in his soul. Platonic *anamnesis*, through the mediation of Ficino and Pico and dialectical reform, was thus used to corroborate naturalistic investigations within a precise design of classification and domain of reality. In Camillo's work, the different disciplines are moreover traced back to the linguistic field. The rhetorical and mnemonic-visual prevalence of this common root allowed domination over a world still governed by analogical principles. In this world, through innate wisdom and its memory,

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[1]     The bibliography on Camillo is vast. For reference, see the following: Yates, *The Art of Memory*, 129-172; Stabile, "Camillo, Giulio, detto Delminio"; Bolzoni, *Il teatro della memoria*; and the rich introduction and bibliography by Bolzoni in her edition of works by Camillo, *L'idea del teatro, con "L'idea dell'eloquenza"*, 9-128. On Renaissance syncretism and the chain of *prisca philosophia*, an extremely broad theme, we refer to the studies and bibliographies collected in Garin, *L'umanesimo italiano*, 105-132; Muccillo, *Platonismo, ermetismo e "prisca theologia"*; Vasoli, "Note su tre teologie platoniche: Ficino, Steuco e Patrizi", 81-100.

the true philosopher was able to harmonize the superior with the inferior, natural science with divine science and the *studia humanitatis*. Both the mnemonic tool and sight (sensory and intellectual) constituted the nexus through which human beings were able to establish themselves as both a cosmological *trait d'union* and as the crossroads of all the *arts*.

At the conclusion of this study, it will also be possible to trace bilateral links between this specifically magical-analogical mentality and the aspirations and instrumental medical-scientific practices that were developing in that century. Paolo Rossi and Frances Yates, in their classic monographs on the art of memory, have already confirmed the continuity of certain mnemotechnical practices with respect to several undisputed protagonists of the scientific revolution, such as Descartes, Francis Bacon and Leibniz.[2] By following this privileged historiographical path, we will see, more specifically, how visuality and memory were considered a no less fundamental key for the anatomist.

## The basis of Camillo's project

If we are to begin from the cultural environment of the academies – and especially those of Venice, which Camillo addressed in a privileged way –, it would be useful to recall their origin. The first significant group to take its name from Plato's ancient institution was that of Marsilio Ficino in Florence. However, this academy was nothing more than a non-hierarchical cultural space in which a select group of associates, of co-philosophers, freely discussed philosophical mysteries, gathered together at a villa in Careggi which Cosimo de' Medici had given to Ficino. While they offered an alternative cultural model to that of traditional universities, the idea of the Ficinian academy as a more formally structured space is a false historiographical myth.[3] The new philosophical model it proposed, that of Platonism reborn, was essentially based on the assumption of the analogical continuity of all levels of reality and on the role of the human being as a microcosm.[4]

During the 16th century, this form of gathering was exported from Florence throughout Italy and Europe, where it assumed significantly more structured and institutionalized forms. While not all remained faithful to the primitive and heterodox project of cultural renewal, those that Camillo frequented over a long period certainly fell into such a category. These academies frequently used the theoretical tools offered by the Hermetic-Platonic tradition and above all by the reborn study of rhetoric. On the one hand, the new philosophy had established the dignity of the human being, as well as the importance of the psychological powers of the imagination and fantasy, with which memory was consubstantial. On the other, there was rhetoric, of which the art of memory was one of its five parts, which

2   See Yates, *The Art of Memory*, 368-89 and Rossi, *Clavis universalis*, 155-281.
3   See Hankins, "The Invention of the Platonic Academy in Florence", 3-38.
4   See Garin, "La filosofia dell'amore", 581-615, and Id., *L'Ermetismo del Rinascimento*.

had been re-founded on a new dialectical basis. These were considered the tools through which the system of knowledge, the *encyclopedia* of the world, could be reorganized. However, we must not overlook the contribution of a renewed understanding of Aristotelianism which, in certain academies, and especially that of the Infiammati, inherited the mission of refounding a knowledge which in other places was delegated to Platonism.[5]

The grandiose project on which Camillo worked throughout his life was fully inserted into this ideology: the construction (mental and material) of a great Theatre of the world (or of the memory). Various reconstructions of this impressive mnemonic-encyclopedic device have been attempted, ranging from plans of the classical theatre to that of the amphitheatre and beyond (Fig. 1).[6] Camillo had originally trained as a rhetorician and was therefore very familiar with the classical and modern methods of the art of memory. He therefore perfectly grasped the evolution of the relationship between mental mnemonic loci and mnemonic images. The ancient art of memory had structured artificial memory through the placement of memory-images within a precise mental architecture which recalled their order. However, the culture of the 15th and 16th centuries began to radicalize the very theme of *order*. There was no longer a tendency to structure the order of memory through, for example, the simple order given by the succession of a series of rooms in a corridor. Instead, the order of loci, containers for the material to be memorized, was increasingly arranged in complex architectural forms composed of several orders and degrees. The order of the loci began to reflect the logical connection of the various information which they contained. In so doing, they were responding to the need for a new instrumentation to compose the new system of knowledge, which was the ultimate goal of the most active academies.[7]

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[5]   Here, we refer only to the study and bibliography in Vasoli, "Le Accademie fra Cinquecento e Seicento", 429-465, and Testa, *Italian Academies and their Networks*.

[6]   See the table in Yates, *The Art of Memory*, 144-145. Here, for convenience, the classical reconstruction of the Theatre proposed by Yates will be taken as the main reference. However, it is currently confirmed that the plan on which Camillo based his theatre was not that of the Vitruvian theatre but rather that of an amphitheatre, as indeed two unequivocal testimonies report, even if they refer not to the actual theater (never built), but to the wooden prototype, built by Camillo for the king Francis I of France. For an overview on this topic see Putti, *Il Theatro Universale di Giulio Camillo Delminio*, and Seip, "Giulio Camillo's Theatre of Knowledge", 59-83. In this sense, it is likely that among the reference models of the wooden prototype there were the precursors of the anatomical theaters (still conceived as ephemeral structures).

[7]   See in the first instance Rossi, *Clavis universali*, taking into account the basic historiographical problem that he shares with Yates, *The Art of Memory*, i.e., the excessive extension of the genre of the treatise of the art of memory to texts of a different nature, such as that of Camillo. Indeed, between the 15th and 16th centuries, art of memory texts had become a very specific genre, consisting of a series of empirical teachings on how the reader could memorize the material he preferred. Texts such as Camillo's instead adopted mnemotechnical tools so that the reader could memorize very specific information, decided *a priori* on the basis of a precise ideological or philosophical project. On this important distinction which, even today, gives rise to consid-
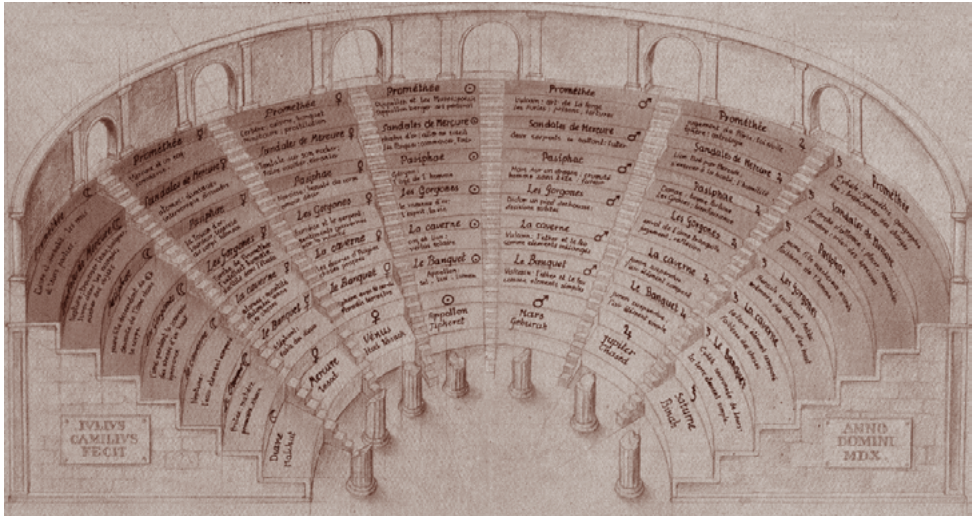
Fig . 1 – Anonymous artist's impression of Camillo's Theatre, 17th century.

Camillo used precisely this theoretical instrumentation to build a mnemonic system refounded on a universalistic and encyclopedic basis. His intentions required that it should be physically constructed. Where the art of memory proper required the user to develop his own personal system for individual purposes, Camillo instead built a handbook of images, set in a grandiose theatrical space, which was to be memorized as such by anyone who wished to master true knowledge. The observer of the images was not seated in the stalls but upon the stage, where he could observe the spectacle of memorable images arranged according to cosmological-astrological order: from the intelligible, to the celestial, to the terrestrial. However, Camillo only succeeded in having a prototype built. Although this has not reached us, it was fortunately immortalized in a letter of 1532 by the jurist Viglius van Aytta, who, having been escorted inside it by Camillo himself, described it as follows to his friend Erasmus of Rotterdam:

> The work is made of wood, marked with many images and crammed, in every part, with small boxes; and there are different orders and degrees […]. He [Camillo] calls this theatre of his by many names, saying now that it is an artificial mind and soul, now that it is a soul equipped with windows. He claims that all things the human mind can conceive and which cannot be

erable misunderstanding, see in particular Matteoli, *Nel tempio di Mnemosine*, 23-25. On the reform of the method see Vasoli, *La dialettica e la retorica dell'Umanesimo*. Regarding the mutual influence between the art of memory and different aspects of the cultural life of the Renaissance, see Bolzoni, *La stanza della memoria*.

seen with the bodily eye can nevertheless be [ … ] expressed by means of certain bodily symbols, in such a way that the observer may instantly perceive with the eye all that is otherwise concealed in the depths of the human mind.[8]

In the *Idea del Theatro*, published posthumously in 1550, Camillo drew a quick sketch of how the definitive project of the theatre was to be arranged. The structure was composed of two systems: one of vertical levels, each corresponding to a sefirah-planet, and one of horizontal degrees, each representing an ontological state according to the hierarchy of being. Through the intersection of degrees and levels, forty-nine loci were formed.[9] In each of them were placed more images which represented every aspect of reality. As we learn from the account of Viglius, these images concealed compartments in which papers were crammed containing textual loci by exemplary authors, especially Cicero, on the subject represented. Apparently, therefore, this device was only useful to the rhetorician who, by memorizing the system of images and the texts that each image contained, could always have at his disposal the material with which to construct every possible discourse. It is no coincidence that the structure was described as a soul made *visible*: all the concepts which the human mind could conceive, in its own invisible depths, were here visually unveiled. In reality, the aim was much more complex, and to grasp it we must turn to Camillo's published and, above all, unpublished texts.

## Beyond the surface of the body and the theatre

Starting from the published texts, it is necessary to dwell in particular on the *Trattato della Imitazione* (c. 1530), which illustrates how to imitate exemplary texts. Camillo explains

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8    "Opus est ligneum multis imaginibus insignitum, multisque undique capsulis refertum: tum varii in eo ordines et gradus. [ … ] Hoc autem theatrum suum auctor multis appellat nominibus, aliquando mentem et animum fabrefactum, aliquando fenestratum: fingit enim omnia quae mens humana concepit, quaeque corporeis oculis videre non possum, posse tamen diligenti consideratione complexa signis deinde quibusdam corporeis sic exprimi, ut unusquisque oculis statim percipiat quicquid alioqui in profundo mentis humanae demersum est" (Viglius, "From Viglius Zuichemus", 29-30).

9    See Camillo, "L'idea del theatro", in Id., *L'idea del theatro, con "L'idea dell'eloquenza",* 150-155. The sefirot were a system of transcendent archetypal principles, encoded by the kabbalah, to which multiple worldly realities referred, similar in many ways to Platonic forms. However, while Platonic forms were a unitary and universal model for what manifested itself as multiple in the earthly world, the sefirot also possessed the prerogative of establishing continuity between the different degrees of being. On the absorption of the Jewish sefirot within the Platonic culture of the Renaissance, we refer to the study and bibliography collected in Busi, *La Qabbalah*. On the continuity between magic and astrology in the philosophical culture of the Renaissance, see the classic Garin, *Lo zodiaco della vita*, and Ernst-Giglioni, eds., *Il linguaggio dei cieli*.

that in order to imitate correctly, the writer must not steal words or rhetorical figures as they appear in classical texts, but instead return to the *topical order* from which these originated (that is, the logical mechanism that produced them) by stripping them of their contingent aspects.[10] In this way, a new work can be created on the basis of the beauty achieved by the classical literary model taken as a reference. Camillo therefore recommends the anatomical dissection of exemplary texts in order to establish the universal logical norms that govern them. This process is compared (albeit seemingly only metaphorically, according to the text) to a real anatomical experiment that he had personally witnessed. He adds that:

> I remember that in Bologna an excellent anatomist enclosed a human body in a box perforated all over and then exposed it to the current of a river, which, through those holes, in a few days consumed and carried away all the flesh of that body, which then showed the marvelous secrets of nature, only the bones and nerves being left. This body, supported only by bones, I compare to the model of eloquence, supported only by matter and by design".[11]

The mysterious anatomist may have been Berengario da Carpi or perhaps even Andrea Vesalio, who, like Camillo, frequented the Accademia degli Infiammati and was a friend of the architect Sebastiano Serlio.[12] In any case, just as the anatomist had to remove the superficial layers of the human body in order to grasp its hidden and universal functioning, the same was true for the rhetoricians who wished to discover the topical orders of their literary models. The text also abounds in parallels that Camillo establishes between his own method of imitation and that prescribed for figurative artists. The principle of *ut pictura poesis* is assumed as a methodological paradigm, though it is already implicit in an operation aimed at making verbal knowledge visible and storable. Indeed, Camillo did not hesitate to address figurative artists directly.[13]

Similar comparisons can also be found in an earlier letter to Marcantonio Flaminio (c. 1525). Here, among other things, a first version of the mnemonic system is outlined, al-

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[10]  See Camillo, "Trattato della imitazione", in Id., *L'idea del teatro e altri scritti di retorica*, 170-177 et seq.

[11]  "Ricordami già in Bologna che uno eccellente anatomista chiuse un corpo umano in una cassa tutta pertugiata e poi la espose ad un corrente d'un fiume, il qual per que' pertugi nello spazio di pochi giorni consumò e portò via tutta la carne di quel corpo, che poi di sé mostrava meravigliosi secreti della natura negli ossi soli et i nervi rimasi. Così fatto corpo, dalle ossa sostenuto, io assomiglio al modello della eloquenzia dalla materia e dal disegno solo sostenuto" (*ibid.*, 192).

[12]  On Vesalio see Carlino, *La fabbrica del corpo*. On the common environments of Camillo, Vesalio and Serlio see Carpo, *Metodo ed ordini nella teoria architettonica dei primi moderni*, and mainly Carlino, "Anatomia umanistica", 77-94.

[13]  See Camillo, "Trattato della imitazione", in Id., *L'idea del teatro e altri scritti di retorica*, 187 et seq.

though the structural model is neither an architectural work or the astrological system, as is the case in the *Idea del Theatro*. The first was deemed too humble, the second too complex.

> On the one hand we had the method of the edifice mainly used by Cicero; on the other hand, that of Metrodoro of the twelve signs of heaven, in which he was very familiar with the three hundred and sixty loci according to the number of degrees. But seeing in the first little dignity, in the other much difficulty, and being both perhaps more suited to acting than to composition, we turned all our thoughts to the marvelous fabric [*fabrica*] of the human body. For we consider that if this has been called a small world since it has within itself the parts that are related to all the things of the world, according to its nature, it can adapt those parts to anything in the world, and consequently the words that express it.[14]

As a microcosm, the human body can provide a correspondence with everything in the world. Indeed, Camillo continues:

> what more divine work came out of the hands of the eternal master than man? Certainly none. And I can say this assuredly not only because I have read the divine *Timaeus* several times with some diligence, in which Plato is with great amazement entirely occupied with the human body, and works on this subject by Galen, Aristotle, Cornelius Celsus, Marcus Tullius in the second book of the *Nature of the Gods*, Pliny, Lactantius and many others who have reflected on this fabric [*fabrica*] with divine thoughts; but also because I have been shown by an excellent anatomist the divine functioning of two human bodies, from limb to limb.[15]

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14  "da una parte avevamo la maniera in alcuno edificio da Cicerone principalmente tenuta; dall'altra quella di Metrodoro ne' dodici segni del cielo, dove trecentosessanta luoghi secondo il numero de' gradi gli erano famigliarissimi. Ma veggendo ne l'una poca dignità, ne l'altra molta difficultà, et ambedue forse più alla recitazione che alla composizione acconcie, rivolgemmo tutto 'l pensiero alla meravigliosa fabrica del corpo umano. Avvisando, se questa è stata chiamata picciol mondo per avere in sé parti che con tutte le cose del mondo si confacciono, potersi a qualunque di quelle accommodare secondo la sua natura alcuna cosa del mondo, e conseguentemente le parole quella significanti" (Camillo, "A M. Marc'Antonio Flaminio", in Id., *L'idea del teatro e altri scritti di retorica*, 6).

15  "quale opra uscì mai fuori delle mani dell'eterno mastro più divina dell'uomo? Certo niuna. E ciò sicuramente posso dire non solamente per aver con alcuna diligenza corso più volte il divino Timeo, in che Platone è tutto d'intorno all'umano corpo con grande meraviglia occupato, le opere di Galeno sopra ciò, Aristotele, Cornelio Celso, Marco Tullio nel secondo della Natura dei Dei, Plinio, Lattanzio e molti altri che sopra tale fabrica con divini pensieri sono dimorati; ma per essermi ancora da uno eccellente anatomista omai in due corpi umani, di membro in membro, il divino magistero mostrato" (*ibid.*, 7). For other relationships between Camillo and anatomical investigations, see also West, "Atomies and Anatomies", 582-603, and Putti, *Il Theatro Universale*, 164.

While the use of the human body as a mnemonic locus was a fairly common practice, both in the Middle Ages and in the Renaissance, what is significant in this passage is how, once again, the visual impact and order that emerge from the *anatomized* body illustrate Camillo's desired mnemonic operation, as well as revealing some of his important sources, specifically those of a medical nature.

The theme of the human being as a microcosm also acquires here a dimension of *artificiality*. Indeed, Camillo uses the lemma *fabrica*, derived from Cicero, to connote the body, and moreover the Ciceronian source is explicitly declared. But *fabrica* was also used in the specifically architectural field: it was the process of building the edifice.[16] Cicero, in relation to the body of animals, spoke of the "wonderful fabric of limbs" and, in relation to the human body, of the "incredible fabric of nature".[17] The body therefore began to be seen as a compound on which the human being could radically act through a specific *ars*. To enrich this triangulation that we have established between body, word and architecture, we must also consider another well-known patron of the Accademia degli Infiammati, Daniele Barbaro, who, in his successful commented edition of Vitruvius' *De architecura*, explicitly spoke of rhetoricians as "architects of discourse".[18] The *ut pictura poesis* was thus reworked as *ut architectura oratio*.[19]

However, as we have observed, the two models that had been discarded in the letter to Flaminio later prevailed in the definitive preparation of Camillo's mnemonic system. Indeed, the final Theatre is governed by the theatrical architectural model fused with the astrological system of celestial images, recalling an already Vitruvian motif of correspondence between the layout of the theatre and the zodiacal system.[20] Nevertheless, it is also described as an artificial mind or soul, thus retaining certain echoes of the *body* system. Indeed, referring to the Theatre in the discourse *Pro sua de eloquentia theatro, ad Galloso Oratio*, Camillo speaks of it as an element with which one might fall in *love*. By engraving itself within the lover's memory, it would start the anamnestic process as if it were the physical body of a beloved one, the first level of the Platonic *scala amoris*. This artificial mind – the Theatre – "indeed presents itself entirely to the senses, throws itself entirely into their arms, so that it can be embraced, it can be held, like something you love".[21] In

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16  On the multifaceted uses of the lemma see Carlino, "Anatomia umanistica", 81-86.
17  "admirabilis fabrica membrorum", "incredibilis fabrica naturae" (Cicero, *De natura deorum*, 238 and 256).
18  "Architetti dell'oratione" (Vitruvius, *I dieci libri dell'Architettura*, 115).
19  See *ibid*., 9. On the parallelism between architecture and discourse that emerged from the text, see Panichi, *La virtù eloquente*, 68-74. On Barbaro, see mainly Angelini, *Sapienza, prudenza, eroica virtù*.
20  See Yates, *The Art of Memory*, 170-172.
21  "tota enim sensibus obiicitur, tota etiam ita sese brachiis dat, ut tamquam cara, tamquam amabilis amplecti, stringique possit" (Camillo, *Pro suo de eloquentia theatro*, 39). On the connection

the final conception of the project, the mnemonic model based on the human being as a microcosm was therefore clearly preserved.

Thus, the lemma *fabrica*, together with the use of an architectural structure, reveals how Camillo was already placing emphasis on the artificial essence of both the body, opened up by the anatomist, and the soul, opened up by the rhetorician-philosopher. It should be remembered that almost twenty years after this letter Andrea Vesalio published the fundamental *De humani corporis fabrica*, with clear reference to the entire cultural tradition mentioned above.

According to the letter of the texts, the passages by Camillo on which we have dwelled up so far might be read as simple metaphors, albeit with some ambiguity. The veil of metaphor, however, can be removed through an important unpublished writing, the *Idea dell'eloquenza* (c. 1530). The lemma *idea* was to be read, including in this case, in all its Platonic weight. Camillo here explains a good part of his philosophical presuppositions. He investigates how the individual beauties which permeate each specific literary work are linked to an eternal and transcendent archetype, precisely the *idea*, of which the human soul has an imprint within itself.[22] The memory discussed up to this point therefore coincides with Platonic anamnesis, and Camillo's mnemonic system, with all its ordered apparatus of symbolic images, is geared towards peeling oblivion away from the embodied human soul. Through this operation the soul could be reoriented, after becoming aware of its own inner traces of the ideal, towards the model of ideal beauty beyond the world that the Theatre sought to visually reproduce. Here lies the fundamental point, since it is precisely this idea of beauty that gives structure not only to eloquence but also to all the other arts, figurative and otherwise. Describing the descent of the idea from the transcendent to the sensible, Camillo makes it clear that "I will paint the universal idea not only of eloquence and grammar, but also of architecture, sculpture, painting and the art of fighting, and you will be able to consider how it is the same in the ideas of all the other faculties".[23] All knowledge and all the arts therefore could be brought back to a single key, from which unprecedented dominion derived. The condition of all this was the reshaping of the mnemonic-imaginative fabric, preparing it for the anamnesis of the transcendent.

At the same time, this principle also made it possible to remove the veil of metaphor from other much more heterodox arts. Camillo, in light of his enthusiasm for anatomical observation, not only sought to grasp the secrets of the human body but also claimed to

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　　between memory and love within the metaphor of the window open to the heart, see above all Bolzoni, *La stanza della memoria*, 148-164.

22　See Giulio Camillo, "L'idea dell'eloquenza", in Id., *L'idea del theatro, con "L'idea dell'eloquenza"*, 249-250 et seq.

23　"dipingerò l'idea universale non pur de la eloquentia e de la grammatica, ma de l'architettura, de la scultura, de la pittura e de la militia, ed il medesimo giudicar potrete essere ne le idee di tutte l'altre facoltà" (*ibid.*, 272).

return to the very root of life, developing this knowledge in an esoteric direction, as his continuous references to hermetic and kabbalistic sources indicate. Returning to the published works, in the *Trattato delle materie* (c. 1535) he even refers, albeit incidentally, to the artificial creation of a newborn, a real *homunculus*.[24]

This tendency can be seen above all in the *Discorso in materia del suo teatro* (c. 1530), where in the mask of an innocent comparison he reveals:

> I have already read, I believe in Hermes Trismegistus, that in Egypt there were such excellent statue makers that, when they brought any statue to perfect proportion, it was animated by an angelic spirit, because such perfection could not be without a soul. I find that words are similar to statues made in this way by virtue of composition, the office of which is, as I have said, to keep in proportion graceful to the ear all the words that can fit a human concept [ … ]. Which words, as soon as they are placed in their proportion, are found when others pronounce them almost to be animated by harmony.[25]

The reference is to the magical statues described in the *Asclepius*, a fundamental treatise of the *Corpus Hermeticum*.[26] The mysterious measures capable of capturing life, as mentioned in the hermetic text, are here subject to an aesthetic reinterpretation by Camillo. The key to life itself is thus the structure of beauty which, encoded by the word, is capable of fixing itself within the memory and revealing its deepest contents, regardless of the field of application.

The notion of eloquence as the privileged access point to the idea of beauty, and therefore superior to the other arts, seems moreover to be confirmed in one of Camillo's most obscure and intricate works, the *De transmutatione* (c. 1540). In the opening he weaves a comparison between what he considered the three *metamorphic* arts, that is, deification, eloquence and alchemy.

> All three have a wonderful correspondence with one another. The purpose of the man who goes to God is to remove from himself (with divine help) all that is impure and created,

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24 See Camillo, "Trattato delle materie", in Id., *L'idea del teatro e altri scritti di retorica*, 130.

25 "Ho già letto, credo in Mercurio Trismegisto, che in Egitto già erano fabricatori di statue tanto eccellenti che, condotta che aveano alcuna statua alla perfetta proporzione, ella si trovava animata da spirito angelico, perché tanta perfezione non poteva star senz'anima. Simili a così fatte statue io trovo le parole per virtù della composizione, l'ufficio della quale è, com'io dissi, di tenere in proporzion grata all'orecchio tutte le parole che possano vestir concetto umano [ … ]. Le quai parole, subito che sono messe nella loro proporzione, si trovano sotto l'altrui prononzia quasi animate d'armonia" (Camillo, "Discorso in materia del suo teatro", in Id., *L'idea del teatro e altri scritti di retorica*, 31).

26 See Hermes Trismegistus, "Asclepius", 556-558 and 582-586. On the reception of the *Corpus hermeticum* in the Renaissance, starting with Marsilio Ficino, still relevant is Yates, *Giordano Bruno and the Hermetic Tradition*, 1-189. Also useful is Garin, *L'ermetismo del Rinascimento*.

and to become infinite by entering the divine abyss. The aim of those who wish to possess eloquence is to remove the impure and created, and to find the product that is infinite, and eternal. The purpose of the natural transmutator is to liberate the seed of virtue, which is infinite, from the impure and created, which is finite.[27]

All three are united by the same mechanism, namely the removal of *surface impurity*. We might observe that the position of eloquence between the other two arts is significant, as if language, aspiring to the world of ideas, were a bridge that on the one hand allowed one to reach God and on the other allowed dominion over the quintessence, extracted from the lower material world. *Res* and *verba* coincide in a dialectic of physical visuality, imaginative visuality and intellectual visuality. The wise rhetorician-philosopher, master of all the arts, must therefore actively investigate reality, dissecting and anatomizing the world beyond the superfluous layers of Creation. Only in this way can the divine measures contained in the human being as a microcosm come to light and strengthen human work.

## Visuality: a bridge between occult memory and naturalistic practice

Many of the greatest achievements of the culture of the 16th century, all related to each other, coincide in the cultural experience represented by Camillo's investigation, which established its conditions of existence in the visual language of memory and in the self-control of the imagination. As Camillo himself makes explicit on several occasions, chief among these are:

- rhetorical and poetic production
- the revaluation and emancipation of figurative art
- new anatomical approaches

It is sufficient to consider the famous passage from Aristotle's *Poetics* – which, at the time of Camillo, was itself being rediscovered and widely disseminated among a vast public of intellectuals – that underlines the philosophical and truth-revealing weight of literary production: the poet's task is to succeed not in slavishly imitating reality as it appears, but in *purging* it of all accidental events.[28] In poetic imitation, which is specifically a *per-*

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[27] "tutte e tre fra loro haver una marevegliosa corispondenza. Il fine del huomo che va a Dio, è da levare da sé (con l'aiuto divino) ogni impuro et creato, et diventar infinito intrando nel divino abisso. Il fine di chi vole possedere l'eloquenza è levando l'impuro et creato, et di trovare il prodotto che è infinito, et eterno. Il fine del transmutatore naturale è di sligare la virtù seminaria, che è infinita, dal impuro et creato, che è finito" (Camillo, "De transmutatione", in Id., *L'idea del theatro, con "L'idea dell'eloquenza"*, 281).

[28] See Aristotle, *Poetics*, 28 (IX, 1451 b1-b15). On the rediscovery and influence of Aristotelian poetics see Vasoli, "L'estetica dell'Umanesimo e del Rinascimento", 376-385; Weinberg, *A History of Literary Criticism*, 2 voll; Garin, "La diffusione della 'Poetica' di Aristotele", 447-451.

*fective* imitation, the universal essence of the human being was to be represented in all its purity, which was not the case in ordinary experience. It is not surprising to witness the widespread reabsorption of this passage, including by Platonic authors, or at least authors who did not consider themselves strictly Aristotelian.[29] Furthermore, pictorial comparisons are continually present in *Poetics*, and the comparison between literary work and organic body plays nothing less than a vital role, radicalizing the link between textuality, memorability and visuality:

> Moreover, any beautiful object, whether a living organism or any other thing made up of parts, must have those parts not only in proper order but also on an appropriate scale. Beauty consists in scale as well as order, which is why there could not be a beautiful organism that was either minuscule or gigantic. In the first case, a glimpse that is so brief as to be close to vanishing-point cannot be distinct. In the second case – say, of an animal a thousand miles long – the impossibility of taking all in at a single glance means that unity and wholeness is lost to the viewer. So, just as physical bodies and living organisms need to be on an appropriate scale that allows them to be taken in by the eye, likewise stories should have an appropriate length, which is such as to enable them to be held in memory.[30]

It is certainly not of secondary importance that the literary genre Aristotle dealt with was precisely drama, capable of revealing the ideal order that was hidden under the apparent surface of the worldly chaos and impressing it on the viewer's memory. This helps to explain Camillo's choice of the theatrical building for his system, although, as we have observed, the fluidity between literary-theatrical experience and the art of memory in the proper sense was well established.

In parallel to the Aristotelian reflection on the right dimension of the literary *body*, Giordano Bruno's *Cantus Circaeus* (1582), one of the most significant treatises on the art of memory of the century, offers a specific recommendation concerning the dimension of mnemonic images: "as far as the size of the shapes is concerned, make sure you take images that are neither too small nor too large. The former do not in fact exert any stimulus on the senses; the latter, on the contrary, confuse the acumen of the inner sight precisely because of its excessive extension".[31] Such examples could be multiplied, since here Bruno does nothing more than take up a motif that was widespread among treatises on the art

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[29]   In this sense, the *Naugerius sive de Poetica* (1555) by Girolamo Fracastoro is significant: see Fracastoro, *Naugerius*. Camillo too, in certain passages, tended to loosen the polarization between Aristotelianism and Platonism: see, for example, Camillo, "L'idea dell'eloquenza", 268-269.

[30]   Aristotle, *Poetics*, 26-27 (VII, 1450 b35 – 1451 a9).

[31]   "quod vero ad quantitatem continuam attinet, caveto a parvis imaginibus et ab immodicis. Illae enim sensum non excitant, istae vero extensione sua visum internumque obtutum dispergunt" (Bruno, "Cantus Circaeus", 698).

of memory. Giovan Battista Della Porta discusses the preferable size of images for correct understanding and retention in the mnemotechnical field with explicit reference to the theatrical experience: "if we wish to remember a story or a fable where different characters appear, we will reduce the story into a compendium that includes people and things, and we will adapt it to the loci. I sincerely appreciate the rule followed by writers of trage-dies and comedies, who represent their work with as few characters as possible; and there cannot be a story so full of variety of things that nine or ten characters cannot optimally represent it".[32]

As we have said, the rediscovery of classical poetic-theatrical precepts should not be separated from other great cultural revolutions, including the gradual professional and intellectual emancipation of the figurative artist from the role of mere *artisan*.[33] Leon Battista Alberti was one of the first figureheads of this neither straightforward nor rapid development, and a passage from *De Pictura* reveals him to be Della Porta's true source. Writing of how the painter should represent a certain event, he specifies that "in a *historia*, I sincerely appreciate the rule that I see followed by the authors of tragedies and comedies, whereby they use as few characters as possible to communicate their work to us. In my opinion, in fact, there cannot be a *historia* full of so much variety of things that cannot worthily be represented with nine or ten characters".[34] Theatricality, memory and painting intermingle deeply in a profoundly gnoseological understanding of the human being. Moreover, in this period, the figurative artist also increasingly undertook precise intellectual and empirical research. For example, as Michelangelo illustrates in a famous sonnet, the artist's aim was to remove the "superchio", the superfluous that held the work of art prisoner within a sterile materiality.[35] The need to cleanse the worldly experience of accidents was therefore recalled in order to go back to the ideal plot of being, which we have seen acting in dramaturgical activity. Ultimately, the absorption of Neoplatonic ten-dencies clearly contributed to the revaluation of the figurative artist as *Saturnian* and fully involved in intellectual investigation through his own activity.

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[32] "At si historiae, aut fabulae, in quibus plures personae introducuntur, historiam in personarum et rerum compendium reducemus, locisque accomodabimus. Id vehementer placet quod a poëtis tragicis et comicis observatum video, ut quam paucis personis possint, fabulam mon-strent, neque ulla erit tam rerum varietate referta historia, quam novem aut decem personae optime repraesentent" (Della Porta, *Ars reminiscendi*, 10).

[33] See Kristeller, "Il moderno sistema delle arti", and Chastel, "L'artista".

[34] "in historia id vehementer approbo quod a poëtis tragicis atque comicis observatum video, ut quam possint paucis personatis fabulam doceant. Meo quidem iudicio nulla erit usque adeo tanta rerum varietate referta historia, quam novem aut decem homines non possint condigne agere" (Alberti, *De pictura*, 71). On the resumption of this passage by Della Porta see Bolzoni, *La stanza della memoria*, 220 et seq. On the intersection between dramaturgical performance and the art of memory, see Torre, "Theatro, corpo, memoria".

[35] See Michelangelo, *Rime*, 82 (sonnet 151).

It is not surprising to observe the interest of visual artists in anatomical investigations which, in turn, focused on the removal of the superficial exterior in order to discover the secrets of the body, as Camillo summarizes in his recollection of the anatomical experiment. But the same anatomy, during the 16<sup>th</sup> century, was not isolated from all these cultural environments. Anatomical tables and so-called anatomical theatres were certainly among the most revolutionary tools of the century. Anatomical images of a purely mnemotechnical nature were constructed, clearly codified according to the dictates of the art of memory; their genuine aesthetic and transdisciplinary value reveals significant variations in their use and audience.[36] As can be seen in an image illustrating Vesalio's *De humani corporis fabrica* (Fig. 2), anatomized bodies were arranged in impressive dramatic poses, situated in recognizable places, landscapes or architectures, and imbued with metaphorical significance, all in order to facilitate memory through a specific visual *choreography*. Thus, even the didactic image, regardless of its user, entered the gray area of the imaginative faculties: visuality, memorability and drama again intermingle. The printing revolution made it possible to accompany the anatomical text with precise illustrations, though their use was not limited to a purely professional audience of physicians and anatomists. As we have noted said, such illustrations also captured the interest of artists and, more generally, of the *curious* public. Moreover, these images fully represent the result of collaboration between anatomists and artists.

It is therefore not misleading to say that medical and anatomical discoveries were displayed in the theatre, not only through the visualization strategies adopted in anatomical images but also, in a literal sense, within the buildings that housed lectures and public demonstrations. Indeed, towards the end of the 16<sup>th</sup> century, the so-called anatomical theatres increasingly became permanent, rather than ephemeral, structures.[37] As with other developments, this began precisely in the cities of the Po Valley, where the need for the new *encyclopedia* of knowledge was so acutely felt and where Camillo's work had circulated for a long time. After all, even anatomy had been absorbed into the humanistic project of refounding knowledge that was perpetrated in the academies. As we can observe in the first example of a permanent anatomical theatre, that of Padua, completed in 1595, the image of the classical theatre and its mnemonic role were enthusiastically adopted.[38] However, a more emblematic case for our purposes is provided by the later anatomical theatre of Bologna, designed in 1637 by Antonio Paolucci (the so-called Le-

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[36]   See Carlino, "Cadaveri, corpi metaforici, corpi memorabili", and Carlino, "Cultura visiva e illustrazione anatomica nel Rinascimento".

[37]   See Carlino, "L'anatomia a teatro"; Mascardi, "I teatri anatomici nella cultura moderna"; Messeri, "La rivoluzione storica del teatro anatomico", 61-3; Beese, "Imaginationsraum oder Sehmaschine?".

[38]   More specifically, on the theatre of Padua see Semenzato, ed., *Il teatro anatomico*, and Klestinec, *Theaters of Anatomy*.

Fig. 2 – Table from Andrea Vesalio, *De humani corporis fabrica*, Basel, 1542.

Fig. 3 – Central detail of Apollo on the ceiling of the anatomical theatre of Bologna, by Antonio Levanti, 1645.

vanti).[39] Its coffered ceiling, decorated in 1645 (Fig. 3), displays the allegories of fourteen constellations to which Apollo is added at the center. The patron god of medicine is therefore surrounded by a series of constellations, each considered to have a precise effect on a specific part of the human body. This astrological system is already present in Camillo's *Idea del Theatro*, albeit lacking the specific variation regarding the relationship between constellations and parts of the body. The fifth level of his Theatre, symbolized by the general memory image of *Pasiphae and the Bull*, dealt precisely with the union of the soul with the body. Each of the seven planets-sefirot was entrusted with a specific part of the body along with the zodiacal signs that influenced it.[40] Another significant detail is that the central corridor of Camillo's Theatre was dedicated to the Sun, thus also giving a central role to the image of Apollo.[41] Obviously, we do not intend here to trace Camillo's

[39]   On the theatre of Bologna and its context see Mascardi, "I Teatri anatomici di Bologna Parte I", 293-335, and Mascardi, "I Teatri anatomici di Bologna Parte II", 1-50.

[40]   See Camillo, "L'idea del theatro", 219-228.

[41]   *Ibid.*, 156-157 and 171. It should be noted that, in order to ensure greater visibility, the image of Apollo was offset from that of the other six planets.

influence on Levanti, direct or mediated, but rather to detect the presence of certain cultural resonances still felt in the 17th century.

An even more significant detail in this regard is the fact that the constellations dominate the lower space of the actual structure of the anatomical theatre.[42] To understand the importance of this aspect, it is necessary to move almost a century beyond Camillo and travel to England. Here we meet Robert Fludd (1574-1637), who, rightly or wrongly, has been credited with having built "what is probably the last great monument of Renaissance memory. And, like its first great monument [Camillo's Theatre], Fludd's memory system takes a theatre as its architectural form".[43] In the second section of the second volume of his monumental work, the *Utriusque Cosmi Historia* (1617-1621), dealing with human *interior* technical accomplishment, there is a chapter dedicated to the art of memory.[44] The architectural model is once again a theatre and, once again, it merges with the astrological system. Fludd distinguishes between an *ars rotunda* and an *ars quadrata*, the former referring to *natural* (incorporeal) elements, the latter to *artificial* (corporeal) elements.[45] Fludd proposed a fusion of the two. In his memory system, the *ars rotunda* provided the celestial orbits as mnemonic loci, while the *ars quadrata* provided the physical architecture, again as loci.[46] The specifically human *ars* was therefore naturalized, made closer to the metaphysical design of reality. Fludd therefore diverges from Camillo not only in the typically Elizabethan (as opposed to classical) plan of his theatre, but also by employing two theatres, rather than a single one intrinsically fused with the astrological system. These theatres also appear to be *extrinsic* to that astral system.

To better understand Fludd's work, it is useful to consider the rich images that accompany it. While the author paid the utmost attention to these, they – probably deliberately – retain a veil of ambiguity.[47] Fludd proposed the design of a theatre which was to be used in two ways (Fig. 4). Two theatres, one *eastern* and one *western*, were arranged according to the same plan but decorated differently, one with daytime colors, the other with nocturnal colors. These theatres were physically placed within the astral system of planetary spheres, although it is not clear whether they were situated in every sky and/or for every zodiac sign: Fludd's drawing, on the page adjacent to that of the theatre, shows only the example of the two theatres within the sign of Aries (Fig. 4). In any case, the fusion between the two systems, the architectural and the astral, differs from that of Camillo. In Fludd, they seem to

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[42]  On the ceiling in particular, see Loreta, "Il teatro anatomico dell'Archiginnasio", 223-231.
[43]  Yates, *The Art of Memory*, 321.
[44]  For an overview of this section of the work, see *ibid.*, 320-341. It is also useful for the relationships between Fludd's theatre of memory and the Globe Theatre, *ibid.*, 342-367 and Yates, *The Theatre of the World*.
[45]  See Fludd, *Utriusque Cosmi Historia*, vol. 2-II, 50 et seq.
[46]  *Ibid.*, 54 et seq.
[47]  See Yates, *The Art of Memory*, 324 et seq.
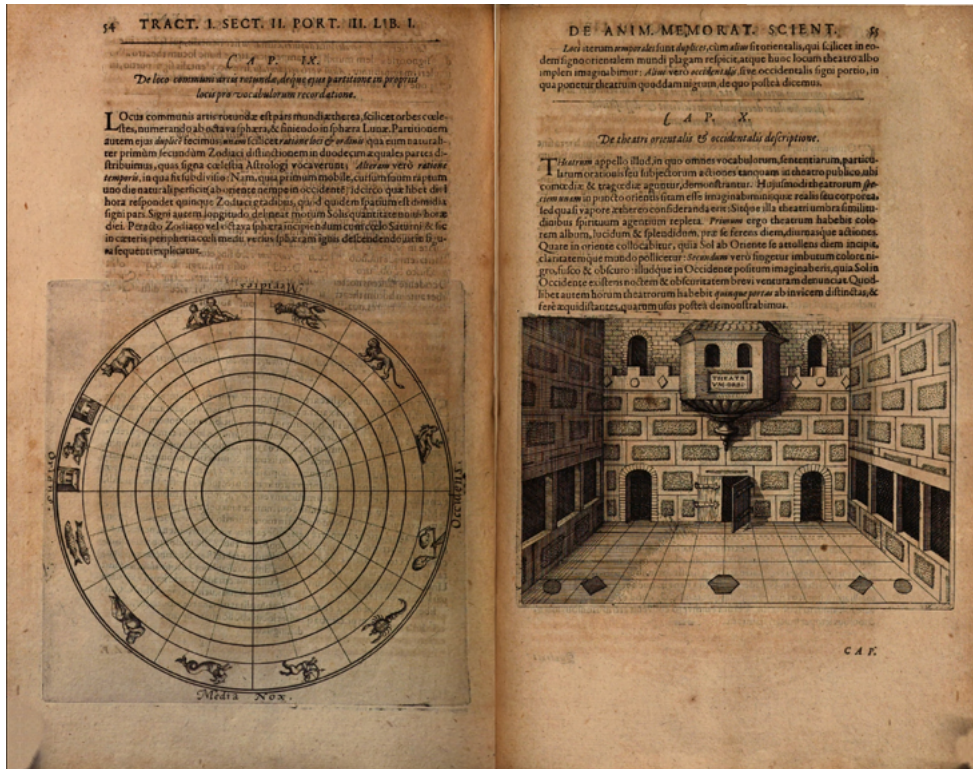
Fig. 4 – Robert Fludd, *Utriusque Cosmi Historia*, vol. 2-II, Frankfurt, 1619, 54-55.

relate in a heterogeneous way. However, as Yates noted with regard to the image of the theatre, attention must be paid to the detail of the ceiling, which is absent in Fludd's drawing.[48] It is most likely that he based the design on the real building of the Globe Theatre, and the majority theatres of this period had a ceiling decorated with the system of celestial spheres (Fig. 5). Indeed, in the construction of the Teatro Olimpico of Vicenza – commissioned by the Accademia Olimpica, a cluster of Venetian intellectuals influenced by Camillo – great attention had been paid to the ceiling, which was painted to represent a sky, albeit without astrological detail. Moreover, Yates adds, we must consider that in Fludd's text the designs of the celestial spheres and mnemonic theatre are paginated in such a way that they overlap perfectly when the volume is closed. This fact seems to reaffirm the mutual reflection of the two systems, but also suggests a more concrete structural detail regarding the ceiling of the theatre. In light of this, a mirroring game of analogies, of a kind very dear to the hermetic

48 *Ibid.*, 347 et seq.
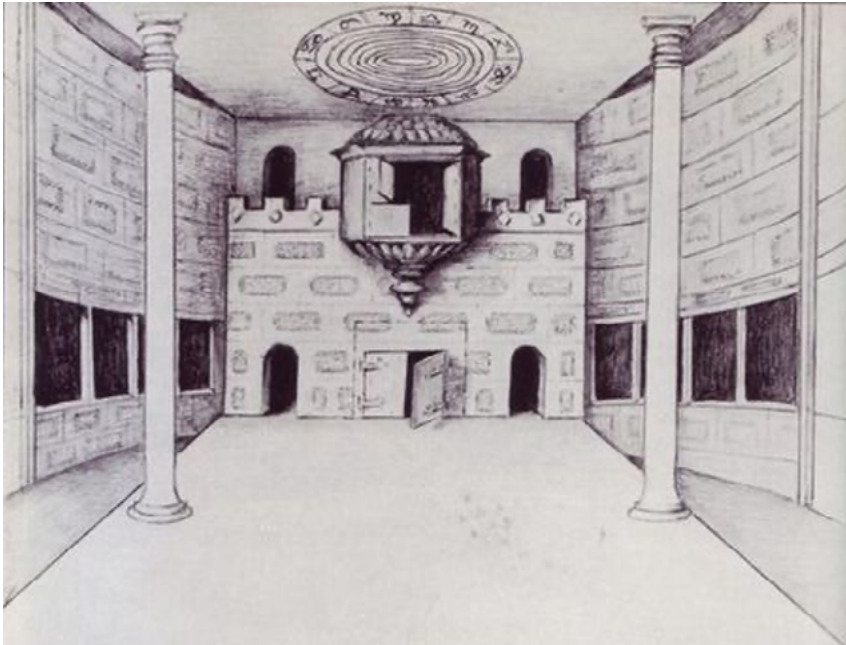
Fig. 5 – Reconstruction of Globe Theatre by Frances A. Yates, *The Art of Memory*, London, 1966.

tradition of the Renaissance, is revealed. Not only were the two theatres to be imagined as extrinsically inserted within the celestial orbits, but internally they reflected those same orbits. This brings Fludd's theatres closer to Camillo's Theatre, with a strong connection between the transcendent and immanent, between metaphysical design and human work.

Returning to Bologna, it is therefore extremely significant to observe a ceiling just above the anatomical theatre that depicts a sky full of astrological references. However, as we have already reiterated, the current state of research does not yet allow us to investigate a more precise network of influences and purposes among the various artists involved in its construction. The influence of the hermetic-Platonic and academic cultural environments, although probably *superficial*, is difficult to deny and constitutes a precious testimony to a still active dialogue between two worlds: that of the scientific revolution and that of hermetic culture, although at this date the two are still hard to separate in a clear way.[49] The strength

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[49]   According to current thinking, the iconographic program of the ceiling appears to obey a decorative need more than a genuinely doctrinal one. Indeed, as Loreta has noted, the constellations presented on the ceiling did not reflect their true order but merely obey a criterion of compositional symmetry, and those represented were most likely chosen on the basis of privileging human figures, deemed more suitable in an anatomical context.

Fig. 6 – Woodcut of the ceiling of the anatomical theatre of Bologna, by Matteo Barboni and Lorenzo Tinti, 1668.

of visuality and the aesthetic and memorial power of the imaginative faculties of the human soul, observer of the complex spectacle of nature and the human body, remain fundamental tools for both anatomists and philosophers (hermetic or otherwise).

However, I believe it is valuable to return again to a detail of the ceiling, and one to which previous scholarship does not seem to have paid due attention. If we refer to the 1668 woodcut attributed to Matteo Barboni and Lorenzo Tinti, in addition to the inverted arrangement of Andromeda and Sagittarius we may observe that the figure of Apollo is vertically oriented, giving symmetry to the overall composition, but also stasis (Fig. 6). This difference further reveals the remarkable dynamism of the actual ceiling, which is facilitated precisely by the diagonal positioning of Apollo within its octagonal coffer. Freezing Apollo's dance in this position seems to convey a *circular* trend to the figure, as if the god were progressively indicating the various astrological figures that surround him. The adoption of a central octagonal coffer, used only for Apollo, seems to make a circular movement more natural within a square frame. This brings us even closer to the circular trend of the illustrations of celestial orbits seen in Fludd, but also traceable to Camillo's Theatre; and

it also recalls another tradition, that of the Llullian wheels. At the time, this tradition had been readily absorbed both in treatises of the art of memory and by the major philosophical and hermetic addresses. Indeed, the graphic representation of Lullian combinatorics within moving wheels had captured the attention of Renaissance intellectuals, who merged them in the most disparate contexts.[50] The most radical experimenter on the fusion between the art of memory and combinatorial wheels was undoubtedly Bruno, yet remarkably this union is present in one of the first printed mnemotechnical treatises, the *Ars memorativa* (1485) by Jacobus Publicius.[51] Here, in a complex system of syllabic construction, Publicius proposes a figure made of combinatorial wheels in which the rotating dynamism is emphasized through the *vermis* placed in the center, which, fixed to the page with a string, can rotate freely[52] (Fig. 7). However, the image used by Bruno in the *Articuli adversus mathematicos* (1586) to indicate the different types of mnemonic loci seems closer to the case of Apollo (Fig. 8). At the center there is a human figure, this time fixed, but whose diagonal arrangement (both of the body and of the open arms) suggests a similar circular dynamism, although the figure is inserted in a square space. Once again, we do not claim to trace a direct link but, at least, to detect the choice of analogous iconographic solutions in cultural contexts and practices that continually refer to: the dynamism of the combinational wheels; their visual strength; their reabsorption into mnemonics systems based on the rotation of the celestial spheres; and the mirroring of the celestial world, theatre and human body. Within the theatre of Bologna, viewers of the anatomical spectacle beheld not only the progressive unfolding of the mechanism of the human body but also the rotating dance of Apollo and the constellations. The corporeal and celestial *fabrica* were united within the theatrical *fabrica*, a place of training and control of imaginative and mnemonic visuality.

To conclude, it can therefore be stated that in Camillo and his cultural environments the paradigm of the human being as a microcosm, an image of the world, remained alive. However, the shift from this *natural* form towards the *artificial* architectural form of the theatre, a new image of the world, highlights a radicalization at that time of trust in human *ars*. This new concept would profoundly undermine the metaphor of the *theatre of the world*, which had survived throughout the 16th century, understood in a derogatory sense to indicate the deceptive nature of theatrical representation parallel to the impossibility of understanding the ultimate root of worldly reality. Theatrical reality, with all its semantic shifts, became the key to reality itself. As Aristotle willed, the dramatic text was able to purify reality of

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[50] See especially Yates, *The Art of Memory*, 173-98 and Rossi, *Clavis universalis*, 63-102.
[51] On Bruno, see Matteoli, *Nel tempio di Mnemosine*, 187-273.
[52] On the wheel see *ibid.*, 155-158. In some editions of the text, other objects appeared instead of the *vermis*. On the complexity of the printed textual tradition of this work, see Merino Jerez, "Iacobus Publicius's *Ars Memorativa*", 85-105. A kind of *vermis*, similarly fixed with the string within the combinatorial wheels, also appeared in the 1520 edition of the very popular *Congestorium artificiosae memoriae* by Johannes Romberch.
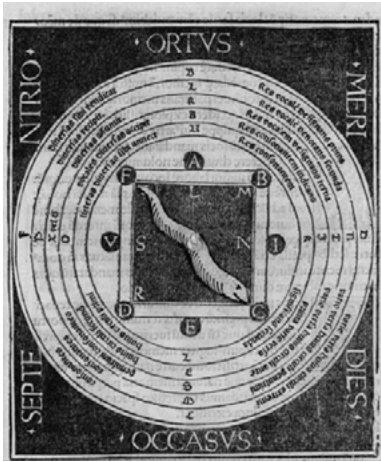
Fig. 7– Jacobus Publicius, *Ars memorativa*, Venice: 1485.
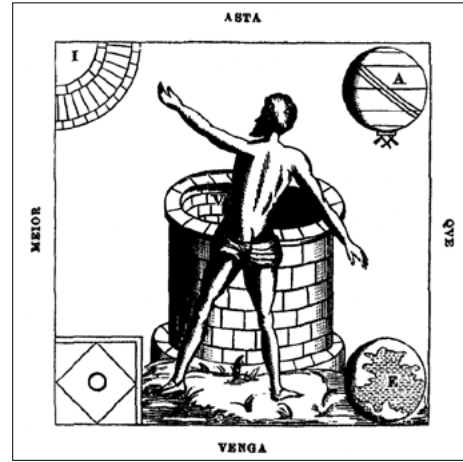


Fig. 8 –Giordano Bruno, *Articuli adversus mathematicos*, Prague: 1586.

superficial chaos, just as the visual dimension of drama established order in the thoughts, and therefore in the memory, of spectators. Based on what we might define the *truthful* theatrical paradigm, which replaced the human figure as *imago mundi*, it follows that the world and human being were no longer *living bodies* but became *living machines*, as the title of Vesalio's work also suggests. The secrets of their gears lay in the hands of *homo loquens*, the builder of mental and physical worlds through visible and memorable speech.[53] In these contexts, the disciplinary and, above all, methodological distance to which contemporaneity has become accustomed disappeared, showing us the profound link between the theoretical and practical conduct of philosophers-magicians, physiologists and anatomists, all of whom were interested in the threshold between the physical and incorporeal faculties of the human being. After all, was not Memory the mother of all the Muses?

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[53] As regards the paradigmatic value of architecture in the constitution of the new circle of knowledge, see mainly Angelini, *Sapienza, prudenza, eroica virtù*, and, more specifically on the hybridization between theatrical performance and encyclopedic practice, see West, *Theaters and Encyclopedias*.

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# Memory as shadow of the method in Peter Ramus and French Ramism

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**Abstract**

The article examines the ambiguous role of memory in Peter Ramus' reform of logic and in sixteenth-century French encyclopedic Ramism. In particular, it shows how, in Ramus' writings on dialectics, the art of memory loses its identity as an autonomous discipline and is entirely absorbed by the doctrine of method. Such an identification of memory and method presupposes a conception of knowledge as an objectification of structures and mental operations that is inadequate to the setup of an encyclopedic project aimed at guaranteeing the objective and extra-mental contents of the disciplines, as the one that asserted itself among the first generation of the *regius professor's* scholars. It is precisely in this context that, also thanks to the revival of Lullist instances, memory is charged with classificatory and unifying functions regarded as necessary and preliminary to the application to all arts and sciences of Ramus' unique method.

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## 1. The Ramist logic like a system of local memory

Among the first clarifications of the ambiguity of the art of memory and its denial by the reformer of sixteenth-century logic, the *regius professor* Peter Ramus (Pierre de La Ramée), were the studies of Walter Ong, Paolo Rossi and Frances Yates that, between the late 1950s and the mid-1960s, did not so much as highlight the disappearance of *ars memoriae,* but the new role that it began to play in the context of the reform in knowledge and logic promoted by Peter Ramus in the mid-16th century. In his 1958 monograph, Ong explained the progressive exclusion of memory – and, notably, local memory – from Ramus' logic with the entirely mental localization and arrangement of logic proceedings, even more distinct in the more mature phase of the Parisian professor's reflections: in his works, the space of the page, topically arranged thanks to the use of tree-like diagrams (the so-called "Ramist trees") that articulated the arrangement of subject matters considered through partitions and subpartitions, reproduced a "mental topic", which made the palaces of memory and the concrete *loci* of classical rhetoric tradition useless, and even misleading. Ramus could free himself from mnemotechnics because all the knowledge that he had based on a topically conceived logic was itself composed of "a system of local memory".[1] Frances Yates presented an analogous evaluation in his judgement of how Ramus conceived his own dialectical method as "the true classical art of memory". Old and new techniques of visualization and systematization justified the author of *Dialecticae Institutiones* in considering the "one method" not as an alternative, but as "another transformation of the classical art".[2] The conclusion presented in the pages of *Clavis universalis* was overturned, and not only in its terminology: it was not memory that contained the method, rather the method, the "systematic and ordered disposition of notions" that "absorbed many 'rules' of mnemotechnics." This was something more than a reform or update of the classical art of memory: "in the Ramist absorption of memory into logic, and identification of the problem of the method with that problem of memory", Paolo Rossi saw the birth of "the concept of method as a classification of reality, a notion which became vitally important to European thought in the succeeding centuries".[3] The issue was no longer testing the permeability of the *méthode unique et singulière* to the rules of *ars memoriae*, but instead evaluating, starting with the stance adopted by the greatest French exponent of logic studies in the 16th century, how much those rules and problems pertinent to memory in general had found space

1   Ong, *Ramus, Method and the Decay of Dialogue*, 280.
2   Yates, *The art of memory*, 236.
3   *Clavis universalis. Arti della memoria e logica combinatoria da Lullo a Leibniz* is the original title of Paolo Rossi's monograph, published in Italy in 1960. The English edition from which the following quotations are taken, has the title *The Logic and the Art of Memory. The Quest for a Universal Language*, 101.

in a wider reform of knowledge's method which would be accomplished in the 17<sup>th</sup> and 18<sup>th</sup> centuries. Thus, Ramus' denial of memory as an autonomous discipline and the absorption of the tasks it had traditionally performed by the method and the new logic, appeared more than the death of the *ars memoriae*, "the birth of the 'new method of the sciences'". According to Paolo Rossi, such a method left behind the *viae investigandi* of mediaeval logicians and took on the task of classifying the reality. The analysis of the places dedicated to memory and the method's ordinal function supports the conviction that Ramus writings actually represent a fundamental passage in the plurisecular itinerary of *ars memoriae* and not simply a variation of Ciceronian paradigms: that in which memory does not disappear, but from an *ars* that it was (from an autonomous discipline or from a part of rhetoric) becomes method.

However, this memory (requiring *loci* "simpliciora and meliora" than those of Carneades and Metrodorus in that it is nothing more than "ars ordinis […] tota posita […] in divisione et compositione"[4]) and the method that absorbs it (removed not only from techniques of rhetoric, but also from *inventio argumentorum*, and collocated in the second part of logic, judgement), although they represent a disruptive novelty full of subsequent developments, do not seem to have yet to embody, at least in the writings of the *regius professor*, the classificatory function regarding reality that will become the signature of the new methods of science.[5] It is with the first generation of his scholars rather than with Ramus himself that memory and method, in their convergence in the need to classify reality, step away from the field of *artes sermocinales* and acquire the function of *new organon* of all knowledge. This happens in conjunction with the arrival of a precise "encyclopedic" function of the Ramist reform of logic and method, as well as the assertion of a conception of the encyclopaedia as a universal system in which knowledge is characterized as an organic interlacement of all the formalized disciplines and the others that could gradually reach an internal articulation that was coherent and theoretically founded.[6] It is worth underlining that, if one excludes *Professio Regia*, an uncompleted work only partially attributable to the *regius professor*, the issue of the arrangement of the *orbis disciplinarum omnium* remains for Ramus an eminently theoretical question.

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4    Ramus, *Scholae in tres primas liberales artes*, 165.
5    Cf. Rossi, *The Logic*, 160.
6    This is a reference to a movement in Ramism tied to the literary and scientific fields of the Collège Royal that, unlike the so-called 'semi-Ramist' or 'Philippo-Ramist' movements widespread in German and English environments and directly involved in the reorganisation of Protestant universalities, was interested not only in the problem of the 'systemisation' and 'methodisation' of knowledge, but also to the specific content of the disciplines and the growth of knowledge. Cf. Ong, "System, space, and intellect in Renaissance symbolism", 235-239; Vasoli, *L'enciclopedismo del Seicento*, 19-29; J.S. Freedman, "Encyclopedic philosophical writings in Central Europe during the high and late Renaissance (ca. 1500-ca. 1700)", 212-255.

The interpretation of the disciplines proposed in the *Scholae* is molded to the *methodus unica* that is invariably applied to every area of knowledge. This approach, when used in fields of knowledge other than grammar, rhetoric and logic, arithmetic and geometry, is primarily a confutation of the criteria according to which the traditions of each discipline are built over time and an analysis of the single reasonings in light of the method, but it does not deal with specific content from the various disciplines.

Emblematic of this declination of Ramism are the *Tableaux accomplis de tous les arts libéraux,* published in 1587 by Christophle de Savigny,[7] a mysterious vassal of Luigi Gonzaga, Duke of Nevers and Rethel, Prince of Mantua and Peer of France. The *in-folio* comprises sixteen sections or "partitions" dedicated to the sixteen disciplines,[8] each of which is printed on two consecutive pages, one dedicated to an exposition in decreasing order of generality of the *praecepta* and the *argumenta* of each particular subject matter, and the other occupied by a "tableau" that presents, in the form of a diagram, the partitions and points of passage through which the *genus* of the discipline evolves into its increasingly specific parts. The encyclopedic dimension of the work derives from a sort of preliminary discourse (*Partition generale de tous les arts liberaux,* Fig. 1) that introduces the sixteen disciplines and the corresponding *tableau,* entitled *Encyclopedie, ou la suite et liaison de tous les arts et sciences* (Fig. 2). It is difficult to establish if Savigny was the actual author of the work or if it is a pseudonym behind which a well-known figure, or group of authors hid; the volume certainly proposes an arrangement of the sixteen disciplines that is consistent with the reform not only of logic but of all knowledge proposed by Peter Ramus at the Collège Royal and continued by the first generation of his followers.[9] The two pages of the *Tableaux* dedicated to dialectics (Figs. 3-4) are those in which the adherence to Ramist theory is most evident, but they are also those in which Savigny displays a perception of an insufficiency in the teaching of his maestro regarding memory, or better, memorative

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[7]   Savigny, *Tableaux accomplis de tous les arts libéraux*; reprinted in Paris in 1619, at J. Libert. The critical edition of the volume is published in Angelini, *Metodo ed enciclopedia nel Cinquecento francese*, vol. II: *I Tableaux di Savigny.* The citations that follow refer to this edition, from now on indicated as *Tableaux.*

[8]   The disciplines included in the *partitions* and *tableaux* are: grammar, rhetoric, dialectics, arithmetic, geometry, optics, music, cosmography, astronomy, geography, physics, medicine, ethics, jurisprudence, history, theology. The pages that contain a *tableau* include a diagram with symbols and instruments that characterise the content of the disciplines considered. For an idea of the layout, see the *partitions* and *tableau* of dialectics (Figs. 3-4), which is the typographic model repeated for each of the 16 disciplines.

[9]   On this work, which represents the first and probably the only encyclopaedia from the 1500s framed by a Ramist method and conception, and on the mysterious author who penned the work, see Angelini, *Metodo ed enciclopedia nel Cinquecento francese*, vol. I: *Il pensiero di Piero Ramo all'origine dell'enciclopedismo moderno.*
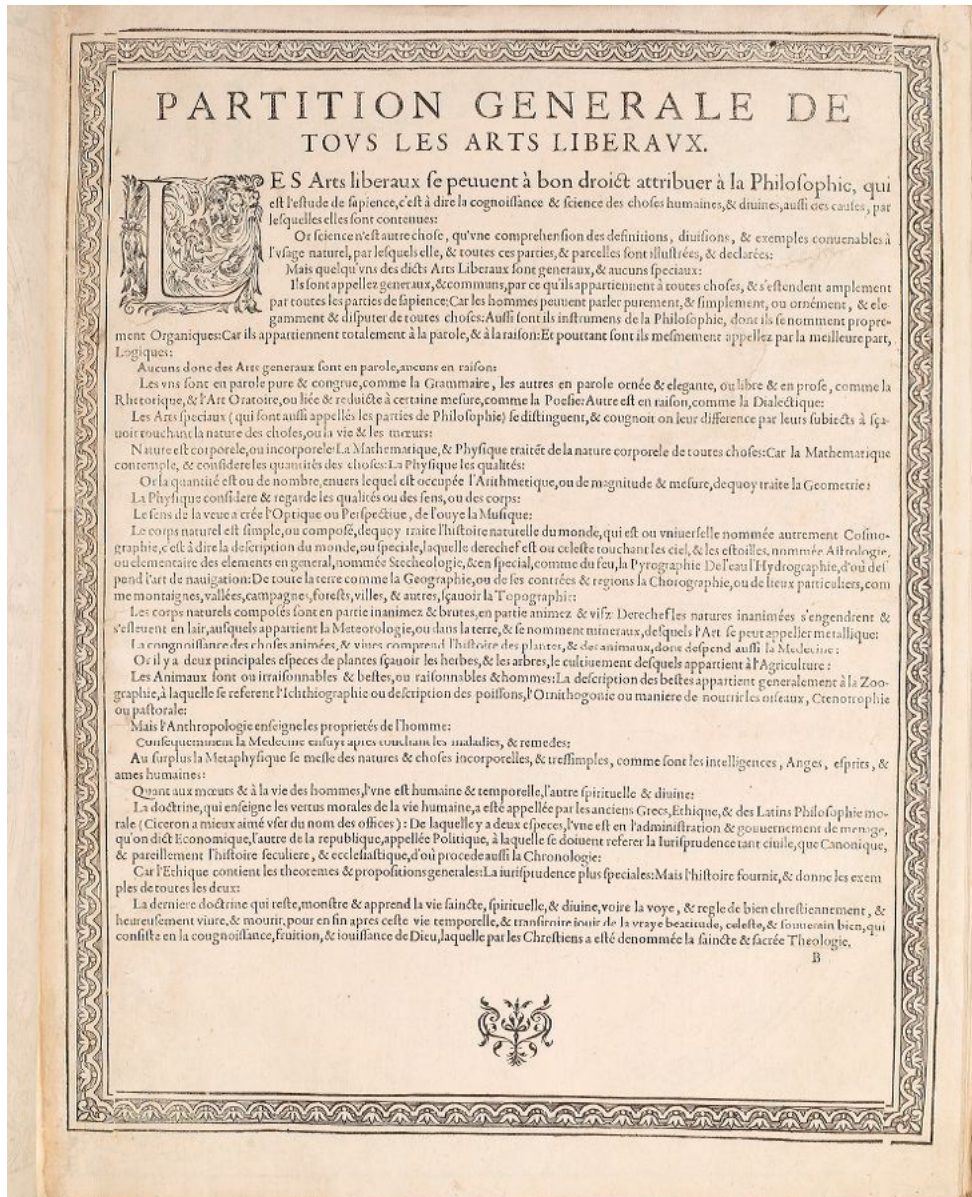
Fig. 1 – The first page of Savigny's Encyclopedia including the "General Classification of all Liberal Arts".

Fig . 2 – The first diagram titled "Encyclopedia as the succession and connection of all arts and sciences", corresponding to the "General Classification".

PARTITIONS DE LA DIALECTIQVE.
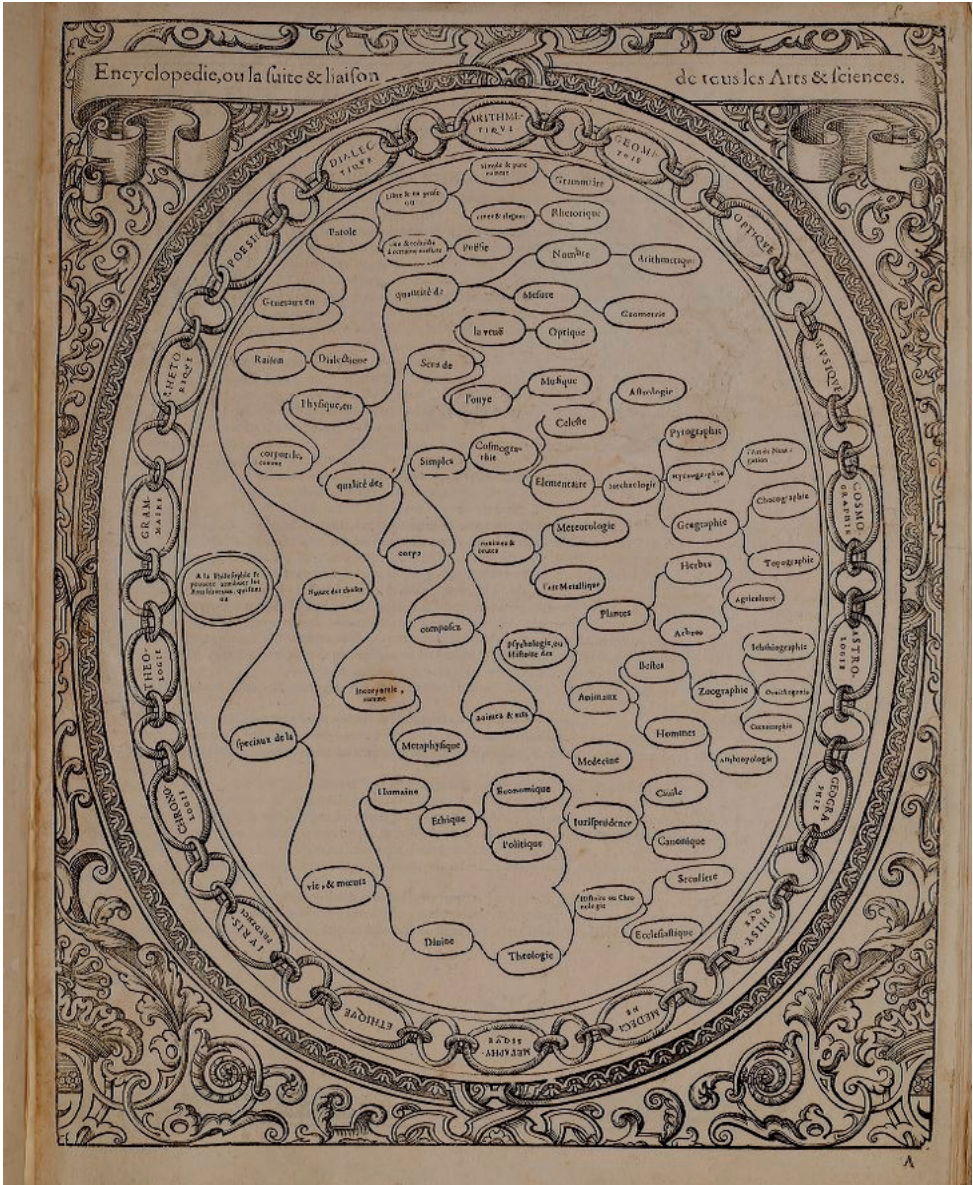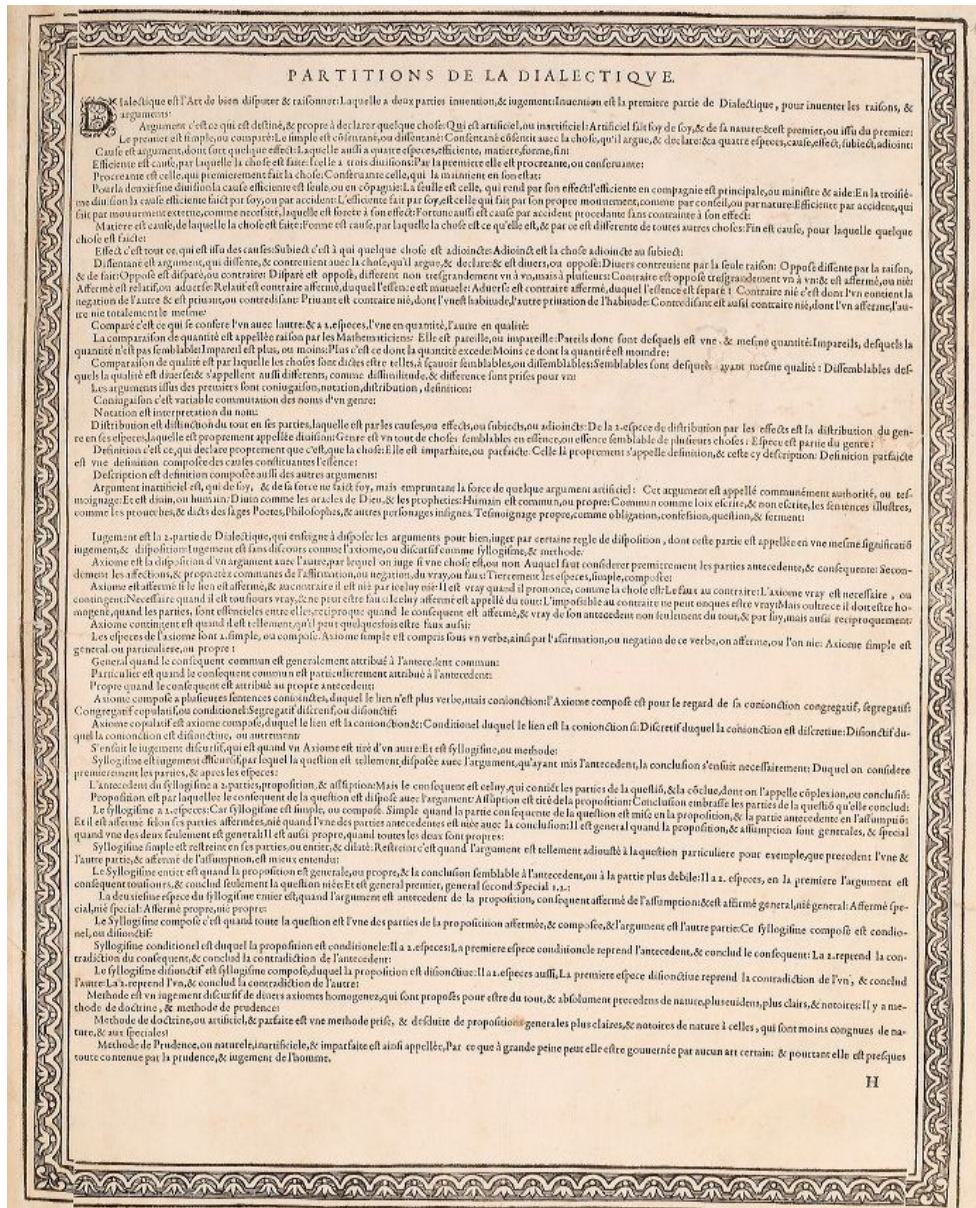
Fig. 3 – The page of Savigny's encyclopedia including the Dialectics' *partitions*.
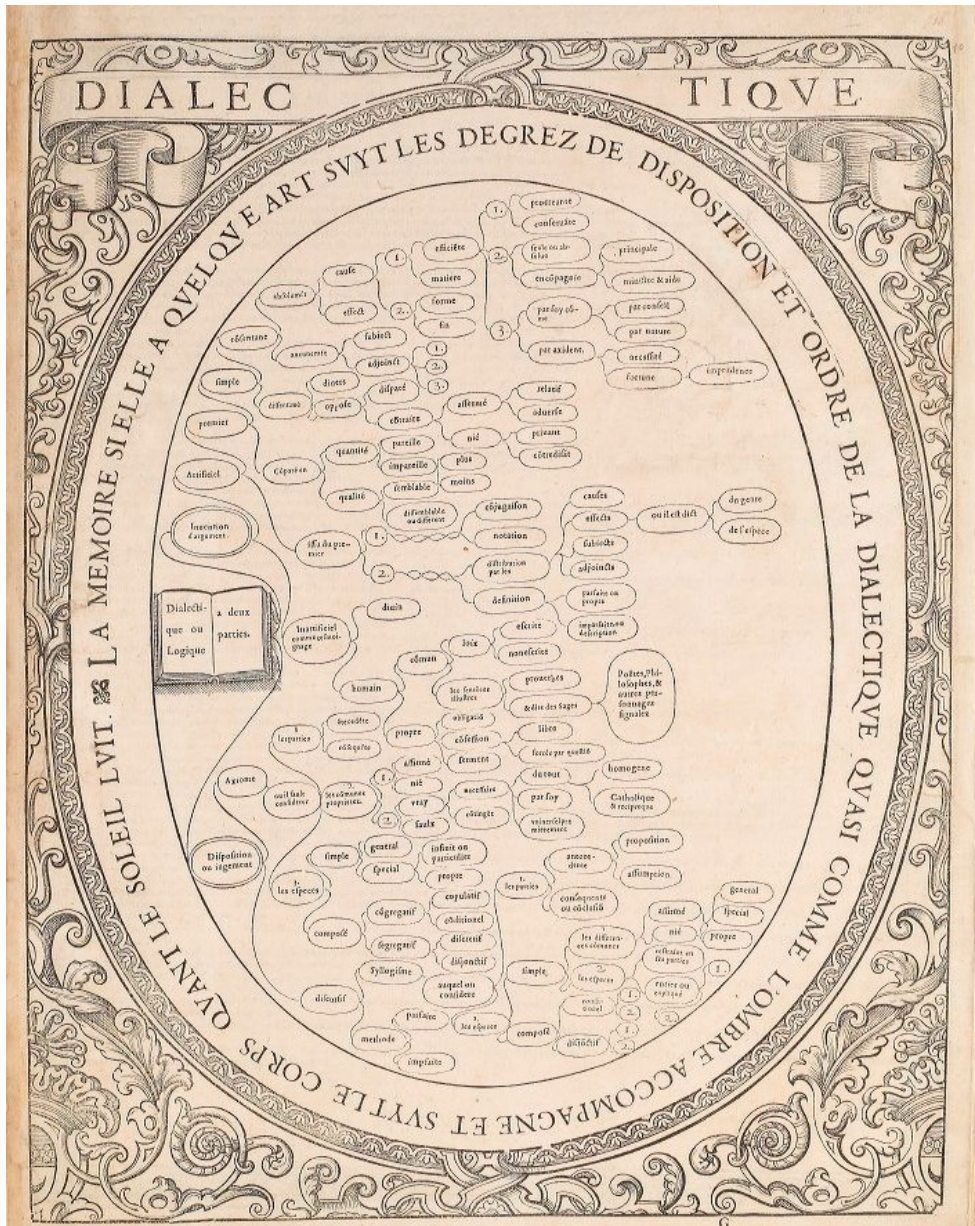
Fig . 4 – The diagram corresponding to the *partitions* of the Dialectics.

logic.[10] This inadequacy is much more evident where Ramism aims to advance a reform not only of the form, but also of the content of knowledge as a whole. The author of the *Tableaux*, who was well inside the Ramist entourage, does not miss how memory, starting with the *Dialecticae partitiones* of '43 up to the final posthumous edition of *Dialectica*, is anything but rejected, but is increasingly distanced from a technic of persuasive discourse to became a very part of philosophy and scientific demonstration, thus anticipating both its collocation in the "ministratio ad memoriam" of Baconian logic, and the meaning assigned to "enumeratio" in *Regulae ad directionem ingenii* by Descartes.[11] Coherent with the mature framework of Ramist doctrine, mnemotechnics disappears, together with the apparatus of *imagines agentes* and concrete places of which the oratory tradition had made full use, and memory, included in Savigny's *Tableaux* in the dialectics section, takes on, despite its name, an unprecedented function that plunders the Latin oratory and appears inseparable from the doctrine of order and disposition, due to the scope of the ambitions it pursues.

It is worthwhile to examine more closely the section of the *Tableaux* dedicated to dialectics. The page featuring its diagram (Fig. 4) does not include any graphic elements, neither in the "mirror", nor the oval frame that surrounds it. There is just one occurrence, an open book as the trunk of "dialectics or logic" from which the two main branches of invention and judgement originate, and an inscription that winds around the tree in place of that usual illustrated frame that is missing in this table, unlike those of the other disciplines. However, the inscription is more meaningful than any other symbol: "*la memoire si elle a quelque art suyt les degrez de disposition et ordre de la dialectique quasi comme l'ombre accompagne et suyt les corps quand le soleil luit*". This is a citation from Ramus, who had stated "dispositionis umbra quaedam est memoria" because "quicquid est artis qua memoria possit adiuvari, ordo ac dispositio rerum est".[12] For Ramus, like for the

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[10]   "Memorative logic" refers to the Ciceronian connection between logic and *ars memoria* frequently, though not exclusively, used by Llullists of the 16th century that interpret the *ars combinatoria* as a universal instrument of judgement (more versatile than syllogism), as well as a mnemonic system (more effective than the Ciceronian system). It is the classificatory aspect of memorative logics that has a bearing on the methodology of the 16th and 17th centuries and, as I will attempt to document in the pages to follow, that orients Savigny's "strategy" in arranging the sciences.

[11]   In Ramus' dialectical writings, the fate of memory follows that of rhetoric: rather than being refuted, the rhetorical scheme is assigned an excess of importance as *inventio*, *dispositio* and *memoria* are transferred from the art of discourse to that of proper reasoning and the functions of logic.

[12]   Ramus, *Scholae in tres primas liberales artes*, 43, 14. Ramus then added that "ordinis porro quoniam sola dialectica dispositio doctrina est, ab ea sola. memoriae praesidium et subsidium peti potest" (*ibid.*, 43). For further reading, see Ramus, *Scholarum Dialecticarum seu amimadversionum in Organum Aristotelis,* 600: "Tum si qua ratio memoriam possit adjuvare, illa dispositionis

Ramist author of the *Tableaux*, this was related to liquidating mnemotechnics, negating any functions it may have other than accompanying the *dispositio* of dialectics; but, upon closer examination it is clear it was also related to recognizing its pervasiveness since, although it was without its own location or physiognomy, it is the shadow of a "lux solis" that radiates throughout all of art and science.[13] Abandoning in the dialectic *tableau* of Savigny's work the symbolic repertory traditionally characterizing the discipline and giving emphasis and symbolic value to two central motifs of the Ramist reform (the book and the "lux solis") means making a dual declaration: *dialectique* does not receive the inheritance of humanist eloquence, nor that of scholastic logic, but presents itself as an entirely new science, without a tradition – an inedited book, opened to the first page for the first time – that, as Ramus reiterated many times, if it has its own antecedent and an authority to harken back to, it is the light of reason;[14] memory is not a discipline nor a technique ("art"), but a part of logic and more precisely the second part of logic, which is the dialectical *dispositio*, namely the doctrine of judgement. The only *imago agens* of the discipline, the book, symbol par excellence of the transmission of knowledge, open to the inscription "*dialectique ou logique a deux parties*",[15] is a book that has yet to be written,

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admonitio juvabit; licebitque philosophis et oratoribus, qui locis et imaginibus artem quandam memoriae confinxerunt, per nos quidem valere; nihil enim pollicentur, quod non uberius multo faciliusque teneamus. Aiunt enim ordinem prodesse memoriae, sed externis et commentitiis eam signis et simulachris instruunt; nos ordinis rebus ipsis insiti doctrinam certissimam et veros locos pro rerum gradibus et generibus distinctos, rerumque verissimas imagines adhibemus. Illi verborum memoriam infinitate formarum conturbant […] nos hanc partem rerum conpositione et collacatione (quantum natura fert) adjuvamus. Quapropter quicquid est, quod ad confirmandam memoriam doctrina possit efficere, id totum dialecticae dispositionis doctrina praescribit". Already in *Dialecticae Institutiones* from '43 Ramus defined memory "umbra iudicii" (f. 43v.); in the field of the doctrine of judgement he specified that memory "iudicii gradus perinde ac umbra lucente sole corpus sequitur" (f. 43r).

13　After having compared the rules of dialectics that are equally relevant in every field of knowledge to a single law that governs over a realm as large as the universe and to which "grammatici, rhetores, poetae, historici, arithmetici, geometrae, musici, astrologi, physici, ethici" conform, Ramus returns to the image of the sun: "Ut in mundo est unicus et singularis […] sic una ratio hominis est generalis et communis […] Lux solis mundum duntaxatistum corporeum illustrat, lux rationis, etiam supra mundum per illas supramundanae infinitatis regiones pervagatur" (Ramus, *Scholae in tres primas liberales artes*, 35).

14　The source of the dialectic art for Ramus is none other than the light of reason, or better yet, the heavenly fire stolen by Prometheus, "artificiosae methodi author et inventor", from which humans were shaped so as to be dialectic in their very nature; cf. Ramus, *Scholarum Dialecticarum*, 4-5, or "Praelectiones" from 1572, in *Dialecticae libri duo*, 532-533.

15　The two branches that extend from the page of the book indicate the two parts into which the dialectics or logic of Ramus is subdivided, *inventio of topics* and *dispositio or judgement*.

that annuls every relationship with logic tradition and proposes a *scientia penitus nova*.[16] A book that is yet to be written and a tradition just sketched out but projected towards the future: and the future of memory, by now stably collocated among the branches of dialectics, is not to provide a repertory of emotionally meaningful *imagines*, but to follow the doctrine of judgement *like a shadow*, supporting the concatenation of the rings that articulate the progression of the dianoetic process.

In Savigny's *Tableaux*, method, with more evidence that what can be found in Ramus' theoretical writings, does not only coincide with the last two definitions of the "ars dialectica", but also constitutes the "ratio ordinis" that, while guaranteeing the proper sequence of phases of reasoning ("the light of natural reason"[17]), from the principles to the conclusions, ensure that in each of the sixteen disciplines – from grammar to theology – "the uninterrupted chaining of the many and different statements"[18] constituting its corpus. If each doctrine or science must descend "*degrez à degrez*" from the general to the particular, if the method coincides with the degrees of the *dispositio*, if the *dispositio* is order and order is method, then *ars memoriae* too, "if it exists", can be no other than the *ars* that accompanies dialectics in its larger acceptation of logic (and thus is the concatenation of homogenous axioms) regardless the various subjects of the judgement, just like "l'ombre accompagne et syit le corps quand le soleil luit".[19] This is equivalent to a confirmation

[16]   The association of this book and what appeared in a dream to Descartes the night between 10 and 11 November 1619 is suggestive, as it illustrates this new logic in the *Tableaux*. Discovered on a table "without knowing who had placed it there", this too without a story and quite "indicative of the future", is interpreted by Descartes as containing "nothing if not all of the sciences gathered together", Descartes, "Olympica", in *Oeuvres de Descartes*, 182-185.

[17]   Beyond the attributes that intervene in its qualification (natural, by nature, of art, artificial, doctrinal) the Ramist method never distances itself from what its own nature teaches: to proceed from that which is antecedent, more general, absolutely clear, more and earlier known, up to its particular consequences, more obscure and less known. Shaped by Prometheus in the divine fire of reason, according to the tale told in *Philebus*, humans are logical by nature; thus, this methodical artifice does not add anything to intelligence, except ensuring that, even during more complex and articulated reasonings, it continues along the straight path established by natural reason; cf. for example De La Ramée, *Dialectique*, 121-123.

[18]   Ramus, *Dialecticae institutiones*, f. 27r.

[19]   The inscription that closes the *tableau* of dialectics (Fig. 4); see also the last three clauses of the relative *partitions* in *Tableaux*, 65. In this case as well, the source is De La Ramée, *Dialectique*, 122: "[…] Toute vraye doctrine et science doibt proceder par des choses generalles, et descendre *degrez à degrez* aux specialles"; even more persuasive, on the serial nature of the "methodical order" in *Praelectiones* from 1566: "singulae ordine alphabeti notae essent, a, b, c, […] tantum notas illas in disponendo spectares, ut quae notam primae litterae haberet, ea primo loco esset, quae secundae, ea secundo, det deinceps consimiliter" (Ramus, *Dialecticae libri duo*, 1566: 374). For Ramus, the uninterrupted sequence of rings of the chain is the most eloquent image of the method as a serial order. Analogously in *Tableaux*, 65.

of what Ramus ultimately concluded at the end of a 40 year reflection: the method is a rational process that connects "homogenous axioms" starting with those that are more evident by nature – which is to say those that are universal – and encapsulates memory.[20] If understood from the right perspective, the method, guarantor of the Homeric chain of which "nil aptius, nil compactius, nil firmius esse possit", does not refute memory, but envelops it, and memory, for its part, does not need to sustain or strengthen itself if not with the order of the *dispositio* of dialectics.

According to Ramus dialectical writings and *Scholae*, it is sufficient to affirm that "ars memoriae" does not need places as it is none else than an "ars ordinis [ … ] tota posita sit in divisione et compositione"[21]; consequently the signs and simulacrums "externi et commentitii" confuse reason, while the single, constant order intrinsic to dialectical doctrine helps and facilitates not only memorisation, but also understanding.[22] Therefore, this form of memory that is *seated in the shadow of method*, does not need *imagines agentes*, not only because it has dissolved its continuity with traditional memorative techniques, but also because, entirely satisfied and absorbed by the arrangement, division and composition of method, it appears entirely dematerialised. Dematerialised and therefore removed from buildings, churches, theatres and concrete *loci* of oratory and mediaeval mnemotechnics, relegated to the shadow of dialectical *dispositio*, which is to say the *habitus* of the correct reasoning.[23]

For Ramus the method is a *habitus* (*habitude* in Savigny's French, like in *Dialectique* from '55) that is, an acquired behaviour characterised by the observance of rational criteria that guarantee the success of a procedure. This refers to *habitus disponendi* and, more precisely to a *habitus dividendi et compenendi*, the technique of which – the control exercised by a rule that impedes the natural propensity for reasoning to distance itself from the "main path" – confers the qualities of linear, ordered progression and graduality, requiring that "les degrez de disposition et ordre de la dialectique" are followed in order.[24] In Ramus *habitus ratiocinandi*, *méthode de doctrine ou artificiele*, *dialectica artificialis*, memory as "um-

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[20]  "Methodus est dianoia variorum axiomatum homogeneorum pro naturae suae claritate praepositorum, unde omnium inter se convenientia iudicatur, memoriaque comprehenditur" (Ramus, *Dialecticae libri duo*, 72-73).

[21]  Ramus, *Scholae in tres primas liberales artes*, 165.

[22]  Cf. Ramus, *Dialectiae Institutiones*, ff. 57r-58v.

[23]  An example of this "dematerialisation" of local memory, made possible by Ramism, comes from Citolini, *Tipocosmia*. The work in large part makes use of the so-called *theatre of memory* from Giulio Camillo, but Camillo's diagram, conceived through *imagines agentes* and *memory places*, is entirely replaced by Citolini, who instead uses tree diagrams whose branches underline the passage from the general to the particular. The work maintains a mnemonic finality analogous to the starting model, but the notion of *memory place* on which it is built goes from concrete to mental. On Citolini's Ramism, cf. Bolzoni, *La stanza della memoria*, 250.

[24]  From the frame in the *tableau dialéctique* in the *Tableaux,* Fig. 2.

bra dispositionis" and "ordo ac dispositio rerum [ … ] qua quid primum, quid secundum, quid tertium animo cernamus",[25] i.e. that which is innate to the same intelligence but the use of which is controlled by compelling rules (*leges imperatoriae*), tend to identify themselves. Therefore, it is clear that for Ramus and for a Ramist like Savigny, memory has a precise role; and it is just as clear that this role is directly related to the introduction of an order that is methodical and almost mathematical[26] in the labyrinth of *argumenta* that comprise the subject of knowledge and the disciplines contents.

## 2. Savigny: a renewed relationship between the lux methodi and the umbra memoriae

The problem of memory in the logic of Ramus could be settled with the definition from the last edition of *Dialectica*: "methodus est dianoia variorum axiomatum homogeneorum pro naturae suae claritate praepositorum, unde omnium inter se convenientia iudicatur, memoriaque comprehenditur",[27] if it were not for the insistence on the adjective *homogeneum*, revived by Savigny,[28] that qualifies the axioms on which method, including memory, is called to judge. The method together with it its *shadow* (memory) is the *dispositio,* or better, the rule that guarantees that *lux rations*, the natural dialectic propensity of reason, will not stray from the main path. Careful to identify *methodus* as "ratio ordinis" and intent on freeing himself from the useless disorder introduced by local memory, Ramus has memory and method coincide on the criterion of graduality and the uninterrupted chain of reasoning. Having established this connection that refutes artificial memory, not memory itself,[29] and having recognised the method as pervasive in the entire *dispositio,*[30]

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[25]  Ramus, *Scholae in tres primas liberales artes,* 14.

[26]  *Ibid.* In the inscription in the *tableau* of *dialectique*, just as in the letter dedicated to the *Tableaux*, method, order and *dispositio* (and therefore judgement) are entirely unified, in a way that is perfectly adherent to Ramist doctrine; this unification that is made even more evident by the terms *ordre* and *disposition* that take on the peculiar qualifications of the Ramist *méthode*: for Savigny, arrangement (like method) is *de doctrine*, that is to say artificial; order (like method) is *singulier*, that is to say singular. But note also how the expression "sommaire et generale partition", and even more so in the second edition "sommaire et generale proportion", subtly communicates that the possibility of unifying and methodically arranging knowledge is placed once again under a geometric-mathematical criterion.

[27]  Ramus, *Dialecticae libri duo*, 72-73.

[28]  "Methode est un iugement discursive de divers axioms homogenez, qui sont proposés pour estre du tout et absolument procedens de nature, plus evidens, plus clairs et notoires" (*Tableaux*, 65).

[29]  This deprives memory of the autonomy and theoretical foundations of *ars* to transfer a substantial part of mnemotechnic rules to method, enough to qualify it, and not memory, as *artificial* (in Ramus' writings: *méthode d'art, méthode artificielle, méthode de doctrine, methodus artificialis*).

[30]  Which occurs in the editions of *Dialectica* from the second half of the 60s.

he is unconcerned with distinguishing the functions of one or the other, merely describing their relationship with the terms *lux* and *umbra*. To guarantee proper judgement, it is sufficient that the method observes rigorous rules and laws, rules and laws that are also partially derived from the ordinative criteria of *ars memoriae*, primarily from the rules of division and composition that, Ramus admits once again, make the art of Quintilianus preferable to that of Cicero or pseudo-Cicero.[31] With this choice Ramus renounces not only the *loci* and the *imagines agentes* of local memory, but also the summary, classificatory and unifying function that was part of some memorative techniques that later is part of Francis Bacon's method, or many systematic classifications of the 17th century.

Ramus renounces these aspects because the logic in which he collocated the method and its *umbra* is expended through being a doctrine of proper reasoning and considering mere dianoetic realities as its own objects. And this is because the reality it faces must be ordered according to the *prius* and the *posterius*, the more and less general, but it in no way needs to be classified because it is homogenous, as it is generated by the mind and organised within a space that is also purely intellectual.[32] The 'mentalist' tendency, or the metaphysical foundation that Ramus is unable to detach from method and that guides it towards the arrangement of knowledge understood as the objectification of structures and mental operations, while it is true that it distances him from the demonstrative methods of late Scholasticism and argumentative modes of rhetoric, it also resolves the problem of variety and multiplicity and heterogeneity in knowledge inside the mind and the consistency of dianoetic operations. This also neutralises the need to identify an instrument able to classify and divide the varied subjects of knowledge with the perspective of a whole arrangement.

While Ramus approaches the problem of method with formal terms, he needs only to respect a *ratio ordinis* "ut absolute notius et clarius antecedat";[33] and, on the other hand, the adoption of classificatory criteria aimed at overcoming the singularity and heterogeneity of data is not necessary either, not even in the arrangement of the *stricto* and *lato sensu* logic disciplines (the first three liberal arts: grammar, rhetoric, dialectics). It is not necessary in the mathematical disciplines either, which he recognises as having a mental origin and considers them an exemplar of the methodical order and the rules of *dispositio* due to their axiomatic structure.[34] If instead he had to concretely apply the

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[31]  Cf. Ramus, *Scholae in tres primas liberales artes,* 165.
[32]  Cf. Ong, *Ramus, Method and the Decay of Dialogue*, 280.
[33]  Ramus, *Scholae in tres primas liberales artes,* 616.
[34]  In these cases, dialectics finds itself in the role of arranging an entirely mental subject and for which it is homogenous or quite susceptible to homogenization in line with *lex iustitiae*. Starting with the *axiomata* that the method judges and claims is *homogenea*, they need to be arranged the more and the less general, but they in no way need to be classified because they are profoundly connected to a reality that is generated and arranged in mental places.

laws of method,[35] and in particular the law of homogeneity, to content and objects from extra-mental topica, then Ramus would have had to also approach the issue of the heterogeneity of the contents to distribute and arrange; he would have to face not only the problem of the linear sequence of homogenous statements ordered according their major and minor generalities by a method that is *one single* because it is based on the unity of the dianoetic rhythm, as well as the issue of how to coordinate varied, autonomous, singular notions, that are nevertheless susceptible to unification and coordination.

But Ramus stops just before this, letting Ramists like Savigny actually engaged in formalising not only the dianoetic disciplines but "tout le savoir du monde" deal with the problem of how to combine the unity and homogeneity of knowledge with the variety and heterogeneity of content derived from a reality outside the mind. Indeed, Savigny accepts and coherently and faithfully applies the "umbratile" conception of memory outlined in *Scholae*, in which he recognises not an art but an organon of the arts that dialectics has encompassed, and more precisely, has replaced within a *habitus ratiocinandi*. But in addition to Ramus' proposal, he attributes a peculiar and distinctive function to the *umbra dispositions*: a function consisting in the mediation between the methodical form of the encyclopaedia (provided by the pages of the *tableaux*) and the contents it unifies (the subjects distributed in the *partitions* that articulate the sixteen disciplines; a function that, in Savigny' encyclopaedia, foreshadows not (only) the order of reasoning and the linear sequence of the rings of the dianoetic chain, but (also) a precise criterion of classification able to restrict, in a finite number of classes, diversified and heterogeneous subjects. It is this criterion that advances concurrently with the "ratio methodi" as the shadow accompanies the illuminated body, but which cannot be identified as nor confused with the other. That's because beyond satisfying the rigour of the *dispositio* invoked by Ramus it needs to

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[35]  This is the most synthetic formulation of the laws of *dispositio praeceptorum singulorum*, which Ramus in the *Praefatio* of the *Scholarum physicarum libri octo,* in *totidem arcomaticos libros Aristotelis*, Francofurti, (the following quote is from a reprint of the text in *Collectaneae*, *Praefationes, Epistolae, Orationes,* 69-70): "Prima lex est veritatis, ne nullum sit in arte documentum, nisi omnino necessarioque verum. Itaque non modo falsa, sed fortuita tollentur. Secunda lege cavetur amplius, ut artis decretum sit non tantum omnino, necessarioque verum, sed homogeneum, et tanquam corporis ejusdem membrum, nec in Arithmetica sit quicquam geometricum, nec in geometriam arithmeticum, secus geometricum, in arithmetica fuerit anariqmos, arithmeticum in geometria agewmetrhton. & Hinc falsi erroris refutationes etiam verae, tamen ex arte tollentur, quia in scientiam tantum dedoceant, scientiam ipsam non doceant. Haec justitiae lex est, ad regendos artium fines, et suum cuique tribuendum, justissima. Tertia demum lege sancitum est, ut artis praecepta non sint duntaxat omnino necessarioque vera, nec homogenea tantum, sed propria et partibus reciproca; neque generale speciae, aut speciale generi tribuatur, sed generale generaliter, speciale specialiter exponatur. [ … ] Haec tertia lex est sapientiae. De forma lex unica est, ut absolute notius et clarius antecedat, quae tametsi verbis paucissimis est contenta, usus tamen et fructu est omnium maxima".

respond to a classificatory demand that was from "encyclopaedic Llullism" well represented in 16th century Paris, not only in the teachings of Bernardus de Lavinheta, but also in the ideal teacher of Ramus and the *regii professors,* Lefèvre d'Etaples.[36]

The fact that Savigny was concerned not only with the *suite* (notions and subjects ordered in decreasing generality), but also the *liaison,* the common element that allows the unification of the multiplicity of knowledge in a an encyclopaedia, makes the need to accompany an *ars diiudicandi* (delegated to the tree laws of the method in the *Tableaux*) with an *ars inventarinadi,* traditionally fulfilled in the field of *memoria artificialis,* much more explicit and consistent than in the works of Ramus. This need also required the consideration of specific functions of a memory whose tasks were prerequisites to, but that did not correspond with, those carried out by method.

The need to not only unify but also classify and restrict knowledge is explicitly declared in the conclusion of the letter of dedication to Luigi Gonzaga in *Tableaux*:

> Afin aussi de nous rafraischir et aider la *memoire* nous a semblé bon de *recueillir*, mettre et *reduire en tableaux* un sommaire et generale *proportion* de touts les dicts arts liberaux, avec *brevité* et ouverte *facilité*, qu'il nous a esté possible, tant par l'observation du stile et *singulier ordre*, ou *methode et disposition de doctrine*.[37]

A twin need, but also the meeting point between two different traditions, connected in a single declaration of intent. The correspondence of memory-method-order-dialectical disposition that Savigny delegates to following statements in the dedication is Ramist in origin: "aider la *memoire* […] par l'observation du stile et singulier *ordre*, ou *methode* et *disposition* de doctrine", "la *memoire* […] suyt les degrez de *disposition* et *ordre de dialectique*".[38] This Ramist bent is also present in the idea that this order ensured by method, an indispensable protection for memory, is modelled on an axiomatic criterion exemplified in the field of mathematical demonstration ("un *sommaire* et generale *proportion*"), which finds itself reflected in the serial and spatial arrangement of the sixteen tree diagrams and the corresponding pages showing the *partitions.* And, of course, the unicity and universality of this method ("singulier ordre ou *méthode*") that is a constantly recurring aspect of all *partitions* is Ramist as well. However, the aspiration towards the most synthetic and simplified presentation possible ("avec *brevité* et ouverte facilité, qu'il nous a esté possi-

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[36]  Bernardus de Lavinheta was a professor of Lullism at the Sorbonne starting in 1514, while Jacques Lefèvre d'Etaples was the supporter of a program of reform of studies at the Collège Lemoine. As for the influence that they had on Ramus and French Ramism, see Angelini, *Metodo ed enciclopedia*, vol. I, 239-256.

[37]  *Tableaux*, 33 (this passage was taken from the letter of dedication as it appears in the second edition).

[38]  As it appears in the frame of the *tableau* of dialectics; see Fig. 4.

ble") has another origin: Savigny is able to achieve this goal through a logico-memorative process that is "sub pauci multa" and "omnia suis locis" in nature, analogous to the process theorised by Bernardus de Lavinheta,[39] thanks to which it is possible to *recueillir, mettre et reduire en tableaux*, an infinite number of notions. If Ramus could be content to replace the *loci* and *imagines* of Ciceronian artificial memory with the "divisionem et compositionem cum labore et exercitatione coniiunctam' prescribed by Quintilian and thus conceive 'his dialectical method of memorising as the true classical art of memory", to the creator of an encyclopaedia as a "sommaire et generale partition" of all the liberal arts, all of this was no longer enough. The homogeneity of the theses essential to the application of the one method[40] was in contradiction with the need to protect the variety and peculiarity of the notions of these disciplines whose contents were extra-mentem, unless you resign yourself to reduce knowledge to a purely formal framework. This homogeneity, intrinsic to the dianoetic disciplines (the sermocinal and mathematical arts), should be generated in all of the other arts and sciences, whose elements were natural phenomena, historical examples, elements of law or politics, etc. Rendering these statements homogenous was a preliminary task compared to the task assigned to method; and now this task was assigned to memory, a task which introduced a classificatory logic that allowed for the organisation of the wide variety of content of knowledge into homogenous classes, similar to Lavinheta's *cellulae* or the *certa capita* introduced by Pedro Grégoire (Petrus Gregorious Tholosanus),[41] or the *communia capita* of Cornelius Agrippa.[42] In essence, memory allowed to transfer the homogeneity required by the "lex methodi", from the statements of the classes: uniform, homogenous classes given that they are empty, whose scope is not to substitute the subjects of knowledge but contain them. It was the role of memory to collocate each thing in its proper place and reduce many things into few *classes* or *cellulae* ("sub paucis multa"); but it was not memory as conceived by Quintilianus to fulfil this function, rather the memorative logic of Lavinheta and the Llullists, which was able to associate the requirements of unity, universality and order claimed by the Ramist *méthode* with an additional synthesizing and discriminative function. This function was not simply the reduction of an otherwise rather long and tortuous process,[43] but thanks to the *reductio ordinata in certa capita* of all the precepts that form particular things, sciences and arts, the mind is now safe from the dangers of confusion, redundancy and pointless effort when

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[39]  "Omnia suis locis collocat sub pauci multa comprehendens" (Lavinheta, *Explanatio*, 634).
[40]  Cf. *Tableaux*, 65.
[41]  Cf. Gregoire, *Commentaria in Prolegomena*, 22-23.
[42]  Cf. Agrippa, "In Artem brevem Raymundi Lullii Commentaria", 788.
[43]  Ramus spoke of "adresse et abbregement de chemin" regarding the method that guaranteed reason's ability to choose, among many possibilities, the most direct, and safest, path on its journey from *prius* to *posterius* (cf. De La Ramée, *Dialectique*, 119).

subsequently performing its operations on these particulars.[44] Whether it was Grégoire's *Syntaxes* to inspire Savigny in this sense, as is most likely, or the teachings of Lavinheta or one of his Parisian students, or comments on Ramon Llull's art, or the more chronologically distant Cornelius Agrippa, it is certain that in light of this classificatory and coordinating instance of heterogeneous and disordered precepts Savigny interprets the Ramist lesson of memory as "umbra dispositionis" and elaborates it through the distributive-classificatory criteria of the diagrams and definitions. The *partitions* of the "art de bien disputer et raisonner" and its relative table, with the image of the book that increasingly adopts the appearance of an encyclopaedia and the mnemonic statement that surrounds it (Fig. 4), are testament to the classificatory and demonstrative process – dichotomic, sequential, gradual, decreasing, synthetic, etc. – that will be unchangingly applied to the expositions of the other arts; in the same way, the *partitions-arbre* pair that illustrates the section of *dialectique* is a model of the relationship between the illustrated table and the summary of the definitions in the other sixteen sections: one (the *partitions*) represents the systematic arrangement of the statements that emphasize the criterion of order; the other (the tree diagram) is the shadow of the method, that allows for the reduction of the *partes* comprising each discipline into homogeneous places and classes.

## 3. *The classificatory function of the diagrams and the transition méthodique*

To ensure the mediatory and classificatory function of memory, Savigny makes use of tree diagrams and the relationships that they establish with the *partitions* and the *imagines agentes* used in the *tableaux*. However, these so-called "Ramist trees" have the non-Ramist function of collocating and conserving *extra mentem* the topica or system of memory that Ramus had expended in the dianoetic space.

It is worthwhile to compare the technique applied to the *Tableaux* with that of the tree diagrams in *Professio Regia*, the only work by Ramus that is truly rich with schemes, in which the graphic form that underpins the order of the arrangement essentially coincides with the discipline, or better, the division of the areas of knowledge considered into

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44   Cf. Gregoire, *Commentaria in Prolegomena*, 22-23: "Sequitur deinde illud quod est confusionis mentis et indispositarum cogitationum coordinatio, in quo latet tota artis noastrae methodus: docet enim omnium praeceptorum quae diffunduntur per res, et scientiaa, artesque particularis, in certa capita reductionem ordinatam, ex cuius cognitione postea mens dispensat ordinate et inconfuse propria uniquique negotio oblato, disputando, tractando, consulendo, probando, vel refellendo, vel docendo, vel eligendo; haec enim in omnibus locum habet. [ … ] Qua ratione et nos in hac arte magna ne quid deeset particularium finium, singularium scientiarum, veluti quoddam epitome contexuimus, ut Dei beneficio et nostro medio, quicunque nostras habuerit lucubrationes, nullis aliis libris, vel certe paucissimis egeat ad scientiarum encyclopaediam addiscendam".
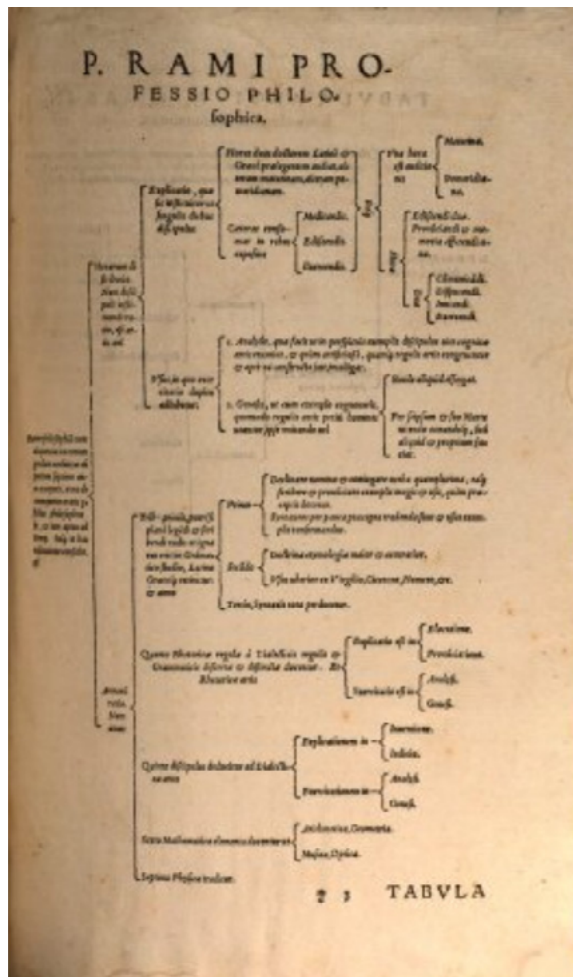
Fig . 5 – One of the tree diagrams of the Ramus and Freigius' *Professio regia*.

disciplines.[45] (Fig. 5) The diagrams of *Professio Regia* consist for definitions in descending order of generality which, rather than being presented in the paragraphs of a usual printed page, are collocated on the different branches of a diagram, so that the volume is none other than a graphic arrangement of subsequent definitions. Here organisation and clas-

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[45]  In the *Professio Regia* the diagrams do not appear next to the exposition, but they *are* the exposition of the various propositions that comprise the disciplines. Excluding the introductory sections of the edition, the text is nothing but the arrangement of extremely succinct definitions on the branches of the diagrams.

sification essentially coincide as much as Ramus' fully developed reflection on method as "ratio ordinis" coincides with memory.

If compared with the pages of the *Tableaux*, the diagrams of *Professio Regia* appear to correspond to Savigny's *partitions* (Fig. 3) rather than his diagrams (Fig. 4): not to the sections of the work that present the disciplines in a schematic form, but those that contain the verbal exposition of the disciplines. In these pages of text, the criteria of order, the dichotomic division and the principle of gradualness are recovered through the systematic and iterative use of adverbs, conjunctions, locutions (*ou … ou; premierement … secondairement …; il est derechef; au surplus; au demeurant; à sçavoir;* etc.) as well as the use of smaller font which highlight the decreasing generality of the statements. The same Ramist compliance is confirmed in observance of Solone's imperative in Ramus' *Brutinae quaestiones:* "artium fines regamus; extra terminos ne excedamus".[46] The exposition of the definitions that constitute the *corpus* of each discipline is all rigorously collected and contained within the frame of a single page allowing for a geometric and spatialized arrangement in which the relationship between the parts is present not only in the *before* and *after*, but also in the respective collocations within an illustrated space that is defined and closed.

The latter is also a determining criterion on the page that features the diagram: unlike in Ramus, in which the diagram presents the theses, instead the boxes ("cellulae") are presented, mostly labelled with a single term and, when necessary, only with a number or symbol.[47] These boxes primarily respond to a classificatory expedient rather than a criterion for definition-distribution, like the trees diagrams in *Professio Regia* or the corresponding pages of Savigny's work. While in the framework of the *partitions* it is the content that is organised in terms of decreasing generality, in the corresponding page depicting the tree diagram it is the classes that are precisely placed within the space of the discipline, enclosed by a frame that symbolically delimits the field, in line with "lex Solonis".[48]

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[46] Ramus, *Brutinae quaestiones,* 21.

[47] See for example the extreme ramifications of the conditional and disjunctive syllogism of the dialectical tree, where further bipartition is simply marked with the numbers 1 and 2 (Fig. 2). The same criteria are followed in the table relative to grammar, where, for example, the four departure points of the oblique conjugation are indicated with the numbers 1, 2, 3, 4; the same occurs in the table of arithmetic, where "proportional distribution" is divided into three subclasses identified as 1, 2, 3.

[48] Particularly consistent with Savigny's arrangement of the disciplines into *tableaux* is the rule of the autonomy of the arts formulated in terms of "lex Solonis": "Omnes artes, omnes artifices ex rebus ipsi proprie subiectis exponantur necesse est, non ex alienis, non ex communibus adumbrentur Rhetoricam unam quondam et singularem artem de liberalibus esse volumus. Haec ars igitur et huius artis artifices materia sibi proprie subiecta definatur. Distinguamus Rhetoricae artis materiam et a caeterarum artium materia dividamus, ut constet quod eius proprium sit, ut omnis omnino confusio tollantur; quod Grammatics praeceptis doceatur, id rursus in

The tree diagram that precedes the page listing the definitions, the *dispositio*, with the rigorous order that rules it, is essentially achieved operating on *homogenous* classes, seeing that, having emptied the "cellulae" of the name or symbol that identifies them and, consequently, the content that they contain, they can be transferred from one discipline to another without jeopardising the demonstrative mechanism in any way, whatever the "matter" which, case by case, discipline by discipline, these classes incorporate. A procedure that can absolutely be defined as *Ramist* as it walks alongside the unity and universality of the method *like a shadow*, but it is a procedure that is not found in the diagrams of *Professio Regia*,[49] useless since it is the case of naturally homogeneous contents as they are exclusively mental

This is not the case for Savigny's work, in which the *orbis disciplinarum omnium* arrangement does not correspond to a methodological and theoretical purely instance as it does for Ramus: not only do many of the liberal arts treated not have a mental origin (namely those indicated as special), but the content of their "summary" and individual *partitions* is the *reductio* of a composite scientific literature to the Ramist method and instances, a literature that draws from works from various authors belonging to disparate genres and linguistic traditions; an unsystematic and nonhomogeneous subject matter that requires a preliminary adjustments to then be methodised. And this is why the tree diagrams with their empty *cellulae* allow for the creation of what one of the sources Savigny has spoliated defined as "transition méthodique", which is the reduction of the variety of "experience" to the rhythms of a procedure that is "unique et singulière".[50] In this "transition" that leads

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Rhetoricis non misceatur, quod in rhetoricis instituatur, a Dialecticis non attingatur. Breviter artium omnium fines et institutiones separentur, usus tamen coniungatur, sicuti in hominum fundiset agris videamus, ut meus ager in tuum non incurrat, nec tuus incidat in meum, rerum tmen nostrarum vendendo, emendo, permutando usus communicetur. Quin illa Solonis legem (quam dicitur Atheniensibus tulisse) nobis proponamus [ … ]. Sic igitur de de sapientibus sapientissimus ille Solon, si quis ad alienum [ … ] fundum septem constituerit, extra terminum ne excedito; si murum, pedem relinquito; si domum, duos pedes [ … ]. Hanc igitur distinctionem finium, quaeso te, bona fide, meditemur, et unicuique quod suum est, attribuamus" (Ramus, *Brutinae Quaestiones,* 15-16). On the "three laws", cf. *supra* n. 33.

49    The same procedure and function are not found in the tree diagrams in *Professio Regia*, neither in those that take inspiration from them, because Ramus interprets the classifications induced by the method and dialectical *dispositio* as functional to "make the mind recognise what is first, what is second, what is third", cf. Ramus, *Scholae in tres primas liberales artes*, 43.

50    This expression is used by one of the first authors that inspired Savigny's *encyclopédie*, Pantaléon Thévenin, as well as in the comments by Ronsard and du Bartas; see *La Sepmaine, ou Creation du Monde de G. De Saluste du Bartas*, *passim*, but for an example see *ibid.*, 294, 308-309, 352. Ramist tree diagrams are used by the commentator of *La Sepmaine* to order and display the general subject matters of the poem, with the intention of marking, including with the emphasis of graphic signs, the decreasing relationship between the general formulation of a motif and its subsequent minute and detailed analysis, equally obtained through progressive dichotomic ar-

to the method, but that is not yet the method as "dianoia variorum axiomatum homogeneorum", lies the specificity of memory, namely the memorative and classificatory aspect of logic. This ensures not only *reductio multa sub paucis*, but also the production of those "homogenous axioms" without which the Ramist method could not operate; axioms that for Savigny do not belong to the *subject matter* of knowledge, but that are no less necessary than Ramus suggested, because it is through the formal consistency that they induce in the structure of disciplines that the *liaison* between the parts of knowledge is possible. And that is because – needless to repeat – knowledge for Savigny is not homogeneous *ab origine*, but becomes so through the discipline formal arrangement.

Once it is accepted that different areas of knowledge have different origins – some organic, some special, others are derived from experience or the reworking of traditions, some have reached formal completion, still others have yet to acquire a full theoretical autonomy – the author of the book that is yet to be written that appears in the *tableau* of the *dialectique* must find a mediator that ensures the transition from the multiplicity of *agrumenta* extracted from the mind to the unity of formal and mental procedures. It is therefore necessary to reduce them to a common syntax that is however not that of things and neither that of the traditions that they have transmitted, rather the syntax preliminarily and artificially imposed by the *transition méthodique* carried out by the tree diagrams. Read contextually, the definitions comprising the sixteen *partitions* and the tree diagrams following them *like a shadow* suggest that the *partitions* are no else but the systematic classification produced by the tree diagrams, as if it was not the symbolic and spatial shape of the diagram constituting the translation and simplification of the statement but the statement transposing a logical and classificatory process into discursive language that

ticulations. If, as it is clear, the *discours* of the commentator ideally follows the poem in order to explain it, the tree diagrams that divide and organise du Bartas' work anticipate their explicative aspect and collocate themselves in an intermediate position between the author (the poem) and the commentator (the *discours* of the comment). Therefore, the trees do not display the comment or compile the commentator's analysis, as was the case in the diagrams of *Professio Regia*, but it is the discourse of the commentator that clarifies a scheme that ideally precedes it. This scheme does not alter the content of the poem, but solely affects the arrangement of its theses. For Thévenin as for Savigny, the graphic schematisation is not carried out in the extreme formalisation of a method or form, which ultimately prevails over the content to the point that the latter is eclipsed. If anything, it constitutes a moment of *mediation* that facilitates a connection between the one method and an arranging lattice as defined by the "three laws" and the plurality of content learned through the territory of the *inventio* and not that of the *dispositio*; it ensures the separation, and the compatibility, of the inventive moment and the demonstrative, methodical moment, protecting on the one hand their heterogeneity and the anteriority of the content of the disciplines and, more generally, the acquisition of knowledge (*inventio*), guaranteeing a homogenous and consistent moulding (*dispositio*) of a scientific subject that is recognised as original and autonomous.

*first* had to be collocated in a distinct space and separated into uniform "cellulae", to *then* make use of words and definitions arranged in methodic order, but already adjusted to the needs of the dianoetic process.Therefore, the novel aspect of Savigny's text is not the use of tables, nor the use of graphic representations in a logic proceeding, a technique widely used in the tradition of mediaeval logic, indeed. Instead, it lies in the logical and chronological anteriority and the essentiality of symbolisation-classification compared to a discursive methodical exposition. Compared to both the schemas of *Professio Regia* and Lefèvre d'Etaples writings on logic – no less rich with graphs than Ramist treatises or the *Tableaux* – Savigny inverts the relationship between the 'word system' (statements, *partitions*, content of the disciplines arranged according to dialectical order) and the 'system of symbols and space' (diagrams, articulation of subjects into "cellulae"). And he does so because through symbols and precise collocations in space he is able to create a progressive restriction of the plurality of "cases" and notions, but above all because the *cellulae* or *certa capita*, empty shapes, are susceptible to a methodisation that, if applied directly to the content of the disciplines, would risk destroying them, much like what occurs in the majority of the systematics of the 17th century inspired by *Professio Regia.*[51]

Perhaps it is precisely this awareness of a preliminary *transition* in order to bend the classificatory criteria of a memorative logic that is decidedly more Llullist than Ramist to Ramus' dialectics, which marks the birth of a method that is not only "unique et singulière" but also able to fulfil a classificatory function regarding reality. And this is precisely what the sixteen tree diagrams of Savigny's *Tableaux* achieve, much like those used by Ramon Llull, but without roots. Because, unlike the Llullian diagrams, they severed the metaphysical roots that anchored the plane of knowledge in the plane of being; because, unlike those used by Ramus, they detach the origins of the sciences from the origins of reality and distinguish, with greater clarity that Ramus' "three laws", the gnoseological and ontological planes, ultimately distinguishing the *inventio* from the *dispositio.* In place of the metaphysical roots used by Llull, as well as by Ramus and Aristotle,[52] Savigny used the uninterrupted chain of the human mind, which alludes to and places a limit on the otherwise undefined ramification and growth of knowledge.

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[51]  See *supra* n. 45.
[52]  It is precisely this association between the logic of Aristotle, Llull and Ramus that characterises the systematic and semi-Ramist orientation of the 17th century, like that of Alsted. In both *Clavis artis* and *Panacea*, the professor from Herborn insists on the necessity of summarising the three logics. And Ramus does not deny the Aristotelian origin of the "three laws" and, therefore, of his own logic; this origin impedes Ramus' method and dialectic from fully freeing itself from metaphysics, or at least from the nexus that connect the logic organ to the ontological plane.

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# Between geometric schemes and mnemonic images: The three paradigmatic figures of Giordano Bruno's *Articuli adversus mathematicos*

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**Abstract**

Giordano Bruno's *Articuli adversus mathematicos* (Prague 1588) is an emblematic text for more than one reason: it contains a harsh critique of the astronomical measurement techniques in use at the time, but also a radical attack on the theoretical foundations of geometry itself, proposing a discrete notion of basic geometric objects such as the point, the line, the plane, and solid figures. Moreover, Bruno enriches the text with some important references to the art of memory, not only to make his argument easier to understand, but also to offer concrete mnemotechnical tools to help the reader perceive and remember the geometric constructions he proposes. In this sense, the three archetypal images are a unique attempt to construct graphic schematisations to illustrate and memorise (by means of a technical tool called *sigillus*) the main propositions of Euclidis *Elements*, as well as the particular theoretical approach that Bruno gives to his geometry.

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During the Venetian phase of the trial, Giordano Bruno reported that he arrived in Prague in the spring of 1588 and stayed there for about six months.[1] From the point of view of his intellectual production, this was a very fruitful period. He printed texts such as those on Llull's art, the Frankfurt poems and the last of the mnemonic works, as well as the so-called magical works and two texts on dialectical and metaphysical subjects, which were published posthumously.[2]

In Prague, Bruno stayed with the Spanish ambassador Guillén de Haro, Marquis of San Clemente.[3] Bruno is in search of a contact with the emperor, and the goodwill of the Spanish ambassador may be his best opportunity in every respect. Rudolf II of Habsburg was a Spanish Catholic by birth – his mother, Maria of Spain, was the eldest daughter of Charles V – and as such had distinguished himself by his open support of the Jesuit Counter-Reformation initiative in the territories of the Empire, he had therefore antagonised many German princes and nobles, while the Spanish court and the Catholic world in general were less hostile to him.[4] The affinities between the emperor and the representative of the Spanish Crown were not only political: Sanclemente, like Rudolf II, was an ardent admirer of the occult sciences and was interested in alchemy and magic; he was also a great admirer of Llull's method, of which he considered himself a descendant, boasting of his ancient Balearic origins. This political closeness, reinforced by common intellectual interests, was undoubtedly the main factor in Bruno's decision to take up residence with the Spanish ambassador. Thus, in order to win the favour of his powerful host, he published a work on Llull's art, taking up the Wittenberg edition of *De lampade combinatoria* and combining it with *De specierum scrutinio* (a rewrite of *De compendiosa architectura*, Paris 1582), creating a new text that accentuated the combinatory mechanisms of the first two for an even more effective and explosive rhetorical *inventio*.[5] This synthesis of Brunian Lullism is, moreover, consistent with the project of unveiling his own mnemonic-combinatorial dialectics, which he began in Wittenberg with the commentary lectures on Aristotle's *Organon* and which culminated in the elaboration and partial publication of the so-called '*Lampades*' cycle.[6] The obvious theoretical proximity between this Prague text and

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[1]  Cf. Spampanato, *Vita di Giordano Bruno con documenti editi e inediti*, 703; Mercati, *Il sommario del processo di Giordano Bruno*, 105.

[2]  Cf. Matteoli, *Giordano Bruno a Praga tra lullismo, matematica e filosofia*, 301-324.

[3]  Cf. Bruno, *Opere lulliane*, 571-573; Brotto, *Haro Guillén*.

[4]  Cf. Evans, *Rudolf II and His World*; Marshall, *The Theatre of the World: Alchemy, Astrology and Magic in Renaissance Prague*.

[5]  On the shift in the interpretative register, with regard to Llull's works, between *De compendiosa architectura*, *De lampade combinatoria* and *De specierum scrutinio*, cf. Cambi, *La* machina *del discorso. Lullismo e retorica negli scritti latini di Giordano Bruno*.

[6]  Cf. Ricci, *Giordano Bruno nell'Europa del Cinquecento*, 398-403; Ciliberto, *Il sapiente furore*, 474-479; Lepri, *Giordano Bruno teacher at Wittenberg and the Rar. 51*.

the previous ones thus shows Bruno's initial desire to continue exposing his philosophy by addressing a readership sensitive to instances of methodological reform, overlapping original philosophical themes with less heterodox dialectical, mnemotechnical and Lulian interests. One of the most curious features of the first Prague publication, apart from its singular revival of Lullism, is the announcement of a subsequent and imminent publishing project, "sub titulo Lampadis Cabalisticae", which can be interpreted as an intention to publish the first version of the *Lampas triginta statuarum*, composed the previous year in Wittenberg. Bruno thus and yet again manifested his ambition to reshape his own philosophy through the evocative representation of a series of thirty visual archetypes, albeit no longer within the mnemotechnical and Lullian framework of *De lampade combinatoria* and *De progressu et lampade venatoria logicorum*.[7] However, this initiative was not immediately successful and instead of the announced work, Bruno printed a geometry text with an explicitly provocative title – *Articuli centum et sexaginta adversus huius tempestatis mathematicos atque philosophos* – which contains an innovative reinterpretation of Euclidean geometry centred on the concept of the geometric minimum, but also some very important theoretical references to his own philosophy and, as we shall see, to the art of memory.

## 1. Between geometry and the art of memory

The *Articuli adversus mathematicos* is a text devoted mainly, if not exclusively, to Bruno's geometrical reflections, although it directs its readers towards a 'different' geometry based on a notion of the minimal point. The reason for this radical and controversial choice is rooted in a discussion which took place a few years before, in Paris in 1586, between Giordano Bruno and the mathematician Fabrizio Mordente.[8] The Campanian geometrician had invented a proportional compass which made it possible to enlarge very small fractions of circumferences and chords so that they could be measured with respect to each other. In practical terms, this made it possible to carry out astronomical measurements more accurately than with the calculations which involved the approximation of $\pi$ and the recourse to the sine and cosine tables then in use. In adopting and making his own this technical solution, Bruno, initially at the request of Mordente himself, attempted to establish its validity not only 'mechanically', i.e. by virtue of the technical and practical effectiveness of the instrument, but also theoretically. Bruno's approach, however, was not appreciated by Mordente, who polemically withdrew from the joint project, but allowed Bruno to carry out a mathematical 'revolution' that had radical theoretical consequences,

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[7]   About *Lampas triginta statuarum* and the two other Lullian texts, cf. Cambi, *La* machina *del discorso*, 159-172.

[8]   To reconstruct how this debate unfolded and evolved, cf. Aquilecchia, *Nota introduttiva* to Bruno, *Due dialoghi sconosciuti e due dialoghi noti*, vii-xxiii; Camerota, *Il compasso di Fabrizio Mordente*, 83-105.

especially at the philosophical level. In fact, in Bruno's hypothesis, the discovery and valorisation of minimal fractions – which, in fact, make the curved and the straight almost coincide – testify to the existence of a material background (both physical and geometrical) corpuscular in nature, which is the ultimate and substantial expression of reality and it is made up of atoms and the void.[9]

As can be imagined, such a perspective has a theoretical implication that is more significant on a philosophical level than on a mathematical one. Nevertheless, it is in line with Nolano's philosophical project, which already, in the years of the so called *Cosmological Dialogues* published in England, claimed the primacy of philosophy over mathematics and mathematicians.[10] In the case of the *Articuli adversus mathematicos*, therefore, Bruno's aim is twofold: firstly, to present his atomistic view of geometry as the technical outcome of his 'physics'; secondly, to show, in the concrete practice of geometric constructions – largely taken from the main practical geometry manuals in use at the time and from the various commentaries on Euclid's *Elements* – that geometry, even if at its base there are minimal points, does not change but rather becomes more functional to the needs of astronomical measurements. In order to act as a 'hinge' between these two requirements, and in a way that is quite unprecedented for a geometry text, the art of memory is brought into play through three interventions that are unusual in both the mathematical and mnemotechnical contexts.

The most significant contribution to this is to commit the understanding and memorisation of the proposed geometric constructions, as well as the corpuscular theory behind them, to three archetypal images: these will be examined in detail in the second part of this essay. Furthermore, Bruno suggests two other very important mnemonic devices. The first of these is found at the beginning of the iconographic corpus that accompanies the text, entitled *Figurae subalternae*, precisely to distinguish it from the three main figures that are functional to the entire work. This section is made up of thirty-one images, the first of which has a completely different graphic connotation from the others: it shows a man standing by a well (marked with the letter U) with his back turned and his arms extended. Around this man, in the four corners of the image, the other four vowels are displayed in order to mark: the sphere of the world (A); a kind of map of the earth (E); a square with another square inside it (O) and, lastly, a circumferential quadrant in which some rectangular boxes are outlined. Finally, the picture is surrounded on all four sides by the motto: "asta que venga meior" (Fig. 1).

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[9]   Cf. Matteoli, *Lo sviluppo dell'atomismo geometrico di Giordano Bruno*.
[10]  Cf., for example, Bruno's judgement on Copernicus in A. Ingegno, *Cosmologia e filosofia nel pensiero di Giordano Bruno*, 26-70; Maspero, *Scienza e copernicanesimo in Bruno: principali orientamenti della critica dal 1950 ad oggi*, 141-162; Granada, *L'interpretazione bruniana di Copernico e la "narratio prima" di Rheticus*, 343-365; De Bernart, *Bruno e i "fondamenti" filosofici della teoria copernicana*, 47-74; Gatti, *Copernico*, 511-520; Bassi, *Il Copernico di Bruno*, 123-137.

The nature of the figures, the order in which they are arranged (in relation to the series of five vowels) and what they refer have a significant mnemotechnical value for Bruno: this depiction represents the five levels of distribution of mnemonic material, i.e. the five types of places used to memorise images. In the *De umbris idearum*, the mnemonic place (*locum*) is called 'substratum' (*subiectum*) and is defined as an "artificial extension, that is, a sinus prepared in the fantastic faculty, occupied by the figures of the receptacles [...], distinguished according to different parts, capable of receiving all the realities seen and heard according to their order and of retaining them according to the will of the soul".[11] According to the 'tradition' of the



Fig. 1. *Articuli adversus mathematicos*, 88.

*ars memoriae*, the place consists of the inner visualisation of a delimited space ("extension" and "sinus") that serves to receive the mnemonic images (the "figures of the receptacles"); it can be of variable width, divided into parts and, above all, inserted into other places. This is how Jacques Colin, author of *De memoria artificiosa compendiosum opusculum* (Paris 1515), defines its characteristics:

> Places are therefore of three types: the first are maxima, the second are majors and the last, which will be considered very suitable as words, we will call small. The maxims contain the majors and the minors are contained by the majors. The maxima are all those complete buildings, such as temples, houses or monasteries; the majors are the individual square dwellings; the minors, on the other hand, are the walls, corners and openings of the majors.[12]

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[11]  Bruno, *De umbris idearum*, 148-149: "subiectum est technica extensio, sive sinus in phantastica facultate ordinatus, ex speciebus receptaculorum consitus, quae ex animae fenestris influxere, diversis distinctum partibus, visa omnia atque audita suo recipiens ordine et ad animae libitum retinens".

[12]  Colin, *De memoria artificiosa*, ff. aiii*v*-a*v*r: "Locos igitur sunt triplices. Alios maximos: Alios maiores: ceteros vero quoad aptiora invenientur vocabula: parvos appellabimus. Maximi maiores continent: parvi a maioribus continentur. Maximi absoluta quaecumque aedificia. ut templa/domus/coenobia. Maiores dicuntur singulae habitationes quadratae. Parvi vero maiorum parietes et anguli cum ianua".

Smaller places, moreover, according to Peter of Ravenna's *Phoenix* (Venice 1491), should not be too "high, for I wished that men placed as images could touch the places, which I have always found useful".[13] Indeed, as Romberch writes in *Congestorium artificiosae memoriae* (Venice 1520):

> If you place a man of suitable stature on the floor with his arms outstretched, you will measure the entire length upwards and the width from right to left. Nor should the place be made higher than the hand of the person standing on the ground can reach; nor should the stature be greater of an ordinary man.[14]

Finally, in *Ars memoriae* of *De umbris idearum*, this very important distinction is made with even greater precision:

> The first of these substrata is maximally common, and may extend as far as the bosom of the phantasy, which may widen the circle of the horizon according to its own pleasure, but cannot limit it to itself. The second is the common substratum, which consists of the set of identified regions within the cosmos. The third is less common, or, if you like, equivalent to a city. The fourth is the proper substratum, and you can call it equivalent to a house. The fifth is the more proper substratum, which is a portion of space that can be divided into four or five sectors. The last is the most proper substratum and coincides with the substratum called 'atom' [...].[15]

The passage describes the hierarchical scale of mnemonic places, from the largest in absolute terms (the imagination itself) to the smallest (the individual place, and for this reason called 'atomic', i.e. which cannot be subdivided into further places), passing from the celestial vault –  it was already customary among the ancients using constellation fig-

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13    Tomai, *Phoenix*, f. [biii]*r*: "loca non sint alta quia volui quod homines pro imaginibus positi loca tangere possint quod utile semper iudicavit".

14    Romberch, *Congestorium artificiosae memoriae*, f. [Cvi]*r*: "ut si competentis staturae virum expansis lacertis superficiei applicueris recte longitudinem scilicet sursum et latitudinem dextrorsum atque sinistrorsum metieris. Non enim altior erit locus quam in pavimento sistens manu contingere valeat; neque amplior erit statura mediocris viri".

15    Bruno, *De umbris idearum*, 150-153: "Horum aliud est communissimum, quia tantum valet extendi, quantum phantasiae potest comprehendere sinus, qui positae orbis quantitati quantumlibet addere potest, licet non quantumlibet substrahere. Aliud est commune quod cosmicarum perspectarum partium cumulo constat. Aliud est minus commune, utpote si libet politicum. Aliud est proprium, nempe si placeat oeconomicum. Aliud est magis proprium, tetrathomum videlicet vel pentethomum. Aliud est propriissimum, quod est athomum, athomum inquam non simpliciter, sed inisto genere".

ures as a mnemonic system[16] –, through spaces configured as cities, houses and, finally, rooms (composed of four or five individual places). The scansion of the types of places suggests precisely the mutual inclusion of mnemonic places: several individual places fill a room, several rooms form a house, many houses form a city, and cities and regions are arranged under the vault of heaven, etc. In *Cantus Circaeus*, Bruno also provides a similar scansion, albeit with some differences. The equivalence between the maximally common substratum and the fantastic faculty is avoided, while he introduces the substratum equal to the "space described by geography" and that which "coincides with the boundaries of a given continent". Furthermore, the "most proper substratum" is "one of the many and varied parts and sections of the house", that is, it reunites in a single typology the space and the corners that can be identified within it; finally, it is specified that those places that, in terms of size, comprise the city, the building and the parts of the building (from the "proper" to the "most proper" substratum) are more useful (or easier) for the mnemonic operation.[17] Beyond the specific details, thus Bruno points out that the system of mutual organisation and inclusion of places is centred on the individual place, which is to be considered as the module at the base of internal architectures: it must be "equal in height and width to that of a man with his arms raised and outstretched".[18]

In this image from *Articuli adversus mathematicos*, we can therefore find the main distinctions of place established in these passages: in fact, in the corner marked by the letter A, there is the representation of the celestial sphere which, in the case of *Cantus Circaeus*, corresponds to the substratum of the "very common" genus (defined instead as "common" in *De umbris*), that is, that which is immediately less extensive than the fantasy and which, in any case, takes as its reference the cosmic space as perceived from an 'anthropo-geocentric' point of view. At the second corner (letter E), comes that of geographical extension (a region of the Earth or a continent), while at the third (I) we find the depiction of a circular set of boxes: this type of structure, in Bruno's mnemonics, is often called an "atrium", a term used to indicate either a very large room capable of containing 24 or 30

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[16] For this aspect, and more broadly for a history of the art of memory, cf. Yates, *The art of memory*, 39-42; Bolzoni, *The Gallery of Memory*, 212-213; Waddington, *Pardise Lost: Memories are Made of This*, 220.

[17] Bruno, *Cantus Circaeus*, 672-673: "Subiectum vero [ … ] vel potest esse communissimum, extentum iuxta latitudinem ambitus universi, vel communius iuxta latitudinem Geographiae, vel commune iuxta latitudinem alicuius continentis, vel proprium iuxta latitudinem politicam, vel proprius iuxta latitudinem domesticam, seu oeconomicam, vel propriissimum iuxta multitudinem atque numerum partium domus, et particularum eiusdem".

[18] *Ibid.*, 674-675: "Quoad quantitatem eorum continuam, subiecta propria debent esse non admodum magna, ne quasi visum obtundant et disperdant, nec admodum parva, ne quasi visum fugiant: sed mediocria ad hominis magnitudinem talem, quae sit iuxta altitudinem elevatorum et latitudinem extentorum brachiorum".

individual places,[19] or a system formed by several rooms placed one after the other (thus more like a building).[20] In the fourth corner there is the figure marked with the letter O, which represents a square in which another square is inscribed: this is the representation of a single space in which there are four, five (the corners plus the centre), nine (if we add the halves of the sides) or even thirteen (one at each vertex of the four inner triangles plus the centre) individual places. Finally, in the middle of the picture, and most prominently, there is the individual place, the basis of the mnemotechnical structuring, represented as a man (at a well that specifically characterises the space[21]) with his arms outstretched across the entire width of the figure: this corresponds precisely to the definition of the individual substratum given in the *Cantus Circaeus* and that of traditional mnemonics.

Bruno's invitation to refer to the art of memory, at the beginning of the section devoted to images designed to aid understanding of the geometric constructions of *Articuli adversus mathematicos*, is all the more disorienting when one understands the specific meaning of this image, namely to describe to the reader the types of places and the structuring implicit into them. No doubt Bruno takes it almost for granted that the reader knows what he is talking about when the only didactic reference he adds is a phrase with a sibylline meaning: "asta que meior venga". This expression can be understood, as Mino Gabriele suggests,[22] as a Hispanism ("hasta que venga mejor"), inviting us to 'heuristically' accept this methodological perspective – perhaps also including the concept and the use of *minimum* – until a better one comes along. In another way it can be read as written in Italian vernacular, in the sense that there is no "asta", i.e. unit of measurement, better than this (and again perhaps with a double reference to mnemonics and the *minimum*). In any case, the only way to mnemonically link these pages to the rest of the text is by direct reference to the three archetypal figures: having used them to memorise and understand the basic concepts and constructions of Bruno's geometry, it is now possible to access these other figures and, through them, to continue to understand and memorise Bruno's new geometry through his mnemonic devices.

A second valuable piece of mnemonics occurs in one of the most original sections of the text, namely when Bruno proposes his own technique for identifying the "common measure" to be used for arcs of circumference to commensurate with chords. Following Mordente's technique, Bruno's hypothesis consists in finding very small fractions on the circumference in a number equal to those taken on the radius (which constitutes the 'inner' unit of measure of the circle) and on the chord taken as the main reference, i.e. that

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[19]  For a technical definition of 'atrium, cf. Bruno, *De imaginum, signorum et idearum compositione*, 552 et seq.
[20]  Cf. Bruno, *Explicatio triginta sigillorum*, 140 et seq.
[21]  Bruno, *Cantus Circaeus*, 676-678: "In quibus tamen si placeat aliquid collocare: instituere potes aliquod receptaculum cuiusmodi est altare, mensa, solium, ceteraque huiusmodi".
[22]  Cf. Bruno, *Corpus iconographicum*, 398.

of the sextant arc of the circumference, which coincides with the radius itself taken six times on it. In this way, the smaller these curved fractions are, the closer they are to the straight ones, reducing the margin of error in their commensuration. According to this Brunian *praxis*, therefore, it is finally possible to "reject that measurement of the circle which has been handed down from the time of Ptolemy to the present day" and to "throw away the tables of sines and chords",[23] "that confused, indistinct and uncertain jumble of arithmetic and tables", since to "carry out all astronomical, geographical and mathematical operations", it is sufficient to "divide the circle geometrically according to a regulated and continuous proportion", that is to say:

> I intend to divide it into twelve regions, or houses, each of which is divided into twelve atriums, which in turn are divided into twelve orders, each of which is divided into twelve rooms, and so on, into twelve sides, twelve spaces, twelve dwellings, twelve inhabitants, twelve faces, twelve members of the body, and twelve articulations of the members. Let us therefore always take parts which are similar in name and nature, and of the same order and analogy, and follow the order of nature which proceeds by division.[24]

The proposed solution divides the circle into parts and subparts of the number twelve, taking as  starting point the sextant arc and the chord formed by the radius, itself divided into two, and then, from division to division, up to the paroxysmal number of $12^{11}$ (743,008,370,688) fractions on the circumference (and on the radius/chord), truly minute and infinitesimal portions of it. However, in order to help the reader understand this progressive and recursive algorithm, Bruno does not resort to mathematical language. Instead, he presents it by means of an 'exercise' in mnemotechnical visualisation, that is to say, by resorting once again to the lexicon of the *ars memoriae* and, more specifically, by suggesting the very distribution of places that has been shown to underlie the image that opens the section on *Figurae subalternae*. Nevertheless, at this stage the structuring of the mnemonic places is even more layered than in the five types previously seen, reaching the even more 'minimal' details of the images defined as 'atomic', such as the features of the face, the limbs and postures they may assume, or the objects they may wear, hold or use. A dense scanning of places, designed precisely to make the

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[23]  Bruno, *Articuli adversus mathematicos*, 69: "Ut mensuram circuli a temporibus Ptolomaei ad haec usque tempora servatam damnas? Ut sinuum et chordarum tabulas abiicis?"

[24]  *Ibid.*, 70: "Ut ad omne astronomicum et geographicum et mathematicum opus circulum regulata et perpetua ratione geometrice dividis, non inquam confusa, indiscreta et indefinita arithmetica et tabularia turba, sed geometrica et continua partium subalternatione? Circulum in 12 intelligo divisum regiones seu domos, harum singulas in atria 12, haec singula in 12 ordines, horum singulos in 12 cubilia, et ita deinceps ad latera 12, spatia 12, sedes 12, sessores 12, facies 12, membra 12, articulos 12".

reader imagine, with the inner eye of fantasy, a deep and articulated fractioning of the circumference, which neither sensitive perception nor reason can grasp in its true extent. An overt and instrumental mnemotechnical solution that, among many possible suggestions, refers very significantly to the first of the thirty "seals" of *Explicatio triginta sigillorum* (London 1583), entitled "the Field", precisely because it defines the characteristics of the mnemonic place, as the "substratum" of the creative and "cultivating" action of the imagination:

> The field is the first seal. It is well to form it from those inner representations whose images are contained in the very wide sinus of the fantastic faculty, precisely for the purpose of bringing to the desired harvest the seeds of all meanings and fantastic images. This, moreover, we want – in order that it may be maximally effective for us – to be divided into parts that are visible, of medium size, neither too much nor too little clear, diverse and differentiated, arranged in order, separated and paced by appropriate intervals, of sufficient width and height to accommodate a man with his arms open and stretched out, provided with additional and movable elements proportional to the number of striking images, and, finally, to be visited and examined many times. Then, if you can divide it skilfully into parts and sub-parts, it will be of immediate and extraordinary advantage to you. Thus the Talmudist, having divided Jerusalem into four sides, east, north, south and west, first of all, in order to multiply the number twelve, distributes in each of them three gates, distinguished according to the names of the twelve patriarchs, and then immediately, in a very precise order, enters twelve quarters, each of which contains twelve dwellings, each of which consists of four floors, all of which are divided into twelve rooms, which in turn are divided into four according to the corners or half of the walls.[25]

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[25]    Bruno, *Explicatio triginta sigillorum*, 79-80: "Campus est primus sigillus. Hic ex illis speciebus confletur oportet, quarum simulacra in phantasticae facultatis amplissimo sinu ideo continentur, ut iacta intentionum et phantasiabilium universorum semina in exoptatam messem promoveant. Hunc etiam, quo nobis maxime subsit officiosus, in eas distributum esse voluimus partes, quae sensibiles, mediocris dimensionis, non excellentis nec diminutae perspicuitatis, diversae, differentes, ordinatae, congruentibus sepositae seiunctaeque intervallis, ad humanorum brachiorum elevatorum altitudinem et extentorum amplitudinem, adiectivatae animataeve, exquisitarum formarum numero adcommodatae, iterum iterumque lustratae existant. Non vulgari tibi praesto erit emolumento, si affabre ipsum divisionum portionibus distributum concipias. Sic Thalmutista Solymam in quattuor latera orientis, aquilonis, austri et occidentis divisam, primo eiusdem laterum singula ad duodenarium multiplicanda numerum, in tres patriarcharum nominibus insignitas portas subdividit, moxque in atria duodecim, quorum singula domorum duodenarium complectuntur, quarum singulae quattuor constant ordinibus, quorum quique duodecim ad summum referunt cubilia, quae tandem vel quattuor angulos, vel etiam in quattuor mediantibus lateribus intersituata recipiant, certo ingressum facit ordine".

This important paragraph brings together all the traditional rules of mnemonics on place: the reference to the "sinus of the fantastic faculty" as the place par excellence of mnemonic activity; the criteria of size, distance, luminosity taken from classical texts,[26] together with the rule that defines the canon for the particular place ("sufficient [...] to accommodate man with his arms open and stretched out"); finally, the advice/rule to subdivide and structure places on the basis of their breadth, in order to guarantee their mutual inclusion. Considering all that, the affinity between these pages and those of *Articuli adversus mathematicos* is not insignificant: in both texts, the criterion for the division of places is based on the recursive division of the number twelve, taking, in the case of *Explicatio*, the Heavenly Jerusalem described in the Book of Revelation as a symbol and inspiration. Certainly, it is not easy for the reader of Bruno, and even more for a contemporary reader, to imagine such a laborious symbolic and visual connection between the Apocalyptic Jerusalem and a circle with so many tiny fractions of arcs and chords to be commensurated, indeed Bruno's suggestion is precisely that: since the irrational measurements and exhausting calculations of the astronomers have lost the true foundation of measure, perhaps the philosopher's audacious vision of nature – a nature that is an infinitely living and changing organism – can help us to understand the right approach to giving each point of view and each object the right position and the most correct (ontological and not only cosmological) distance.

## 2. *The three archetypal figures and their mnemotechnical use*

The three figures, defined by Bruno as *principes*, are placed, from the very opening of the section in which they are presented,[27] in a close relationship with the construction principles of geometry. Since every measurement practice can be traced back to two basic instruments – the square and the compass –, so these figures must to refer back to the primordial forms of all geometric constructions, which are the straight and the curved line. The straight line and the curve, as we have seen, are also the 'problematic' object of any astronomical measurement practices, since it is their commensuration (by the arc, the chord and the radius) that determines the distance of the celestial bodies from the observer. Moreover, these two 'primordial' types of line correspond to the two primary figures of geometry, the triangle – from whose construction the propositions of Euclid's *Elements* start – and the circle: in Bruno's 'atomistic' perspective, they are expressed by the circle-minimum (or point), which for Bruno is the material constituent of the line; additionally, by a form with three tangent minima (among which there is a curvilinear triangular space called the 'term-minimum'); finally, by a circular/hexagonal structure consisting of six minima tangent to a central one, a figure that is the starting point for

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[26]  Cf. Yates, 1-26.
[27]  Cf. Bruno, *Articuli adversus mathematicos*, 19-21.

considering measurement, since in it the minimum radius, the minimum chord and the minimum arc are all formed by two point-minima and thus are equal.[28] These three basic and fundamental forms are therefore embodied and represented in the three archetypal figures (especially and most clearly in the second). It is from them that all geometric figures can be developed, since, in Bruno's view, they are to be considered "as if they were" composed of many minimal particles. This is a crucial aspect of Bruno's geometry, because it marks his theoretical attempt to hold together his atomistic view of nature and a mathematics that, as knowledge and *scientia*, must be philosophically consistent – hence also 'corpuscular' – while still working according to the rules and laws of Euclidean geometry. This is realised, not without strong and significant tensions, through an idea of geometric figures that are precisely constituted by an indefinite and indefinable number of indiscernible points: they are revealed in the very small and numerous fractions of measurements and, in Bruno's opinion, provide a legitimate explanation for the irrationality of certain measurements; finally, through the minimal points, the continuity of lines, surfaces and solids is made real, albeit discretely. Indeed, if we imagine the line to be composed of an infinite series of minimal points, phenomena such as tangency, intersection or the relationship between the diagonal and the side of a square, the height and base of an equilateral triangle and the circumference and diameter of a circle take on a completely different theoretical value. In fact, the point of contact (and/or section) between two minima is defined by Bruno as the 'term' and, in general, it is the geometric 'space' (*vacuum*) between all minima, whether they are minimally packed (and thus three points-minimum tangent to each other), or otherwise arranged. This gives rise to those 'inconsistencies' which, in Euclidean geometry, lead to the impossibility of relating different objects. If we imagine a 'minimal' square composed of four minimal points tangent to each other, we have a 'square' shape whose sides are the two minimal points tangent to each other, but whose diagonal is the two minimal points not touching each other and separated by the space between them; this, therefore, produces a length that is not 'congruent' with that of the side. By increasing this compositional practice to the utmost and understanding it as the geometric 'substratum' of every figure, one can understand the structural and 'philosophical' reason for every geometric form, and therefore it is both pragmatically and theoretically permissible to abandon measurement practices based on the approximation of $\pi$ in order to adopt the method of ever smaller fractions (tending towards minimal, constitutive and unitary fractions), as Mordente had done with his proportional compasses, unaware of these philosophical and theoretical implications. In brief, to use Bruno's words, if one only understands "that all plane figures are made up of straight triangles", even though one has "clearly perceived the continuity of the plane", but does not have a full understanding of the minimum, or that these figures "are made

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[28]    Cf. *ibid.*, 21-27.

up of minima", then he cannot really understand "that the straight triangle is made up of the curved triangle [i.e. the 'term'] and the circle [i.e. the point-minimum]".[29] Consequently, when one measures "by dividing to the minimum", he discovers that the *continuum* of geometric figures is "instead divided into heterogeneous parts", which "is at the foundation of reasoning and intending",[30] because the minimum (physical and geometric) "is the primary matter and substance of things, since it really implies the maximum to such an extent that every quantity, whether physical or geometric, is in it, with it, from it, through it, at it, and in relation to it".[31] The latter formulation explicitly takes up the terms that traditionally define the material substratum, because Bruno philosophically considers, "rightly" and "with certainty", that "all quantities and dimensions are understood to be implicated in potency or action in matter, insofar as it is pregnant and insofar as it generates, inasmuch as outside of potency and the act of the unity there is no number".[32] It is therefore, and ultimately, to this principle of unity and oneness that underlies all things (metaphysically as the monad, physically as the atom, and mathematically as the unit and the point) that geometric considerations must be traced, in an unprecedented convergence of atomism ("Democritus and the Epicureans correctly state that the sensible minimum is composed of several physical minimums"[33]) and monism:

> Therefore, not false were the statements of Xenophanes and Parmenides, but too sublime to be perceived by the coarse senses of the Peripatetics: the essence is one, immovable, because in its essence it is principle and principled; just as at the level of substance there is no number but unity; what is not one is nothing; therefore the one is essence, the one is true, and multiplicity remains instead as accident, as vanity, as non-entity. So you will understand when you hear the voice of the monad affirm: I AM WHAT IS. [...] Just as, therefore, apart from the monad there is nothing, and apart from atoms and points there is no quantity, so

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29  *Ibid.*, 23: "Ubi ex triangulis rectilineis omnes planas figuras constitutas intelligas, continuum certe, sed non minimum vel ex minimis percepisti; rectilineum quippe triangulum triangulo curvilineo et circulo compositum indicamus".

30  *Ibid.*, 23-24: "Tale igitur continuum non mensurando intelligis, et ego tecum esse dico, quale si metiri velis usque ad minimum resolvendo, vel etherogeneis discretum partibus invenies. Ad talia etenim minima natura omnis (quae rationis et intentionis est fundamentum) resolvendo progreditur".

31  *Ibid.*, 24: "Minimum ergo est prima rerum materia et substantia, quod sane ita implicat maximum, ut ab, in, cum, ex ipso, item per, in, ad ipsum sit omnis tum physica tum geometrica magnitudo".

32  *Ibid.*: "Bene igitur atque tuto in materia quantitates omnes atque dimensiones implicatae intelliguntur virtualiter aut actualiter, ut est parturiens et ut est pariens, quemadmodum extra virtutem et actum unitatis nullus est numerus".

33  *Ibid.*: "Minimum sensibile ex pluribus admodum physicis minimis esse compositum bene dicit Democritus et Epicurei".

apart from the part that is the minimum and its definition there is no measure, no geometer and, consequently, no philosophy.[34]

Having adopted this position, which is radical mainly on a philosophical level, it follows that "for those who admit the existence of the minimum, all things are commensurable, and the concept of continuous necessarily derives from that of discrete; therefore, as has been argued, both number and unit constitute the common notion of all numbers".[35]

Returning to the three archetypal figures, it is therefore important to read them both as 'symbols' representing and showing all this fundamental theoretical background, and as tangible signs explaining and helping to recall not only this primordial perspective, but also the practical and geometric applications deriving from its concrete application to geometry and astronomical measurement. Thus, and in summary, these "three figures that generate all the others" are intended to "reveal in them all the concepts of this art".[36] In order to further emphasise this double value of the archetypal figures – methodological and mnemonic – Bruno uses a metaphor that recurs frequently in his writings, precisely to express the dual idea – visual and conceptual – of the unity, at once organic and composite, of what is to be analysed. The image chosen is that of the human body as a 'statue':

> Just as someone who wants to show the parts of a human being must first present the whole, composed and formed, instead of presenting the individual parts that contribute to it and are known one by one, so before teaching we must first acquire all things and prescribe to take possession of the book that contains them all.[37]

[34] *Ibid.*, 26: "Non igitur falsa, sed altior quam a triviali Peripateticorum sensu perceptibilis, fuit illa Xenophanis et Parmenidis sententia: Ens unum, immobile, quod in rei veritate idem et principium et principiatum; sicut substantialiter praeter unitatem nihil est numerus; quod non est unum, nihil est; ergo unum est ens, unum est verum, multitudo vero relinquitur ut accidens, ut vanitas, ut non ens: ita intelliges ubi Monadis vocem audies SUM QUOD EST. [...] Ut ergo praeter Monadem nihil est, praeter atomos et puncta nullum est quantum, ita et praeter minimi portionem et definitionem nulla est mensura, nullus est geometra et nulla consequenter philosophia". On Bruno's monism, cf. Tirinnanzi, *La monade e le sue ombre nell''ars memoriae' di Giordano Bruno*; Blum, *Auf dem Weg zur Prozessmetaphysik: die Funktion der Monaden in Giordano Brunos Philosophie*; Zaffino, *Totum et unum. Giordano Bruno e il pensiero antico*.

[35] Bruno, *Articuli adversus mathematicos*, 26: "Dantibus minimum omnia sunt commensurabilia, sequitur ratio continui discreti rationem necessario; ut ergo vel numerus vel unitas communis est ratio omnium numerorum, ita in proposito".

[36] *Ibid.*, 19: "Figuras ergo tres omniparentes (quamvis adhuc earum fabricandarum ratio non sit adducta) docturus ante oculos obiicio, ut in ipsis universos artis huiusce terminos aperiam".

[37] *Ibid.*: "Ita eum qui partes hominis indicare decrevit, prius universum compositum atque formatum obiectet oportet, quam quae sygillatim in ipso concurrunt atque comperiuntur insinuet, sicut antequam doceamus, omnia nos praehabere oportet, et librum omnia continentem assumere praecipimus".

This metaphor, it has been said, also appears frequently in other Brunian writings. In *De umbris idearum*, for example, it has a purely methodological function:

> When you move from a confused plurality to a clear unity, then you will truly discover and experience that you have completed the itinerary we have described. [...] The hand joined to the arm, the foot to the ankle, and the eye to the forehead, when placed together, have the capacity to be known more clearly than when placed separately; likewise, since none of the parts and configurations of the universe are placed separately and without order – which in the first mind is the simplest, the most perfect, and independent of number – if we construct our concepts by joining the different parts and uniting them according to reason, what is it that we will not be able to understand, remember, and do?[38]

The idea of an image as a semantically active composition, because of its structural complexity, also has a mnemotechnical value, not only because what is well organised is best remembered, but because the organic unity of a composition can inevitably act as a visual pathway for information, in short, it is a local system contracted into a single complex image (as indeed the mnemonic tradition already did). In *Explicatio triginta sigillorum*, Bruno proposes a specific mnemotechnical device for this purpose, entitled "Phidias or the Sculptor". It consisted of a system of images arranged within the same "common substratum" – i.e. a room – "so that [...] certain figures, in contact with different wandering images, emit a different sound", i.e. that such figures are "activated" within the *locum* in such a way that "with different postures and placements, and after having considered the substratum in relation to the various parts and according to the various relations, it will make the consonant letters multiply the five vowels".[39] In this way, he can visually and symbolically express the value of a syllable or a word, a technique proper to (and also 'typical' of) the *memoria verborum*. In general, as we learn from the explanation of the seal, this specific expedient is based on a particular conception of imaginative action, since the phantasy can be metaphorically compared to a sculptor:

[38]  Bruno, *De umbris idearum*, 100-101: "Talem quidem progressum tunc te vere facere comperies et experieris, cum a confusa pluralitate ad distinctam unitatem per te fiat accessio. [ … ] Sicut manus brachio iuncta pesque cruri et oculus fronti, cum sunt composita, maiorem subeunt cognoscibilitatem quam posita seorsum, ita, cum de partibus et universi speciebus nil sit seorsum positum et exemptum ab ordine – qui simplicissimus, perfectissimus et citra numerum est in prima mente –, si alias aliis connectendo et pro ratione uniendo concipimus, quid est quod non possimus intelligere, memorari et agere?"

[39]  Bruno, *Explicatio triginta sigillorum*, 58-59: "In proprias sedes subiectum commune atque totale distinxi, quae quidem easdem in sua domo perpetuo immorantes imagines quasdam retineant, quo diversorum peregrinantium attactu diversimode sonent. Ibi forma subiecto adveniens, penes locales situalesque differentias nec non per varias partes et secundum varias habitudines considerato, consistentia per subsistentia quinque multiplicare faciet elementa".

It is it [phantasy] which erected the famous statue of Nebuchadnezzar, and which described in signs the orderly sequence of the fortunes of the kingdom; it is it which fabricates the succession of rhetorical figures, and it is it which describes, in a precise order and in the same sequence as we wish to recall them, the conditions of the physical appearance of some sensible subject about whom and in whom it describes many things metaphorically.[40]

The three archetypal images thus fulfil the 'technical' – methodological and mnemonic – function described in this specific seal (the thirteenth of the thirty proposed by Bruno): they show a system of references that are different but united by a common theoretical background; moreover, in the articulated and systematic organicity of the figures, they help the reader to remember as well as to understand the concepts gathered in them. The reference to the sculptor's seal, however, not only helps us to have a clearer reference to their function, but also shows us that the three archetypal images, read precisely in their mnemotechnical specificity, are themselves "seals", i.e. one of the various 'semiotic' typologies that Bruno identifies in order to define the relationship between content and mnemonic sign. Bruno treats this in detail in the first part of *Ars memoriae* annexed to *De umbris idearum*, in the pages where he describes the "twelve substrata of garments", namely "species, forms, simulacra, exemplars, spectres, traces, hints, signs, notes, characters and seals".[41] Seals belong to the last group, along with "signs", "notes" and "characters", those that "seem so appropriate to the mode of art [of memory] that in all these cases it seems to support natural realities"; indeed, with "signs, notes, characters and seals [...] art acquires such great power that it seems to act outside of nature, above nature and even – if the task requires it – against nature".[42] "To the lastmentioned", Bruno continues, "the art resorts when it cannot produce figures and images, because the contents in question do not belong to the genre of realities susceptible to fantastic representation or depiction".[43] Signs, notes, characters and seals therefore serve to visually and mnemonically represent information that is more abstract, precisely because they are essentially symbolic and 'graphic' in their nature, and not superficially 'mimetic'. Therefore, if "species, form, simulacrum,

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40  *Ibid.*, 122-125: "Haec est statuarius ille, qui famosam Nabuchodonosoris statuam erexit, haec ordinatam fortunae regni successionem descripsit, haec tropologiarum fabricat discursus, haec formae conditiones in aliquo sensibili, circa quod et in quo pleraque metaphorice delineat, certo quodam ordine ea demque qua meminisse volumus serie describit".

41  Bruno, *De umbris idearum*, 136-137: "Habes in libro Clavis magnae duodecim indumentorum subiecta: species, formas, simulachra, imagines, spectra, exemplaria, vestigia, indicia, signa, notas, characteres et sigillos".

42  *Ibid.*: "Quaedam vero adeo arti videntur appropriata, ut in eisdem videatur naturalibus omnino suffragari: haec sunt signa, notae, characteres et sygilli, in quibus tantum potest, ut videatur agere praeter naturam, supra naturam et, si negotium requirat, contra naturam".

43  *Ibid.*: "Hisce succurrit ubi figuras et imagines reddere non potest, cum in imaginabilium vel figurabilium genere non versentur".

exemplar and specter thus represent Mercury" – this is the example Bruno gives – "notes, characters and seals instead represent the substance, essence, goodness, justice and wisdom of Mercury".[44]

Finally, let us look in detail at the three images, how they are defined and formed, and the theoretical level and geometrical applications to which they refer. The first of them is called the Figure of the Mind (*Figura Mentis*) by Bruno and, in the pages of *Articuli adversus mathematicos* in which its explanatory use is recalled, it is designated by the astronomical symbol of the Sun. Geometrically, it "consists of four circles placed side by side, which penetrate and intertwine through the centres"



Fig. 2. *Figura Mentis. Articuli adversus mathematicos*, 78.

(Fig. 2),[45] and it is called Mind because it "contains all things and gathers them into a kind of unity".[46] The main meaning of this illustration, therefore, lies in the concept of unity, symbolised by the fact that the circles, triangles and quadrilaterals drawn in the illustration manifest their geometric properties and their mutual relationships by virtue of the main circle that encloses them all and from which they derive. From a technical point of view, however, this image does not occur in many of the constructions in the text and is used mainly to illustrate the procedures relating to the line and triangles, although it is also evoked in some pages dealing with regular polygons.

The second figure, which "consists of seven circles touching each other at certain points, so that they cannot penetrate or intersect each other" (Fig. 3), is called the Figure of Intellect (*Figura Intellectus*), because it "distinguishes all things and orders them according to the reasons of each";[47] the graphic/astronomical symbol representing it

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44   *Ibid.*, 138-139: "Mercurium ergo praesentat species, forma, simulachrum, exemplar et spectrum. Mercurii vero substantiam, essentiam, bonitatem, iustitiam et sapientiam praesentant notae, characteres et sigilli".

45   Cf. Bruno, *Articuli adversus mathematicos*, 21.

46   *Ibid.*, 20: "prima, quae quatuor circulis mutuo se per centra penetrantibus, implicantibus atque coinsitis perficitur, figura Mentis universa continentis et in unitate quadam implicantis appelletur".

47   *Ibid.*, 20: "Secunda, constans septem se attingentibus circulis, nempe in punctis quo mutuo non penetrent et intersecent, figura Intellectus omnia distinguentis propriisque rationibus distribuentis appelatur".
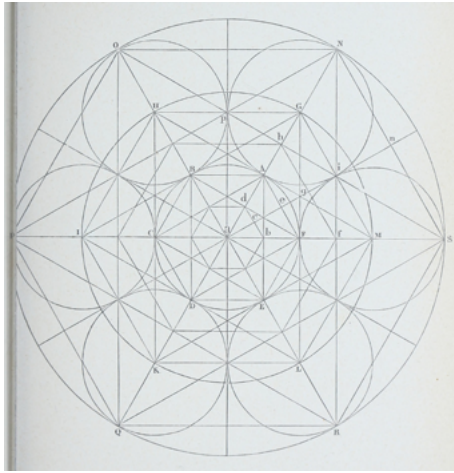
Fig. 3. *Figura Intellectus. Articuli adversus mathematicos*, 79.

is that of the Moon. It is perhaps the most important figure from a theoretical point of view and with regard to the particular atomistic geometry postulated by Bruno: it is formed by six tangent circles arranged so as to touch a central one, according to a hexagonal and compact pattern, which in fact constitutes the primary matrix of all material reality, both in the physical and geometric sense. This form is the basis of the composition of the minima, so that all geometric figures are composed by this fundamental schematism, but also the physical bodies respond to this configuration, since the atoms have a spherical, minimal form and therefore, in forming the earth element, the densest and most solid, they compact according to this pattern. Obviously, the circles, equilateral triangles, hexagons and circles derived from this main composition have an important function in describing and explaining geometric constructions, which is why it is referred to so often (more than the other two) in the pages of *Articuli adversus mathematicos*, especially in the theorems relating to line, angle, triangle, polygon and, above all, circle. The reference to the symbolism of the Intellect/Son as the first 'emanation' of the Mind/Father[48] is finally symbolically justified by the fact that this figure "is also formed by three concentric circles – since their centre is the same and unique individual, which is the first circle, and no less unique is also the last circumference, which is the outermost circle", so "it is rightly said to be a figure of that which embraces and unites all things".[49]

The third and final archetypal figure – graphically symbolised by a star – "unfolds in circles, now intersecting, now tangent" (Fig. 4) and is called the Figure of Love (*Figura Amoris*), "because, as the substance of all things is both contrary and concordant, it perpetually preserves concord in opposition and opposition in concord, distinction in union and union in distinction, the multiplicity in unity and unity in the multiplicity".[50] Made up of four mutually tangent and secant circles, plus numerous inscribed

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[48]   Cf. Carannante, *Unigenita natura*, 93-209; Id., *Giordano Bruno e la filosofia moderna*, 225-252.

[49]   *Ibid.*, 20: "Tribus etiam concentricis efformata circulis, utpote quorum idem et unum individuum est centrum, quod est primum, unica quoque non minus est ultima circumferentia, quae est extremum, figura certe omnia complectentis et unientis dicitur".

[50]   *Ibid.*, 21: "Tertia tandem, quae tum attingentibus tum intersecantibus se circulis explicatur,

squares and a total of sixteen squares forming a larger grid that surrounds the entire figure, it symbolises the close relationship between arc and chord, curved and straight, and thus, from a theoretical point of view, the union and complementarity of opposites (especially the minimum and the term/vacuum, which are present in everything and in all figures). From a geometrical point of view, it is recalled mainly in demonstrations related to quadrilaterals and other regular polygons: in particular, in the pages related to the square, it is used to solve problems related to the gnomon and other operations of algebraic geometry, that is, the construction of equivalent rectangles or multiples of squares.
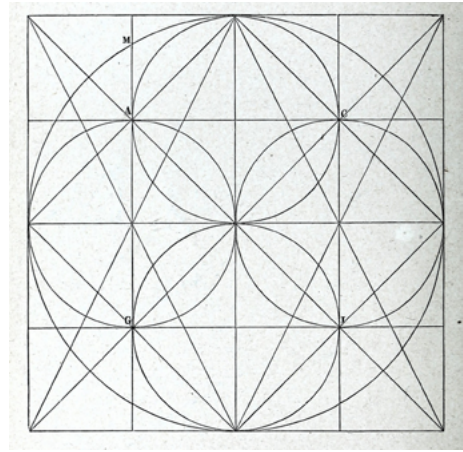


Fig. 4. *Figura Amoris. Articuli adversus mathematicos*, 80.

## Conclusions

Although *Articuli adversus mathematicos* is not a mnemonic text per se, both the context in which it was conceived and published – the German period of Bruno's *peregrinatio* and, in particular, his stay in Prague with the Spanish ambassador and among the circle of intellectuals close to Rudolph II's court – and the presence of these three important mnemonic passages, offer an unprecedented and original mnemonic implication, especially considering that it is a geometry text. Specifically, we have seen how the rich set of ancillary images that close the text (the thirty *figurae subalternae*) is opened by an image with a very clear mnemotechnical value, since it represents the typical structuring for mnemotechnical places provided in the traditional *ars memoriae*, and not only in that of Bruno. Furthermore, in one of the most important sections of the text, devoted to the particular technique of measuring astronomical distances that Bruno developed, the explicit choice is made to describe the dense and recursive fractioning of the circumference by means of a metaphor that visually recalls precisely the system of dividing places into virtual spaces

Amoris figura noncupatur, quandoquidem substantia universi tum contraria est, tum quoque concors, utpote in contrarietate concordiam et in concordia contrarietatem, in unione distinctionem in distinctione unionem, in unitate multitudinem in multitudine unitatem perpetuo reservans".

that are subordinate to each other. Again, this is a rather unusual application – undoubtedly of more metaphorical and symbolic than technical value – of mnemotechnical instrumentation to a field that is anything but humanistic. To conclude, the value of the three archetypal figures is shown to be both methodological and mnemonic: in this case, the recourse to the mnemonic technique is certainly more explicit than in the other two cases examined, but no less original. It should be noted, however, that at this point Bruno creates three veritable mnemonic 'seals', according to the 'semiotic' division and definition of mnemonic signs elaborated in *De umbris idearum*: firstly, by creating images specifically designed to describe and represent the various abstract contents, i.e. the geometric constructions appearing in the text; secondly, by offering the reader a concrete and visual means of memorising, enabling him to review in each figure, easily and all at once, the numerous geometric patterns of which it is composed; finally, to symbolise and remind us of the no less important philosophical considerations that run beneath the surface of the entire text of the *Articuli adversus mathematicos* and which constitute its inescapable theoretical foundation.

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# Walking through ideas: Memory and the body in the premodern memory palace

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**Abstract**

Early Modern Italian manuals for memorization present memory as deeply embodied, especially through the memory palace technique. Here, physical sensation, emotion, navigational skills, and personal experience, are all functional to intellectual learning. This article individuates these embodied tools through the analysis of three memorization manuals from 16th century Italy – a time, place, and religious context, in which the body could still be involved in mnemnonics: Dolce's *Dialogo del modo di accrescere e conservar la memoria* (1562), Della Porta's *L'Arte del Ricordare* (1566), and Gesualdo's *Plutosofia* (1592).

In these manuals, it is especially the *loci*, the architectures of the memory palace, which show sensory participation. Fundamental for place-navigation skills, these embodied techniques are a theoretical challenge for the manuals' authors, tied to the period's view of memory as a fundamentally abstract process. Their various approaches are reviewed, and organized along a spectrum, from claiming to denying the contribution of the described practices to a theory of memory and knowledge.

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In the 16th century, the borders of knowledge were expanding like never before: a new continent appeared within the horizon of European intellectuals, as well as a new branch of Christianity. The printing press was capable of spreading information with unprecedented speed and reach, as well as doubts, anger, hopes. Scholars were left without social, epistemological, and cognitive structures able to manage the growth. As a consequence, the 1500s saw thinkers passionately engaged in active debates over a wide number of possible solutions. Of these, only a handful would survive the century and eventually be welcomed in the culture as an adaptive mechanism.

In this study, successful adaptations are not the main point of interest. I will focus instead on an unsuccessful set of solutions elaborated to cope with the century's information overload, that of the Memory Arts. This ancient discipline, rooted in oratorical necessities and transmitted within rhetorical and monastic traditions, dealt with the coupled needs to have one's knowledge at hand, and to make that knowledge meaningful, when books were scarce or even non-existent. The Memory Arts consisted of a multiplicity of techniques, accumulated through centuries of trial and error, which made use of automatisms of the body-mind unit, like muscle memory and emotional memory. Their aim, as Mary Carruthers has observed, was mostly compositional: to select, order and organize, preserve, and ultimately reuse, information.[1] In the 16th century, the Memory Arts gained interest and traction, since literate people's information-management skills were under the combined pressure of Gutenberg, Columbus, and Luther.[2] Rooted as they were in practical tasks and empirical procedures, the Arts were however somewhat controversial: they had a distinct embodied character that did not translate easily into the time's philosophical frame – especially the Protestant one. Besides, their somewhat cumbersome sense-making tools could not equal the speed and reach of the printing press, eventually relegating them – ironically – to oblivion.[3]

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[1]   "This extraordinary elasticity of mnemonic places could bring great advantages for the management of information in an age flooded with ever-increasing notions coming from all over the world": Bolzoni, *Memoria e Memorie*, 67. From here on, all translations of Italian titles will be my own.

[2]   "Toward the end of the sixteenth century and the beginning of the seventeenth, however, the structure of the art became so complex that many intellectuals found it almost impracticable. Abandoning the traditional, strictly mental method, they increasingly made recourse to external devices as 'secondary memories' such as commonplace books, elaborated indexes, slips of paper or note cards and branching diagrams": Kuwakino, "From *domus sapientiae* to *artes excerpendi*", 59.

[3]   "The development of Memory Arts in 1500 is something paradoxical: it coincides with the expanding of the printing press, that is, with the creation of a condition in which the art of memory becomes less and less important, and eventually, substantially useless. At the same time, we register a long phase of co-existence, of interaction: we witness then a precarious yet fascinating balance": Bolzoni, *Memoria e Memorie*, 15.

I am interested, in particular, in what was lost along with them. That mnemotechnics declined in Western 16th- to 18th-century culture is undeniable: what is surprising is rather their lingering, well after technological advancements had made them obsolete.[4] Such persistence is symptomatic, I believe, not only of burdensome structures within the institutions designated for knowledge production. But also, and importantly, of the Memory Arts' peculiar capacity to bridge the gap between localized individuals and collective knowledge: they systematically brought this second one quite literally inside the cognitive system of each person. As Luis Merino Jerez writes, "[mnemotechniques'] function consists in mediating between textual and oral, that is, between private and public" (25). The Memory Arts, with their embodied and personalized mechanisms, allowed for the holding together of personal stories with collective myths; of the everyday and physical with the eternal and cosmic; of the city or the monastery with the monastic order, the nation, the empire. The Memory Arts thus testify to the importance and centrality of the personal, physical, local aspects characterizing pre-modern approaches to cognition and knowledge. My proposal is that of problematizing a narrative that equates these aspects' later dismissal with their being obsolete. Moreover, I aim to encourage scholars to deepen our analysis of embodied, personal practices at the basis of Western culture.

The existence and implications of embodied practices is here shown through the comparison of three books: Lodovico Dolce's *Dialogo del modo di accrescere e conservar la memoria* (Venice, 1562), Giovan Battista Della Porta's *L'Arte del Ricordare* (Naples, 1566), and Filippo Gesualdo's *Plutosofia* (Padua, 1592). These texts are representatives of the mature phase of the Memory Arts' revival in Italy (1560-1600), which was characterized by a high degree of popularization. As such, they pertain to the manual genre, they are printed in rather inexpensive formats, and are written in the vernacular. Moreover, they support their proposed techniques through very accessible (even though not always extremely clear) theoretical explanations. In these, one finds a preoccupation with the role of the body in processes of knowledge-acquisition and -administration. The three authors express distinct instances of mediation between traditional views of human cognition, as well as new necessities; their different solutions are contingent on each author's position within the power structure and on their specific goals: pedagogical, social, commercial. As will later emerge, these instances translate into significantly different approaches to the problem of embodiment in cognition.

This comparison shows, firstly, that the reflection of the body/mind problem went beyond university walls. Secondly, but not less importantly, that the time's exploration of this problem still fully recognized themes that would later be dismissed, such as the importance of physical perception and of emotions in processes of learning. In

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[4]   Notably, as I will articulate in a few pages Dolce's is a (rather free) translation of Romberch's Latin text, for popularizing purposes; Della Porta's was also originally written in Latin, and the author then curated a translation into the vernacular for publication.

other words, the approach to knowledge proposed in these books takes into account the contribution of perception, emotion, personal participation, etc., showing different possibilities of their harmonization with the Western epistemic system. These memorization manuals thus showcase a discursive development down an alternative path to the dis-embodied one adopted by the West – traditionally blamed on Descartes, and often deemed as the only one possible. For a brief time, before the Memory Arts were discarded as incompatible with new methods of knowledge-formation, we can recognize an attempt at bringing this body-mind integration into modernity. Perhaps a missed opportunity then, such an attempt gives us an opportunity now: that of using it to better understand the early modern conception of human cognition. Recognizing these manuals' willful involvement of the body in knowledge-making, in other words, opens the way for us to elaborate a more nuanced formulation of the early modern "body-mind problem".

## New problems, old solutions?

In *Uncertainty in Post-Reformation Catholicism: A History of Probabilism*, Stefania Tutino highlights how, among what we now frame as technological and scientific revolutions, Renaissance probabilists usually turned to traditional knowledge for solutions, even radical ones.[5] Rather than shaping brand-new ideas, that is, they refashioned those they had received, finding potential for rearrangement of values and practices from within the canon. This is a similar case, which shares with probabilism a deep connection to practical knowledge. The Memory Arts belonged to the European canon: as the fourth part of Rhetoric (*memoria*) they represented an element of every pupil's basic education, from antiquity well into the 18th century.[6] However, around the 1500s, the archive shows a distinct shift in the Arts' application toward general knowledge. While this turn

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[5]   "Figurae dicuntur ea quae in locis reponimus, pro rebus memorandis, quae figurae *immediate* memorandas res, nostrae representat memoriae": Rosselli, *Thesaurus artificiosae memoriae*, 77v; my italics.

[6]   "The idea of an art of remembering and thinking that functions "mechanically" will be newly relevant between mid-1500 and mid-1600. At this time, we witness a deep intertwining of different Memory Arts traditions. […] The idea resurfaces of a concept-generating mechanism able, once set into motion, to self-perpetuate, almost independently of the individual's contribution; and to continue until the final consequences, until total comprehension. This would have allowed humans to read, in its integrity, the book of the universe": Rossi, *Clavis Universalis*, 5. Also, Bolzoni: "In the mid-1500s, method becomes one of the new aspects of the art of memory. Great faith is placed in the possibility of formulating a method that will rigorously regulate both knowledge and the ways of communicating and recalling it. […] The new directions of logic and dialectics interact productively with the new possibilities created by the book and by the ordered and reproducible space of the printed page" (*The Gallery of Memory,* xix).

in the discipline has been explored by scholars ever since Frances Yates's 1966 seminal work *The Art of Memory*, and has been connected to the centuries' technological and conceptual innovations, I want to bring attention to an aspect of this change so far overlooked: the centrality of bodily perception and performance in cognition. In 16th century Memory Arts in fact, the body is not a spectator of the process of memorization, nor is it merely an aid to it: it is often the main factor in determining cognitive change. This becomes particularly visible when the printing press makes the Arts available to a wider audience through the manual genre.

The Memory Arts manual was a desired object in the 16th century. It had evolved from being a part of the Rhetoric manual (that dedicated to memorization of speeches) into a stand-alone text. The printing press aided and enhanced this independence. Almost a century after the (then) famous Petrus Ravenna's *Phoenix, sive de artificiosa memoria* (1491) had reached enormous circulation and success, the genre underwent important changes.[7] The books here selected showcase the main traits of this development. Firstly, they are written in the vernacular, as opposed to the traditional Latin, granting them more reach and appeal among non-erudite publics.[8] Secondly, they show encyclopedic and literary ambitions, explaining their own processes toward theoretical explanations and erudite citations, as opposed to the initial scrawny lists of practical precepts on which a teacher would have to elaborate. Thirdly, they advertised their cognitive tools way beyond the traditional uses of memorization and meditation, mostly limited to monks and scholars. According to these books, anyone would benefit from the Arts, for any everyday activity, from trade to prayer. Lastly, they are all products of the tension between Italian philosophical discussions – especially the Paduan milieu, but also voices like Campanella and Bruno – and post-Reformation Catholicism.

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[7]   For an account of the Protestant attitude towards sensory stimuli (in the form of images, but also of objects, spaces, sounds, etc.) as both a threat and a resource, I refer to Koerner, *The Reformation of the Image*, especially the final section of the Introduction, "A Reformation Altarpiece", 69 and "Part I: Cleansing", with a particular attention to the sections on "Beliefs", 94 and "The Arrested Gesture", 153. As Koerner analyses mostly early German thought, I would add Tribble and Keene's *Cognitive Ecologies and the History of Remembering*, which expands its attention toward post-Reformation England.

[8]   On the other side of this spectrum – the Catholic one, the senses were still problematic, but solidly encapsulated in the religious and civic life, in a way letting tradition and habit act as soothing factor against a theology that saw in the body the place of sin. In fact, Haigh in *The Plain Man's Pathways to Heaven*, 2007 argues that it took a generation for Protestants to feel comfortable enough, and not constantly conflicted, within the new rites and habits. Studies of post-Reformation Catholicism that pay special attention to materiality and embodiment are De Boer and Göttler. *Religion and the Senses in Early Modern Europe*, Noyes's *Rubens and the Counter-Reformation Crisis*, and Tutino's *Empire of Souls*. Michelle Molina's *To Overcome Oneself* richly engages the embodiment of specifically Jesuit practices.

The Memory Arts had had millennia to accumulate techniques with the aim to quickly and efficiently individuate, store, retrieve and reuse data.[9] Facing an unprecedented tide of information, scholars turned to them to find solace and, perhaps, the roots of a new method.[10] This happened regardless of the methodology that had been behind the Arts, which had very little to do with rigorous philosophical inquiry, instead showing solid roots in use and habit. The manual genre allowed, or even celebrated, knowledge coming from, and aiming for, practice. On the other hand, the demands of the market for entertainment and for a master-less teaching favored the expansion of the manual genre into a more encyclopedic enterprise, richer in theories and not just in practices. In this interesting cohabitation of a practical and theoretical attitude, we can find, firstly, beliefs derived from practice -often treated as obvious despite being mostly absent from theoretical treatises; secondly, we can find the tensions that these practice-bound beliefs create when their authors attempt to justify them in theory. Therefore, the theoretical apparatus of these books can be used as a way to investigate ideas of the time that were widespread among the widening literate, but not necessarily erudite, population.

With regard to these common ideas emerging in the genre, a Catholic perspective offers a peculiar set of solutions. Protestant and Calvinist systems[11] were ambivalent towards the heavily visual and sensory component of the Arts – from the crafting of gruesome and stunning images, to the selection of the angle and light from which to watch them. While still controversial, these practices were not as problematic in Catholic environments:[12] they could be fully utilized, rather than rejected.[13] In fact, as we will see in

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[9]   "The *Bildkritik* of the Reformers implies thus a *Gedächtniskunstkritik*: the art of memory is dangerous because it leads to introduce into one's mind and heart images that can ignite the senses and, in so doing, is inherently impious: de facto, it substitutes the divine word, which is the inspiring agent par excellence. In Catholic milieus instead, the survival of the Memory Arts depends exactly on its long-time fortune as, on the one hand, a fundamental support to the discipline of interiority of clerics and monks; and, on the other hand, as a valid aid to the believers' indoctrination": Torre, Introduction to *Dialogo*, XXV -XXVI.

[10]  Lina Bolzoni defined the art of memory as a "cultural fossil, the residue of a world that is deeply other". While at the same time it invites "To experiment techniques aimed at controlling the connections between body and mind, between the sensory images and those populating the spaces of one's interiority": *Memoria e Memorie*, 2.

[11]  "The art of artificial memory, born with Cicero and Quintilian, and recuperated by Albertus Magnus and Thomas Aquinas, were considered essential for the exercise of the Christian virtue of prudence. The Memory Arts, cultivated by Lull, Bacon, and Leibniz, are then pushed aside: eventually joining anthroposophy and spiritism in occultist publishing enterprises": Rossi, *Clavis Universalis*, XIII.

[12]  For a deeper treatment of the genre's evolution, see Poupard, "*La méthode des* loci", 19-55.

[13]  While I will quote the *Plutosofia* from its original Paduan edition (digitized), I will approach Dolce's and Della Porta's texts from their relatively recent editions curated by, respectively, Torre and Sirri. Even though the originals are available, and I first read both texts in that form,

a moment, these manuals show resistance toward the abandonment of an Aristotle-derived idea of cognition as embedded in one's body and life. The books analyzed here treat the senses as an integral part of the knowledge process, pushing to problematize the role of perception despite theoretical (and real-life) risks. Dismissing such insistence as a relic of a dying system could cause us to overlook a trait of Western culture that was central to the formulation of its values and practices,[14] before fading into obsolescence.[15] The embodied, personal, situated nature of knowledge is expressed through the centuries in myriads of ways: from didactic methods, to storytelling practices, to thinking processes. It is especially apparent in places, like the Memory Arts, where the subject matter consist of the mechanisms of the mind and soul.

## *Three specimens*

The three popular books I selected were published by Italian authors in the second half of the 16th century. I had three, interwoven criteria for this selection: a chronological one, in that I wanted books that reflected the moment of greatest expansion of the genre, including its attempts at encyclopedism. Beyond this, I used a cultural and rhetorical criterion, in that I wanted books written for a wide public in a Catholic context. Hence, these texts are in the vernacular, they tend to be exhaustive and clear in their explanations, do not take for granted higher education (in theology and philosophy), but they do rely on basic education (rhetoric and common knowledge). Moreover, they pertain to the Italian milieu: given the divide created by vernacular use, and the prolific Italian book market, that seemed like the best possible choice to individuate typically Catholic traits of the genre.[16]

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I am grateful that I could rely on experts for a proper transmission of the texts' language and meaning. Their comments, contextualization, and insight have been more than precious for my research, and I wish my thought and translation could do them justice.

[14]  "[Dolce's adaptations] aim at making the work more comprehensible and at widening its reach, in order to reach one final goal: a balance between utility and pleasure – which was a trait of poetics too – able at once to distance this text from the courtesan treatise form (which was intended for the pleasure and education of a limited audience), and to highlight the will to help a wider public": Torre, *Clavis Universalis*, XII. The Romberch-to-Dolce passage has been studied in depth by Ramos Grané, especially in her "De Johannes Romberch a Lodovico Dolce: la metamorfosis del *Congestorium artificiosae memoriae*".

[15]  Della Porta, *Ars reminiscendi, aggiunta l'arte del ricordare tradotta da Dorandino Falcone da Gioia*.

[16]  "Dolce indeed seems to be demonstrating how it is possible to make literature of texts that have been long confined within the borders of proto-scientific expertise. A literature, as he envisions, that is surely mass-oriented and aiming at public utility; but also, it still possesses 'order and ornament', able to reach and involve a growing number of readers; without the presumption to make them experts, but maybe [ … ] interested": Torre, Introduction to *Dialogo*, XVI.

The first text I will introduce is Lodovico Dolce's *Dialogo del modo di accrescere e conservar la memoria*, published in 1562 by Sessa in Venice.[17] As is common for Dolce, he is not properly the author: this work is a translation, with Dolce's own additions, of the *Congestorium Artificiosae Memoriae*, published in Venice some 40 years before (1520) by the Dominican friar Johannes Romberch. While this is therefore not technically an original work, Dolce's late translation presents key differences from its original, which resonate with an embodied, and culturally relevant conception of the Memory Arts. Tellingly, Dolce's additions to Romberch's texts are, on the one hand, the reference apparatus integrating theological and classical authorities with those of vernacular literature (notably, Dante); on the other hand, his translation into the vernacular, its transmutation to the dialogue form, and many other adjustments, which render the text available not to a wider audience (since Latin was the lingua franca), but to a different one, whose interest in a text was more likely to include entertainment, pleasure, and curiosity.[18] The timing is also important: almost half a century after Romberch's publication, the book can be proposed and perceived as a popularizing project. Memory Arts manuals were common by then – and they commonly explained more than just memory techniques. In this context, Dolce's text was what Romberch's could not be: a neutral, easy to sell, pleasant read.

The second text is Della Porta's *L'Arte del Ricordare*, published in 1566 by Cancer in Naples. This work is also a translation, but from the same Author's Latin text into the vernacular (by Dorandino Falcone da Gioia). Della Porta's original *Ars Reminiscendi*, which he had written in Latin, was published only later, in 1602 (still in Naples, but with Sottile). However, the Italian version was curated by Della Porta, and was part of his project in producing and popularizing culture. Following Raffaele Sirri,[19] I will refer to the 1583's edition, which differs from the 1566 because of the deeper revision it was subject to through the Latin text. Della Porta was exceptionally erudite. His fervent interest in the sciences

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[17]  The brain was not the sole organ of the body devoted to cognition; at this point in time, however, the brain had outruled the other organs in theoretical importance. For further insights on this passage, see Vidal, *The Sciences of the Soul*, especially chapter 2, "Psychology in the Sixteenth Century: a Project in the Making?", 21-47, and the section of chapter 3, "From soul-form to soul-mind", 74-82.

[18]  Credited to 11th century pedagogue Guido of Arezzo, this mnemonic for music inscribed in the hand traveled the centuries. This was "The system by which he [Guido] pointed to joints in the fingers of the left hand in order to teach solmization. Each joint represented a specific pitch in the scale". Weiss, "The Singing Hand" in Richter Sherman, *Writing on Hands*, 17. See also Berger's chapter "The Guidonian Hand" in Carruthers, *The Medieval Craft of Memory*, 71-102 (but especially 71-82).

[19]  "The point of departure is sight [ … ] However, what we see here goes well beyond that: images, once they are visually constructed, acquire life, density, depth. This process is aided by the intervention of the other senses (touch, hearing, for example); at the same time, it calls them into play, and elicits their intervention": Bolzoni, *Memoria e Memorie*, 4-5.

and the magical arts led him to develop a constant intellectual exchange (with correspondents from Galileo to Campanella) and also his own scientific activity, as well as an incessant effort of knowledge dissemination. His choice of the vernacular is thus not casual. It is telling that he only published his manual in Latin when the *Sant'Uffizio*'s interest in his work grew enough to steer him away from popularizing literature.

The third text is Filippo Gesualdo's *Plutosofia*, published in 1592 by Megietti in Padua, and reprinted in 1600 in Vicenza by Bertelli. Solidly into a period of popularity of the genre, this manual comes late into the century, showing its belonging to a now mature genre: preceded by many authors (which he quotes), Gesualdo is comfortable proposing his work as part of a tradition. A Franciscan, he lived all across the Peninsula, while pursuing the task of restoring, promoting, and realizing, methods of virtuous communal life, in line with directives from Trent and Saint Francis's original rule. His *Plutosofia*, published while he was appointed to the restorative task by the Pope, echoes this larger moral plan. On a more formal level, it also reveals the typical down-to-earth attitude common to the manual genre. A characteristic particularly precious for Gesualdo, who was deeply aware of the power of didactics in ideology battles.

The authors of these books were not unaware of the mediation they were facilitating between specialist and general cultures. Their texts are punctuated by explicit references to the tension generated by the translation of knowledge from the original monastic and academic circles to the much wider readership of popular printed books. Looking across these authors allows us to see different angles from which this problem was approached. Gesualdo is a representative of the monastic ascendancy: closer to the traditional channels of knowledge reproduction, especially in this field. The other two instead represent the new channel opened by technological and social changes: Dolce and Della Porta are "popularizers", educated people who dedicated their efforts to the production and dissemination of knowledge on a large scale. Through their different backgrounds (north and south, university and homeschooled, respectively) and different motivations, dictated by their professional and social status (Dolce more on the commercial side, Della Porta more invested in his own interest), these authors represent different viewpoints on dissemination within and beyond institutional and traditional ways. Gesualdo's interest was that of making a For Dolce, this was part of an equally commercial and ethical enterprise,[20] utiliz-

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[20]   See Anderson's statement that "Both body and world were generally understood to dynamically participate in human cognitive processes. Also noteworthy is that the soul is portrayed as distributed within the body, rather than as head bound", *Renaissance Extended Mind*, 82. In the memory manuals, this is expressed explicitly: "Eating too much greatly compromises memory, and so does excessive drinking, and foods that are hard to digest: bovine meats, hard-boiled eggs, and the like. They either produce bad humours, or they fill the head with damaging vapours. Other than this, sleeping too long, staying awake for too long, excessive heat or cold, and everything that is extreme: like strong passions, and the pleasures of the flesh": Dolce, *Dialogo*, 28.

ing the printing press as a way to improve society as a whole. Della Porta instead, because of his abiding interest in topics such as magic and natural science, could not enjoy the same delusions of harmony and fought censorship in the name of his beliefs.

## Embodiment in the memory palace

The body and the senses are present in several ways in the art of memory. Firstly, cognition is localized in the body: all memory manuals of the time follow the Galenic-Aristotelian superimposition that attributes knowledge mostly to the workings of the brain.[21] In this diagram, memory occupies the last chamber of the Galenic three-part brain, which is usually the scheme used by memory manuals to describe it. Moreover, the body is a source and repository of mnemonic tools, able to give way to devices like the famous Guidonian hand.[22] However, the least obvious sign of embodied cognition is the most significant here. While the explicit involvement of the body is of interest in itself, what is peculiarly visible in Memory Arts manuals, making them such precious documents, is the role of bodily stimuli in determining even the most "internal" processes of the mind.[23] The whole body, from sensory organs to the heart and veins, is seen as a system – it participates as a

[21]  For an analysis of this shift, see Piro, "La semplificazione dei sensi interni", in *Il Retore Interno*, 123-129.

[22]  The memory palace is but one, although the most complex and articulated, possible use of *loci* and *imagines*. Its efficacy is testified already in the pseudo-Cicero of *Ad Herennium*, who describes the technique almost verbatim to the Renaissance authors. He suggests crafting vignettes (famously, the man holding a ram's testicles to remember the presence of two witnesses, a truly memorable example), ordering them onto imagined/remembered architectures. In the Middle Ages, however, when these techniques were appropriated by monks and embedded in religious practices, their spatial character was utilized in various ways. For example, Carruthers (*The Craft of Memory*) describes pathways of meditation embedded in church decorations, as well as manuscript illuminations that were meant to be "folded" in one's mind to make them tridimensional ("Two Unusual Mind Diagrams in a Late Fifteenth-Century Manuscript"). Other applications of the technique of place-memory can be found in the use of the body as "holding" structure for images, instead of the palace. The Guidonian hand is the most famous such instance, but in both Medieval and Early Modern texts, examples abound of this use of the body: from the placement of entire and structured images (like in Peter from Rosenheim) to that of symbols and letters (like in Marafioto's *De arte reminiscentiae*). In this essay, I will mostly engage with the memory palace specifically. As alternative naming, I will use "*loci*-system" to mirror the lexical choice in my corpus, and I sometimes use "local memory" as a rough translation.

[23]  "We witness that naturally, whoever wants to remember a long event, they always try to remember, first of all, where that event took place, and then recounts the event following the order of the places where it happened": *Arte del Ricordare*, 62. "Because too small a place cannot contain the image; but one that is too big would distract the sight, and the Mind as a consequence, which in turn attends to Memory, which is funded on the senses": Gesualdo, *Plutosofia*, 20r.

cohesive unit to the cognitive work.[24] This conception was not easily viable in theory any more: the process of concentration of cognition that had brought a very diffused system to a one-chamber brain in the course of three centuries had almost come to its end.[25] However, the old theories held their place in the Memory Arts' practices, which were derived from a tradition that informally passed down techniques on the basis of their effectiveness – not of their theoretical soundness. Perceptive stimuli were thus the centre around which memory techniques were arranged. Allowing the body to perceive, and to do it with ease, is in fact fundamental to the functioning of the Arts.

Such an approach does not falter in the Renaissance, quite the opposite: we witness a particular focus on the body in one technique of the Arts, the *loci*-system technique, especially in its manifestation known as the memory palace.[26] If learned properly, the memory palace promises to expand one's memory considerably and with relative ease. The *loci*-system consists in translating concepts and words into images, called *imagines agentes*, by virtue of personal association. Such images are then arranged onto ordered spaces, often architectural in nature, called *loci*. These span from the human body, to palaces and churches, to the entire order of the universe. These *loci* (referred to as *loci communes*) are subdivided into sections, each signposted with a specific element -an elbow, a window, a *girone* of hell- (called *loci particulares)*. These ordered spaces, fixed in our memory either by familiarity or by precise hierarchies, keep the *imagines* in a chosen sequence and in precise relationship to each other. This technique combines and exploits two cognitive mechanisms: the *loci* employ our natural tendency to remember physical places and paths to keep a stable order; whereas the *imagines* utilize our ability to remember visual stimuli with an emotion attached, rather than disinterested lists.

Premodern Memory Arts manuals included directories of precepts on how to best craft *imagines agentes* and *loci*. On top of that, typical of these Late Renaissance manuals are lengthy discussions listing the various options emerging from different traditions, with subsequent reflections on which characteristics were indeed the most useful, and comparisons of different acquisition methods. These discussions are a rich basis on

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[24] Petrus from Ravenna in his *Phoenix* adds to classical rules of memorization "Some innovations, dictated by his personal experience rather than by a theoretical research". Matteoli, *Il Rinascimento Italiano e l'Europa*, 394.

[25] For example, Thomas Murner, in his *Logica Memorativa* (1507) portrays logic constructions through human figures interacting with several perplexing objects, such as flying fish and scorpions. An explanation of his mnemonic system for logic can be found in Ong, *Ramus*. Gesualdo's *Plutosofia* offers a model for a human body to be used for *loci*. And Piero Veglia in 1626 writes a *Computo Ecclesiastico Sopra le Pieghe e Nodi delle Dita,* where he teaches how to calculate the liturgy calendar's days through complicated distributions on one's hands.

[26] "The figures, and images should be proportionate in height, so that the eye does not get strained in trying to look too far up, in order to see them; nor in lowering the gaze too much to contemplate them": Gesualdo, *Plutosofia*, 47v 48r.

which to explore the time's shifting theories. Across the board in fact, *loci* and *imagines* are deemed most effective when they mirror the natural predispositions of the human mind:[27] therefore, these precepts, and the conversations accompanying them, grant a view of the time's common beliefs on the nature of cognitive functioning. Moreover, this view has an empirical character, required by the Memory Arts[28] and amplified by the practical nature of the manual; but still quite troublesome in the context of an encyclopedic expansion of the genre that involved explicit reference to "official" theories. Thanks to this expansion, in fact, the practical and theoretical sides of this discipline are pushed to co-exist: but at that time, a mediation between experiential observation, and the philosophical and scientific knowledge, is still debated.  For this reason, often points of tension coincide with the passages in which the fundamental role of the senses is explicitly stated for the creation, the use, and the efficacy of mind-images necessary for the Memory Arts.

Any reader of Memory Arts manuals will be intrigued, entertained, sometimes even troubled, by the illustrations and descriptions present in these books. The forefather of the genre, Peter Ravenna's *Phoenix*, famously invites the use of naked women as *imagines*, and other manuals like Nicolaus Simonis', *Ludus Artificialis Oblivionis* (1510) use human-shaped monsters that would compete with the most nightmarish creatures in a Jeronimus Bosch painting.[29] Entire sections of these manuals describe mechanisms for forming images so as to make them striking -thus memorable. Depending on the item to remember, which could be a concept as well as a single word, one might attach to it a vignette or a single object in the designated space; even, as Della Porta describes, headless geese and doves (89). Importantly, though, whatever is represented should not counter the rules of human perception -or strain the senses.[30] Therefore, a figure of excessive size, like a tower or a mountain, cannot be placed inside the mind-palace, with-

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27  "If things are excessive, we have to either imagine them smaller and proportionate [to the *loci*] with the force of our mind; or, keep the essence of the thing, without paying too much attention to the size; or else (which to me seems the best solution, and the most secure) we can put in that place the image of some artificial painting or sculpture portraying that thing. For example [...] a house, or a mountain, or a big tower": Gesualdo, *Plutosofia*, 34v.

28  "About the quantity and size [of the memory images], they must not be (as said for the *loci*) small, because small things do not move others and are not possible to see well or at all (the way geometrical points, atoms and such things are; since they are so small, that they barely move the senses). And similarly, they will not move fantasia enough": Dolce, *Dialogo*, 89.

29  "Measure the place through a man of good stature, with his arms stretched out, so that you can get the size from his height and from his width (right to left). The place should not be taller than what the hand of a standing figure could reach; and it should not be taller than a standard man": Dolce, *Dialogo*, 60.

30  For a thorough description of the precepts from antiquity to the Early Modern, see Merino Jerez, *Retórica y artes de memoria*, 57.

out creating confusion. It is advisable to substitute it with a representation – a painting, for example.[31] Conversely, a single ant will be difficult to spot: it is better to place a multitude of them, or to have an ancillary figure point at the single ant, or be bitten by it.[32] The ideal size of a *locus*, and of the *imagines* there included, is that of a person with their arms stretched out.[33]

Likewise, the characteristics of the *loci* are meticulously listed in terms of their ease of perception.[34] Della Porta insists that the *loci* be well-lit and "risplendenti" (shining) (63), in order to facilitate distinguishing pictures and figures, their outline and colour.[35] Conversely, the others (consistent with the majority of the tradition from the *Phoenix* on) warn the reader of the risks posed by an excess of brightness, as well as by excessive darkness, which impede clear perception of visuals, overwhelming the senses. A dimly lit environment, for them, is thought best to make the task easier on the mnemonist. Similarly, the distance between *imagines* is also taken into consideration and regulated. They need to be far enough from each other for the figures to be distinct, but not so far that they would strain the viewer having to keep them in the same mind-space.

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31  "A dark place is not right for this art, because it buries, covers, and blinds the image. Conversely, an image in an open space becomes too bright for the eye, because of the excess light, and the eye itself is darkened when looking at it, unable to contemplate it clearly and comfortably. Similarly, the mind cannot effectively grasp, nor memory can show, an image upon which an excessive light is cast": Gesualdo, *Plutosofia*, 16v.

32  A little further he adds: "In the corners, however, experience teaches me that *loci* can be only two feet apart; and it is necessary that we place some kind of separation between them". *Ibidem*.

33  "When you are designing particular *loci*, make them face each other: so that standing in the middle, you can see both of them without turning your head [your eyes] around too much": *ibid.*, 28v. Whether this turning movement is performed with the whole body, walking around the room, or just with the head standing at the door, it changes from manual to manual, but it is usually specified.

34  "In this we will follow Peter Ravenna's suggestion: that is, moving from the left side, we follow the Sun's path going towards the right-hand side, forming with our thought the loci with the same order that we would use to write letters: this is the best way to do it": Dolce, *Dialogo*, 66. This metaphor, as we will see later, mirrors that of the mind as a *tabula rasa* imprinted by the seal of the senses.

35  "And I believe that the reason why our memory presents items from the right-hand side, as well as from the opposite one, is the following: because [our memory] does not follow the order imparted by the movements of our feet, but that derives from seeing the objects with our eyes. These items in fact are not only ordered first to second to third and so on until the last one; they can also be seen from the last one back up to the first. Therefore, once we order the *simolacri*, a sensory-based memory can present the items in one sense or the other, with no effort. Just like the eye can scroll through items in a right-to-left order just as easily as it does left-to-right": Gesualdo, *Plutosofia*, 19v.

It is good to keep a five feet distance between loci. Truly, Cicero wanted these places to be medium-sized, that is, around thirty feet. But Petrus Ravenna claims that the space in-between loci needs to be five, or even six, feet. And in my own experience, this opinion is the most useful. Because, if the interruption is too wide, mental application is less effective, since additional distance has one spending too much time walking around; just like the eye that, in reaching to things that are too far, risks losing them, because the rays that tie it [the eye] to the object, get scattered around. Conversely, an excessive proximity mixes the images and confuses them, because distinction becomes hard; just like letters that are written too close to each other do not let us read [aloud] with ease.[36]

The ideal, as Gesualdo specifies, is that figures would be at an even distance (predictable), still close enough to permit one to see them all just by turning their head around.[37] The same holds for the order in which these places are reviewed. Some, like Dolce, maintain that the order should be from the left-to-right, thus recalling the metaphor that equates the act of creating *loci* with that of writing:[38] others, like Gesualdo, reclaim the profoundly oral and visual character of the discipline, which keeps order of placement distinct from the sequence of processing.[39] For the same reason, the various spaces that are used as *loci*

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[36] Dolce, *Dialogo*, 59. Without going deeper into the formative role of Platonic images, even in the Aristotelian camp it was difficult to achieve a balance between senses and cognition, as Spruit explains: "The ontology of the intelligible species, and its consistency with other endorsed views were hardly ever addressed issues. […] The basic tension underlying these observations is hard to solve: intelligible species are produced on the basis of physically grounded sensory representations; and yet, they are received by an immaterial mind": Spruit, *Species Intelligibilis*, 6-7.

[37] For a reflection on the theories and practices of the chimera as an inner process of combination and/or invention, see Swan, "Counterfeit Chimeras: Early Modern Theories of the Imagination and the Work of Art". In Payne, *Vision and Its Instruments*, 216-237.

[38] "Many say that you need to craft *loci* out of solitary and empty places; but based on our experience, we disagree, and also based on the authority of Peter Ravenna. According to him, it is enough if we see the buildings (in which we have to craft the *loci*) devoid of crowds only one time": Dolce, *Dialogo*, 64. As opposed to Gesualdo: "Let us form the Places when the weather is cloudy; or, during those hours, when the day darkens at night, or when it is just getting brighter in the morning. And let us forever remember them like so, as we saw them the first time we formed them": Gesualdo, *Plutosofia*, 17r. In this quote, it is also possible to imply that the formation of the *loci* happens at the same time as their sensory experience.

[39] "Peripatetics consider sense perception as a process delivering information to be selectively used by the mind. Before making effective use of this information, the mind has to transform it: in the abstraction of an intelligible species the active feature of mind ('intellectus agens') provides the knowing mind, which is also a mental record ('intellectus possibilis') with a cognitive content transcending the content represented by sensory images. Only after the reception of the intelligible species, concept formation and discursive reasoning are possible": Spruit, *Species Intelligibilis*, 8.

*communes* (usually the edifices containing *the loci particulares*, that is, the signposted spaces where individual *imagines* are placed) need to be contiguous. An interruption in the mental walk and in the visualization it elicits, inevitably breaks the spell and hinders the capacity to remember and connect. The connection between bodily sensations and mental processes is, in short, essential rather than strong.

## Embodiment in practice: the loci problem

The visual aspect is crucial for the art of memory, but vision is not the only sense that is present and important. Because of this, there was tension between, on the one hand, a heavy reliance on sensorial stimulation; and on the other hand, a more theoretical horizon in which the senses had but a limited, and controversial role to play, in the workings of the human soul.[40] While the emergence of such themes is not surprising, given that philosophers and theologians were busy with them as well, the same cannot be said of what resulted from this reflection centered on *memoria*. Aristotelian claims regarding the sensory origin of all knowledge are in fact thoroughly upheld. However, there is division over whether and how mind-images are derived from direct experience, or rather from the successive workings of the inner senses, especially imagination (*phantasia*). This oscillation is visible in multiple ways: from questions on how combined images can exist,[41] to discussions on whether it is necessary to first see the edifices empty, in order to use

[40]   Bolzoni's observation on how this metaphor changes with the advent of the printing press is very insightful: "These are obviously not neutral metaphors. The art of memory changes deeply, in a fruitful interaction with the realities created by technologies of writing first, and of the printing then. [ … ] It is significant that the most explicit testimonies of such changes are found in people like Dolce, literati who work in close contact with publishers and printmakers": Bolzoni, *Memoria e Memorie*, 16.

[41]   As Renaissance scholars start to approach the cognitive sciences, interesting reflections emerge. During her exploration of Rabelais metaphoric language, Banks finds a concept in cognitive neurology that can help explain the different levels of embodiment these Memory Arts authors refer to: "Experiments carried out by Rutvik Desai and colleagues strengthen the view that to understand relatively unfamiliar action-related language we use a relatively detailed simulation, whereas, as conventionalism increases, our reliance on sensorimotor systems is reduced. These findings contribute to a 'graded view of conceptual embodiment,' according to which conceptual representation consists of multiple levels of abstraction from sensory, motor and affective inputs. The top level contains schematic representations that are highly abstracted from detailed representations in the primary perceptual-motor system; these are sufficient for adequate and rapid processing in highly familiar contexts. By contrast, in novel contexts, or when the task requires deeper processing, sensory-motor-affective systems make a greater contribution": Banks and Chester, *Movement in Renaissance Literature*, 85.

them as *loci*, or if it is enough to imagine them as such.[42] As a consequence, in the description of practices and exercises, while in some cases the senses are so present that they seem to linger well after the generating moment, some other times they are relegated outside the "headspace" of cognition entirely.[43]

By comparing these three works, however, some distinct tendencies emerge. As is already visible in the previous section, *loci* and *imagines agentes* respond to different principles. Going back to an ever-present metaphor of the genre, the *loci* are like the blank paper onto which the images are inscribed like writing.[44] The *loci* images thus need to be as neutral as possible, permanent, and reliable, like paper (or wax, or parchment). Whereas the *imagines* have to mimic the ink, and be stark and distinct enough to mark the page. In other words, *loci* need to be assimilated like a background, i.e., always present, but not requiring too much attention to unfold. Conversely, *imagines agentes* need to hit the imagination as hard and quickly as possible, in order to be memorable and unequivocally connect to the designated concept, word, or sentence.[45]

Despite their different goals, the instructions on how to "form" images for *loci* and for *imagines agentes* are at times so similar, that reading the later sections gives a sense of déjà vu. However, a closer look reveals some meaningful distinctions. In all three manuals, in fact, the sections pertaining to the *loci*, compared with those pertaining to the *imagines*, are more explicit in suggesting that direct experience is necessary to provide working memory images. For example, Della Porta, the most radical of the three in affirming this necessity, insists that the senses need to be responsible for the *loci* images,[46]

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[42] "When choosing this universal place it is necessary to abide by certain conditions. First, that we inhabit or frequently find ourselves in this place and that we know every last part of it. Let travelers choose for themselves the place where they were born or where they have had some pleasurable experience, because these places often remain impressed in our memory more than others": Della Porta, *The Art of Remembering*, 93.

[43] "Even admitting into the discipline these *personae*, I say that they are analogous to the places (*loci*): since they are formed to support the *imagines*, as usage will make clear; by contrast, the *personae* that are placed daily and that are movable, are analogous to the *imagines* [*agentes*]": Gesualdo, *Plutosofia*, 22v.

[44] "As observed by Aristotle [...] Imagination does not comprehend a similitude that is not proportionate to the thing we have to remember: since there is nothing that can go through fantasia without going first through the senses; and the object that transcends, damages the senses": Dolce, *Dialogo*, 90.

[45] "Our imagination and fantasia thus follow mostly what our external senses apprehend, as the Master said, and as long experience teaches": Dolce, *Dialogo*, 62.

[46] "The faculties were located in the ventricles of the brain [...] around which the 'animal spirits' circulated [...] The data arriving from the external senses (sight, hearing, taste, touch, smell) were unified by one of the internal senses, the 'common sense' (*sensus communis*), which activated memory as well as the active and passive imagination (*vis imaginativa, fantasia*). On the basis of the sensory images thus generated, the intellect derived through abstraction universal

but not necessarily for the *imagines agente*s, which can derive from literature, religion, or any other story.

This sharp contrast in Della Porta's treatment seems to suggest different paths to memorization depending on the goals. The author does not indulge in explanations, and we as readers are left to hypotheses. The job of remembering places, which is recognizable in animals too, could pertain to a lower level of intelligence, to the Aristotelian *anima sensitiva*, needing an embodied experience. Conversely, the formation of mental images through imagination had been at the centre of philosophical debates for centuries. As a result, while the *imagines* were undoubtedly a slippery ground for theoretical speculation, the *loci* could enjoy some wiggle room to present a different idea of cognitive processes that would not necessarily interfere with the tradition.

However, Della Porta pushes his ideas (and his fate) further, even though mostly between the lines. Indeed, he seems to suggest that the processes of memorization needed for the *loci* could be applied to the *imagines* as well. In a later passage, he proposes to populate his *loci* with human figures (*personae*) not in the role of *imagines agentes*, but as an ulterior technique of memory anchoring: the chosen people will then populate the *loci* in neutral form (naked, in a passive pose). Every time that the mnemonist uses the memory palace, they will clothe, position, animate, in a theatrical way "direct", these figures, and make them interact with objects. In this "mental puppet theatre", as Bolzoni defines it (*Memoria e Memorie*, 3), Della Porta strips the *imagines agentes* of some more metaphysical trait: he shifts the universally recognized mnemonic power of human figures in action, the *imago agens* par excellence, towards the fixity of *loci*. In doing so, he also claims for these figures the same characteristics of familiarity he deems essential for the *loci.*

> In the aforementioned places [*loci*], we will situate some people whom we know well, and not whomever we come across or dream up ["come to our *fantasia*"]. We will choose our dearest friends, ten or twenty beautiful women whom we have loved or revered, and others, ridiculous people such as fools and the like, and we will mix them with matrons, noble persons and lowly persons, with young boys and girls and others, and make a mixture of them. It is necessary to know the habits and deeds of all these people fully, along with the things that have happened to them, especially cheerful things. … If we cannot come up with a good number of these, being poor in friends, we will fill the places with common people, reserving every third or fifth place for one of these, so that the memory can stop at them and rest as it tires.[47]

concepts which enabled us to understand the objects perceived; it also carried out its other specific operations, such as subdividing and combining, distinguishing, inferring, deducing, and choosing": Vidal, *The Sciences of the Soul*, 33.

[47]  Della Porta, *The Art of Remembering,* 97. See also Piro, *Retore Interno*, 126: "At the beginning of the 16th century, scholars in Paris were mostly inclined to the maturing doctrine, according

We do not know whether Della Porta believed in a different acquisition of *loci* and *imagines*, or if he believed in one same embodied process, but was allowed to express this belief only regarding the *loci*. In any case, he is not alone in these oscillations. Gesualdo agrees with his statements: Della Porta is one of his main sources of inspiration.[48]

> From this principle we get this art's method, which aims as making us easily remember sentences, or words, through sensory supports. In the end, the imaginary *loci* are onerous; because memory is doubly burdened, because of the *imagines*, and of the *loci*; whereas, if we have stable *loci*, formed by the senses; the only effort, is that of inventing and placing the *imagines*. [ … ] Since in this art we aim at conferring tenacity and vivacity upon our memory, with the utmost ease: therefore, it is very beneficial, leaving aside imaginary places, and artificial, to form instead in our memory real *loci*, natural or man-made, that we have seen, and understood through the senses, which are the origin and the foundation of the *simulacra*, which pass through the inner senses and come to reside in memory.[49]

Hence, Gesualdo also proposes the necessity of first-hand experience for the formation of the *loci*, offering reasons and details to support this principle. In particular, he justifies this choice of *loci* as a way to unburden the memorizer's mind, already crowded with *imagines*. It is noteworthy how, while sustaining the same radical principles of Della Porta, he does so with a very different attitude, careful to keep his rules within the limits of what is acceptable. He fully uses the manual genre's flexibilities here, in invoking practice as a deciding element, and in cherry-picking his theoretical references. He also takes care not to exclude alternative possibilities to first-hand *loci*, if determined by necessity or preference. This reassuring approach, Gesualdo's belonging to the institution of the Church, and his working actively for a pro-Trent enterprise, made his statements less potentially inflammatory than those of his colleague Della Porta. Therefore, a few pages later, while discussing the formation of imagines, Gesualdo can write:

> Above all, try to have images from things that are known to you, as familiar as possible. Thus, if you have images from real things, stay away from using fabricated ones; and if you have images from things you know, stay away from the unknown ones.[50]

to which there was only one inner sense. Among Italian Aristotelians, influenced by the Greek commentators [Alexander of Aphrodisia, Themistius, etc.] and in general by philological work on Aristotle's texts, the tendency is the same: but the problem of differentiating *Sensus Communis* and *Phantasia* remains".

[48]   "There can be nothing imaginable, that is not also sensible": Dolce, *Dialogo*, 90.
[49]    Gesualdo, *Plutosofia*, 12v.
[50]   *Ibid.*, 48r.

Gesualdo is here endorsing the deep embodiment Della Porta suggested, and pushing it further: he expands it directly into *imagines* territory. This time he does so *in passim*, within a list of miscellaneous rules, thus not as boldly as in the *loci* section.

We understand the importance of such operations when we compare them to Dolce's text, true to Romberch's original, more plain and conservative. His section on *loci* is, of the three manuals, the least insistent on realism in the mental imaginary. Even though he quotes the Aristotelian primacy of the senses in theory,[51] and even though he insists that the senses are the origin of imagination,[52] he then proceeds to ignore, or water down, these premises. In the practices he proposes, for *loci* and *imagines* alike, he keeps suggesting that imagination is suited to the task alone, not needing the support of an active and experiencing body for memorization. In clear but fruitful contradiction, on the one hand he echoes the others, predicating the necessity to "anchor" images to sensory perceptions and experiences, especially for the *loci*. On the other hand, Dolce still maintains the use of entirely imaginary, i.e. not experienced, settings and images:[53]

> Some places are common property, some are private; either way, they can come from nature or be constructed, that is, formed by our thoughts; since we can form *loci* that we never saw

[51] "Therefore, even though this Renaissance allegorical model initially seems oppositional and centralised, there is a complex division of the self into a mass of internal agents, who operate through a coalition of quasi-independent animal and natural processes, and on which reason is dependent. In addition, these agents do not share unified purposes, connections with, or perspectives on the world since they operate on different levels of an epistemological and ontological hierarchy. The assumption of a centralised controller, with which the kingdom model appears to begin is resisted by the recognition of the multiplicity and dispersed nature of the mind…": Anderson, *Renaissance Extended Mind*, 90-91.

[52] Vidal briefly and effectively explains the baseline of the many variations on this doctrine: "The faculties were located in the ventricles of the brain (hence the name of 'cell theory') around which the 'animal spirits' circulated. They were interlinked in accordance with the principle that *nihil est in intellectu quod prius non fuerit in sensu*, that nothing is in the intellect which was not previously in the senses. The data arriving from the external senses (sight, hearing, taste, touch, smell) were unified by one of the internal senses, the 'common sense' (*sensus communis*), which activated memory as well as the active and passive imagination (*vis imaginativa, fantasia*). On the basis of the sensory images thus generated, the intellect derived through abstraction universal concepts which enabled us to understand the objects perceived; it also carried out its other specific operations, such as subdividing and combining, distinguishing, inferring, deducing, and choosing. Scholastic psychology in the seventeenth century focused on the acts of the sensitive and intellective faculties in man": Vidal, *The Sciences of the Soul*, 33.

[53] "We can, in our mind, imagine further places from what we have so far described: things that do not exist, fake and imaginary, which have in their part some likeness to the real ones. In the same way that we imagine a mountain made of gold because we have seen mountains and gold, so the parts of different animals, which we deem familiar, we compose into the Chimera": Dolce, *Dialogo*, 69.

or heard of, based on those we know in reality. Just like the ones that never existed, nor do they exist today, nor will they ever exist in any other place than in our imagination. And that this is easy to do, it is demonstrated by the work of the architects [builders], who, when ordered, produce beautiful and proportioned buildings, which they never saw before.[54]

Let us go inside and outside (the places), for how much our imagination allows; and let us notice, among the imaginary things as well as among the real ones, what there is (that is, outlining the walls, the entrances, the doors, etc.): this we can do from outside. And if we wanted to also consider the inside of the building, through our person or our *fantasia* (whichever works best for us).[55]

In other words, while *imagines* can be created by our mind or by other people's, this is not always true with the *loci* for all authors. In fact, while Dolce concedes such possibility and even encourages it, Della Porta denies it vehemently; he insists that *loci* need to be experienced first-hand. Gesualdo leans toward Della Porta's position, but also recognizes the option of fabricating places, too. The fact that this disagreement emerges during the discussion of the *loci*, and not of the *imagines*, is noteworthy. Differences in scopes and structure can ignite a reflection on the origin of mind-images: recognition or denial of such distinction, and to what degree, depends in most part on the author's ideology. *Loci* and *imagines agentes* thus are either presented as pertaining to the same mind-forces, to the same inner-sense mechanisms; or else, they reflect two specific processes, relying on different relationships of the inner and outer senses. In both cases, the seed of doubt is planted: is direct experience necessary for knowledge? What is the cognitive role of this powerful grounding into memory provided by one's own embodied experience and attachment?

## Theories and embodiment: three strategies

In every manual, the way internalization and anchoring worked, both in the case of sense-derived *(loci)* and in that of book-derived knowledge (*imagines agentes*), depended on a system of beliefs that combined the time's theories with the practical approach required by the Memory Arts. However, it is not easy to parse out the composition of this system. What is striking is not that outer- and inner-senses would give origin to reciprocally comparable, or even identical, entities. The tradition maintained the idea that sensory perception entered the *Sensus Communis* chamber at the front of the brain, where perception was collected and experienced more or less radical transformation through the inner

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54    *Ibid.*, 37.
55    *Ibid.*, 71.

"faculties" of the mind (or *inner senses*).[56] Thus, it was normal to talk about images travelling from the senses to memory through the various faculties, and then being recalled for reuse and modification. Rather, it is significant how, while treating practices that insist on the distinction between sensory- and intellectually-generated sources, these authors tend to avoid engaging in explanations that bring to the fore the full theoretical consequences (including heresy) suggested by such insistence. This problem, in other words, is acknowledged, but not entirely and clearly developed to explain the multiple processes of memory, despite all three authors being educated in this realm.

It is not, I would argue, a lack of education motivating such theoretically unsatisfactory treatment. Instead, based on a comparison between the three manuals in context, I consider silence, confusion, and compromise, as choices preferred to theoretical clarity. Choices made for survival, surely, as Bruno will learn the hard way soon thereafter. But I argue that this is also a form of negotiation, which allows the Memory Arts to continue to function through multiple contrasting systems of thought. On the one hand were the traditional theories of mind, which allowed for a flexible exchange between senses, thoughts, and mind images. This framework, however, could not explain why some images are internalized more quickly or more solidly than others, and what role the senses play in this equation. On the other hand, new theories emerged in philosophy departments from Padua to Paris. These posited a simplification of the *inner senses* system (from various reductions to a one-chamber brain with unified stimuli),[57] which would give more coherent and unified explanations on the foundational role of the senses in the cognitive system. Such a move however needs inner unity: they so postulate, and thus require, a coherence that was never before needed. One of the consequences of this passage is the confining of sensory interventions to "outside the head": sealing them into the world of matter. Both frameworks (the traditional and the new, the multiplicity and the unity) need to be active for 16th century Memory Arts to stand theoretically. Yet the mediation at the time was far from easy – especially in systems, like academia and post-Trent Europe, that did not aim at reconciling contradictions, but rather at resolving them.

Here the contrast between Dolce's slipperiness, Gesualdo's attempts at normalization, and Della Porta's relative intransigence, can be illuminating. While the latter chooses to

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56   I here kept both the vernacular and Latin where significant. I know it is a bit messy, but the oscillation between correspondence and distance between the two languages is telling of the manual's appeal for theoretical relaxation. In Sirri's edition of the original Italian, this is also on page 57.

57   Reflections on these metaphors are common among scholars of the Memory Arts. Carruthers's chapter "Models for the Memory" (18-55 in *The Book of Memory*) explains the most common metaphors active in the Middle Ages, especially those referring to various kinds of containers (the treasure chest, the satchel, the arca … ). Both Luis Merino Jerez, *Retórica*, 55-61, and Seth Long, *Excavating*, 58-81, instead, focus on the value of writing as a metaphor.

be coherent regarding sensory perception as an origin of knowledge, the other two are not as consistent. Their theoretical explanations tend to be recursive rather than clarifying; this is as typical of the time, as it is strident, especially in an author like Gesualdo, whose awareness of the problem clearly appears between the lines, and even, at times, within them. As an almost inevitable consequence, they do not always cohere in their own theoretical explanations, leaving room for perplexity and doubt. Most importantly, their theory does not always cohere with their practice, with the techniques they recommend. In these cases, looking at the practices can be revelatory of un-theorizable mechanisms that were nevertheless accepted at the time. Not only that, it can also help to understand the rhetorical strategy of the author in mediating between official theory and working ideas.

## Dolce's strategic confusion

While the original author of his text, Romberch, wanted to express his political and theological beliefs, Dolce did not desire to, and could not afford to, clash with any authority. His strategy was thus one of suggestion and accumulation. In this excerpt, for example, Dolce insists on the different nature of the matter of memory from that of the senses, right before declaring, as we saw, that imagination and senses are connected:[58]

> Because, just like the image in a seal ring remains in the wax, but the matter of the ring does not, so memory as well receives from the senses (through the sensitive faculty) the image (*somiglianza*), that is, the representation (*dipintura*) without its matter. Therefore, memory is not employed on the thing itself, but rather on its image.[59]

Dolce's theoretical oscillations are reiterated throughout his book; the practices he suggests reflect this, but are inclined rather towards the prevalence of the inner over the outer senses. His form of coherence is thus one of nuanced preference, which allows him

[58]  This metaphor is a re-proposition of that dominating Aristotelian theories of the mind, which saw the latter as a neutral place where significant signs would be impressed: "Sense data are impressed, whereas intelligible species are not. Sense data theorists were in the grip of a powerful but ultimately misleading metaphor: the mind as a *tabula rasa* upon which the objects of the physical world leave their imprint". Memory in this instance acts as the particular *place* in the mind that receives these signs; and similarly, theorizing about this is complicated by the fact that sensory input is not the only dataset that memory processes: "The classical doctrine of intelligible species, on the other hand, claims that sensory information is qualitatively processed by the inner senses and the agent intellect; this information is just not 'impressed' upon the mind": Spruit, *Species Intelligibilis*, 15.

[59]   Dolce, *Dialogo*, 86.

to hold together the visual creativity of the Memory Arts with their moral pursuit, their necessity of sensory experiences with a strong reliance on an entirely book-learned system of references.

Dolce's confusion is telling: Aristotle's affirmation of the experiential origin of knowledge indeed serves the purpose of the Memory Arts, in some of their parts; while it is an impediment in understanding other parts. Recuperating the original message of the Philosopher, thanks to the time's philological approach, was not a solution for this branch of knowledge, because it would contribute to minimizing, or even eliminating, the ambiguities. Conversely, the tradition of *inner senses* and brain-chambers that emerged around Avicenna's and, especially, Averroes's interpretations, allows for more nuance and, even, fruitful confusion. In other words, the complex and stratified system composed by the body and the inner senses[60] could be a limitation and a frustrating tool for some, but in this, and many other cases, it is a resource as well. The blurred boundaries of many different faculties' tasks, as well as in their superimpositions, allowed the coexistence of opposing priorities with respect to human nature. Moreover, Romberch could stand by his text, which he stated as viable for a generalized public, but that was mostly aimed at knowledgeable, academically-minded people who could argue against him. Dolce's use of this philosophical language instead sounds different. In his book, explicitly written for a large and non-academic public, the heavy philosophical discussion is rendered in an imitation of orality (it is a dialogue, after all) that, rather than making things more legible, covers the contradictions. In a discipline like the Memory Arts, moral and sensory tasks converge, which is especially true in Dolce's case (and Romberch's before him): he insists on this double nature of the art, able to bring intellectual and moral betterment to the readers. It is thus useful, for him, to forego consistency in favor of accumulation.

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[60] "Hylomorphism persisted, however, particularly in the university. […] As far as the concept of soul was concerned, the 'mechanized' vision of the universe and the explanation of physical phenomena in terms of the movements of matter played a major role in dislodging the Aristotelian definition. The rejection of 'qualities' and 'forms' in the natural realm entailed the rejection of the idea of souls in animals and plants. When René Descartes (1596-1650) banished the soul from nonhuman living beings, he performed one of the most radical acts to emerge from the mechanistic reform of natural philosophy in general, and physiology in particular. […] From an ontological point of view, however, this distinction persisted. The objects of Aristotelian and post-Aristotelian psychologies were different: the soul-form and the soul-mind, respectively. For post-Aristotelian psychology, the human being was indeed a union of two substances, but these substances were joined in a relation quite different from that of form to matter. The union of the body with the soul therefore emerged as problematic, beyond the terms of hylomorphism": Vidal, *The Sciences of the Soul*, 74-78.

## Della Porta: wise omissions of a humbler Minerva

At first glance, these manuals follow the traditional doctrine of the *inner senses*, distributed through a physiology arranged after Galen's rule.[61] The diagrams and the explanations accompanying these books show the path of images and thoughts from the *Sensus Communis* at the front of the head all the way to Memory, housed in the farthest chamber at the back of the brain. Medical advice also focuses on this position of the memorial faculty, targeting the area above the nape for compress application and healing movements. However, while the "first entry" of what will become memories is clear in its trajectory (often echoing the Aristotelian *thauma* principle, according to which wonder is the first motor of knowledge), less clear are its successive uses after storage; not to mention in the creation of new ideas and Chimeras.[62]

For instance, as just illustrated, Dolce foregoes strict theoretical coherence. He reassures his reader that his was not meant to be a philosophical reflection, but offers some authorities to provide the comfort of approval for the practices described in the book. Thus, right after having declared Aristotle's truth, he pivots to an inner-generated array of images. These are not only based on, and originated by, but also interacting with, the derivation of sensory perceptions – as if there was no substantive difference. Conversely, Della Porta operates a courageous choice, which he explains swiftly, almost unnerved:

> We shall explain what each of them is [memory and recall] in a style that calls upon a humbler Minerva, so that our rules may be clearly understood. We shall leave off the diverse and difficult opinions of the philosophers who have written on this topic, because this is not the appropriate place for such an analysis. [63]

He is working here in both an offensive and defensive mode. In fact, he calls the opinions of philosophers "difficult", which deems them unviable for a non-specialist text. At the same time, he proposes a description of the cognitive operation, which he protects

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[61] "[ … ] Thus, the seal bestows characteristic of singularity, which then assigns it to the Senses and not to the Intellect; and so Memory pertains to the sensitive faculty, and not to the intellective. And I answer you, that singularity is not exclusively pertaining to the senses, but it can regard the intellect as well; this one in fact is not so restricted to knowledge of the universal, that it cannot know the singular. And therefore, the intellect preserves the object with its contextual actions, and times. Thus, not just in the sentient, but in the intellective part also there is Memory": Gesualdo, *Plutosofia*, 7v.

[62] As Baldriga also states in *L'occhio della Lince*, 133.

[63] Della Porta, *The Art of Remembering*, 89. On Bruno, see Matteoli, *Nel tempio di Mnemosine,* 2019 e Canone, "Phantasia/Imaginatio nella lessicografia filosofica", in Centro per il Lessico Intellettuale Europeo, ed., *Phantasia/Imaginatio*, 239. On Camillo, the main work is still Bolzoni's *Il Teatro della Memoria* and her introduction to *L'idea del Theatro*.

from accusations by stating it as a rough simplification. The lack of complexity thus, and not the content *per se*, is at fault here:

> Like an excellent painter, the imagination [*imaginatio*], which is located in the head, has the power through its many windows [*speculis*] – the eyes, the ears, the nose, and the other senses [*reliquisque sensibus*] – to create a portrait of material things [*hausta rerum sensilium simulacra*], and uses its brush to sketch in the memory, which stands like a canvas before the imagination. So, when we have the will to remember something, we remember what we want through the intellect, which promptly goes to the memory [*intellectus ope, qui illico ad memoriam occurrens*] and there contemplates that ideal painting [*idealem picturam*], as if it were present before our eyes [*ac si prae oculis essent*].[64]

The vernacular as well as the Latin texts often refer to the senses, and ostensibly to the outside senses. The imaginative faculty (*imaginatio*) then controls the act of "painting" performed in memory, which is like canvas. This painting act portrays material and sensible things, creating *simulacra*, mind-images. The recuperation of these is performed by the intellective faculty (*intellectio*), which Della Porta describes as quick and able to penetrate memory, in order to recuperate the information orderly stored in there. A multiplicity of actors thus intervenes in the process; while memory is quite passive and static. *Imaginatio* and *intellectio* perform the cognitive functions, moving, connecting, and translating different stimuli: both real stimuli, and their representations. This system explains simply the complex operation of retrieval of data from material reality on the one hand, and from memory on the other. However, it does not explain how images reach memory when they are not produced by the senses: does the "painting" look different when it represents a house we lived in, as opposed to a coat of armour we only know through ekphrasis? Does the intellect retrieve the picture more quickly if the painting highlights some elements rather than others? Given Della Porta's insistence on the sensory origins of *loci*, it is somehow disappointing that he would not express explicitly his theory of mind. However, in giving the readers the above-mentioned explanation, he only describes the memorization process when generated by the external senses. This gave such a process a central role that the reader was then authorized to retain as an explanation for all other memory phenomena. In the case of such an erudite and polemic author, we cannot think of ignorance or forgetfulness as reasons for this one-sidedness. Conscious of the inflammatory character of his views, Della Porta probably was being prudent: suggesting and omitting, when declaring was dangerous.

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[64]    Della Porta, *The Art of Remembering*, 89. See also Matteoli, in Clericuzio and Ernst, *Le Scienze*, 394: "[In the Renaissance,] building memory images became one with crafting metaphors. The exclusivity of the former private and personal vocabulary, constituted by inner scenes, became a communal patrimony, belonging to a popular collectivity whose language was just as iconic and vision-based"..

## Gesualdo: the authority to redefine cognition

Gesualdo attempts to answer these questions as well. He, too, uses a metaphor for memory, that of the seal with wax, rather than that of painting.[65] Tellingly, the main difference in using this metaphor is that, if the passivity of memory is confirmed, the actions of imagination and intellect are removed. This has the effect of making the stimulus pass more directly from the outer to the inner senses:[66] even more so than the classical doctrine would dictate:

> It is not a contradiction that Aristotle in his booklet on Memory says that Memory is a passion in the First Sensitive, that is, the Sensus Communis; because here, the Philosopher reasons around sensitive and organic Memory. You tell me that the Philosopher himself says that the simulacrum is imprinted (imprints itself) into Memory, like an image would be imprinted by a seal-form of the sensory object. 5v.

Gesualdo explains the process in terms similar to those of Della Porta, referring to the sense-derived memory images as *simolacri*. He, however, adds the explicit mention of "second-degree" images formed from the elaboration of such *simolacri*, which Della Porta chose not to do.

> I will say two things. First, how this memory is made inside of us. Second, if we can form memories beyond sensory acts. About the first point: the *simulacrum* (memory image) is

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[65]  I cannot expand here on this important aspect, but reflections on the composition and role of communal stories and references are very present in this age. The need to systematize a collective cultural patrimony is extremely visible in enterprises that the printing press disseminated widely, like emblem books, commonplace books, etc. For its applications to memory, see Bolzoni on the conscious efforts by the Venetian Academy and by Orazio Toscanella in particular (a milieu Dolce was part of), which were twofold: on the one hand, the aim was the expansion of shared, collective knowledge; on the other, the facilitation of the assimilation of such knowledge (*The Gallery of Memory*, especially chapters 1 and 5).

[66]  This aspect echoes the Medieval tradition that saw memory as a quintessentially emotional matter, as described by Carruthers here: "Memories themselves are *affects* in the soul and mind. In ancient philosophy, that property classified memory with the emotions and meant that each memory involves some kind of emotion; each memory is thus to an important degree a physiological, bodily phenomenon. It also meant that there is no such thing as an emotionally detached memory. As understood by the early scholastic philosophers, Aristotle taught also that *every memory is composed of two aspects*: a 'likeness' or 'image,' which is visual in nature (*simulacrum*), and an emotional resonance or coloring (*intentio*), which serves to 'hook' a particular memory into one (or perhaps more) of a person's existing networks of experience". *The Medieval Craft of Memory*, 8 (original italics). Here Carruthers refers to "bodily" differently than Della Porta does: the latter in fact specifically refers to the distinct power of the senses in creating impressions, while the former points out how the whole body plays a role in producing the passions.

made into us mostly from the senses, who receive the sensory images (*simolacri*) and then, through those same senses, like through windows and doors, they pass into the inner chambers of the Sensus Communis and Memoria, where they settle. … As to the second point: our memory not only receives the *simolacri* which were wholly in the senses. But also those imagined in our Cogitative faculty, which can, contemplating those in our memory, connect a *simulacrum* with another and craft from it new images, which then get stored back into memory.[67]

However, his choice to delve into this question, instead of dismissing it like Della Porta, complicates Gesualdo's task. More coherent than Dolce, he attempts to hold together the moving parts of a composite, often contradictory tradition. Regardless of Gesualdo's preparation (which was at once wide and extremely focused on didactic practices), such a task was hard enough for academic philosophers,[68] even without taking into account the contribution of empirical data. He knew that by connecting the senses and memory so directly, theoretical problems would arise. Hence, he tried to explain how it was possible that memory images pertain to the intellectual part of the soul, and therefore to the eternal and divine, rather than to the sensitive, thus mortal, part.

This is especially complex because the mark of the sensitive realm is the particular, that is, the contingent quality of the object (time-bound aspects, individual traits, etc.), which is definitely a strong feature of memory images.[69] After some complex explanations, however, he frustratedly admits that there is no ultimate solution but to renounce the ambition of a satisfying theory to this practice. Similarly to Della Porta, he relegates the task of these reflections to the philosophers' arena. Contrary to Della Porta however, he does not distance himself from the reflection, but rather from the expected approach of a philosopher. Indeed, Gesualdo explicitly, and wittingly, defends his right to be unfaithful to Aristotle, when needed:

And even if Aristotle's doctrine was completely contrary to this notion, I do not know if you want to be among those Philosophers, who do not think that any other Truth can be found, outside that coming from the mouth of Aristotle. If so, then remember that Aristotle himself in his Ethics (1,6) says that he prefers truth over the philosopher, and not the other way round.[70]

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[67]   Gesualdo, *Plutosofia*, 7v.
[68]   "These structures, in other words, are not informative. They are *inventional,* both in the sense of putting things away and in the sense of discovering things": Carruthers, "The Poet", 887.
[69]   "Early modern probabilists used traditional categories and a well-known vocabulary to grapple with profoundly novel challenges": Tutino, *Uncertainty*, 2. For the specific ways in which traditional concepts and terms were repurposed, see her chapter 1, "Building Blocks", 1-26.
[70]   Gesualdo, *Plutosofia*, 6r.

Notably, the need to distance one's position from traditional doctrine emerges around the definition of memory as deeply connected to the material world through the senses. In these books, such connection is certified by personal experience and by the collective practice of many other mnemonists. Gesualdo, when expressing this need, speaks as a cleric and an educator, from within secure hegemonic positions. It is important to restate, in fact, that Della Porta's perplexities and difficulties might echo Gesualdo's, but could not be expressed as liberally; and that Dolce's commercial mentality did not allow him to efficiently separate Romberch's pre-Trent anti-Lutheran positions from his own literary and popularizing intents.

## Conclusions

These three positions on the interactions between outer and inner senses reflect the authors' approaches to the management of information, that is, together with the resulting moral betterment, the ultimate goal of the Memory Arts. If we set theoretical expressions alongside practical advice, these books are representative of three disparate solutions to the problem of information overload faced by 16th century readers. The Memory Arts' peculiar approach is that of modifying one's inner system of reference, so as to enhance one's capacity to receive, register, retrieve, and utilize information. Della Porta leans toward a strong recognition of the role of the personal in this. His focus, in line with countless memory manuals,[71] is highly individualized, based on information derived from one's internalized knowledge. What is uncommon of Della Porta, however, is the insistence on utilizing information that is not just familiar to the individual, but especially retrieved through first-hand experience. His theoretical stance backs up this view by radicalizing the idea of memory as a derivation of sensory experience.

Dolce, on the other end of the spectrum, presents a system in which the personal and the communal are fused together. In an operation that echoes Camillo's and Bruno's,[72] he proposes that the inner structure organizing knowledge be derived from literature and religion.[73] In other words, he, even more explicitly than Romberch, envisions a scaffolding made largely from the same material that will be arranged on it. This superimposition of personal and collective knowledge requires a theoretical apparatus, down-

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[71]   For the persistence and modalities of the five rhetorical "parts", see Ward's study "The Medieval and Early Renaissance Study of Cicero's *De Inventione*" (1-75); for memoria in particular, see Carruthers's "Rhetorical *Memoria* in Commentary and Practice" (109-143); both are found in Ward and Cox, *The Rhetoric of Cicero*.

[72]   For a study of the *Phoenix*'s success, see Merino Jerez's "The Fortune of Peter of Ravenna's *Artificiosa Memoria siue Phoenix*".

[73]   I am quoting the translation by Maggi *et al.*; the pages referenced are relative to this text. However, in Sirri's edition of the Italian original, this text is on page 70.

playing the difference between information acquired through direct experience, and that coming from interacting with cultural products. The oscillations shown by Dolce's discussions of theory give way to such a position, where sensory and imaginative stimuli are not starkly distinguished in origin, nor in goals.

Finally, Gesualdo's stance is one of mediation: he recognizes the importance, for the interaction with knowledge, and the production of it, of both an individual's biography, and of collective stories, myths, beliefs.[74] In this context, the discussion on *loci* might be designated to host this divergence of opinions because it was less theoretically dangerous. *Imagines* were clearly the product of imagination, involving superior faculties pertaining to elevation, be them spiritual or artistic endeavors, or both. *Loci*, instead, were just part of an operational, animal, part of cognition, that was assigned to the movement of the body. This topic's lower position in the hierarchy might have encouraged the inserting of an empirically observed fact -we remember familiar places with more ease if we have known them with our bodies- into a theory of cognition. Acknowledging this theory emerge, despite its unsatisfactory elaboration, and despite having to read it somehow between the lines, is still meaningful. It signals the (possibility of an) awareness of embodied cognitive mechanisms in the 16th century. Such awareness in turn could have determined the development of various solutions, which required a different approach to knowledge. One solution, that by Dolce, relied on the powers of the mind alone to conjure all the tools needed to build, retain, and utilize knowledge. Its counter-theory, portrayed as essential by Della Porta and recognized as a game-changer by Gesualdo, involves the body as part of cognition, a powerful one too, that should be used to our advantage.

Adding a layer, these various solutions are expressions of an emerging problem of Modernity. The Memory Arts in fact try to manage a mass of knowledge expanding beyond the individual's traditional reach.  In all three instances, what surfaces is the problem of connecting two elements: the person learning and elaborating, and the information to internalize. To solve this problem, these three authors all try to augment the power of the *loci* system. Dolce does so especially by expanding, in width and reach, the mind palace itself, which will then be able to accommodate a larger bulk of information. This however can only be done by stretching beyond the experience of the self, and utilizing the products of collective culture. On the contrary, Della Porta bridges the gap through an empowerment of the individual over the information. The personal is not only sufficient, but also stands alone as the only tool that is at once strongly attached to the self, and flexible enough to adapt to a great variety of information.[75] Finally, Gesu-

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[74]  In Sirri's edition of the original Italian, this is on page 57.
[75]  This was the norm in Medieval mnemotechniques, as Carruthers explains: "In monastic teaching [ … ] the ordinary practice was to construct a wholly fictional building, rather than to use an

aldo distinguishes the superior strength of personal experience in creating attachment, on the one hand; and the highly flexible and adaptable character of cultural products, on the other. What all of these solutions highlight is the difficulty of reformulating a relationship with knowledge from within the drastic changes of the 16ᵗʰ century.

Challenged by the fast, overwhelming growth of data, and by the progressive loss of physical presence as a prerequisite of knowledge (intellectual, political, social, etc), these Renaissance authors turned to the body. They defined the lived experience, the sensory stimuli, as unequivocally part of the thinking process, even fundamental to it. The experience of the world thus, which philosophers were starting to propose as the basis of knowledge, is also embedded in cognitive operations, in the most personal, contingent, and situated way possible. From Della Porta's insistence on the use of bi-ographical data, to Dolce's suggestion that we internalize Dante's cosmology, these re-flections invite us to consider how, in this system, a disembodied, impersonal rapport with information seems unthinkable. Conversely, a participation in knowledge, and not just its use, was considered the natural goal: a deeply, almost absurdly personal connection, through one's life and body.

In these books, it is precisely this embedded, embodied experience, developed in its own terms, that allows humans to interact meaningfully with an unprecedented amount of data. the Memory Arts techniques make this data relevant and present to every single individual: they *de facto* incorporate it into each mnemonist's knowledge system. Such an approach to knowledge suggests an early modern awareness of the role of the body in cognition; one that had been lost for centuries and is only now being (re)discovered in Western *scientiae* – mostly, cognitive sciences and neuroscience. Significantly, this awareness emerges in specific texts, pertaining to a moment of epistemic (and political) crisis, as well as to a practice-oriented genre, less prestigious but still theory-informed. Today, the presence of such embodied-ness tends to go doubly undetected, as it is elu-sive in the time's sources, and alien to our body-less ideas of cognition and knowledge. However, the small, but excellent group of scholars who devoted their efforts to this topic, testifies that once individuated, the presence of the body in knowledge is robust and pervasive. With this essay, I hope to encourage more research towards mapping the still largely unexplored influence of embodiment on disciplines and works of the period – as well as its legacy on our own interpretations of human nature and of its possibilities.

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actual one. When invoking a building plan as the device for a compositional structure, monastic writers did not customarily use the monastery buildings that they lived in daily, but rather laid out a typical, exemplary construction […] At the same time such buildings are not 'wholly imaginary', in our sense of that phrase. They exist as words in a text (the Bible) that can be 'revisited' often, and in this way made fully familiar and habitual": *Craft of Thought*, 238-239.

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# The epistemological and artistic relevance of Robert Fludd's memory theatres

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**Abstract**

This article explores the memory theatres in Robert Fludd's major work *Utriusque cosmi historia* (History of both worlds), focusing in particular on their epistemological and artistic relevance. My recent research into Fludd's manuscripts has revealed that the British philosopher invested his personal skills in the art of drawing, in order to materialise his ideas for images. He created appealing designs for his books, which worked as visualisations of his philosophical texts, both allusively and didactically. In this article, I develop my earlier findings by arriving at the conclusion that Fludd also used skills in the art of memory to create and organise his ideas for images. Most notably, Fludd preferred round and square shapes, corresponding to the shapes that he applied in his "Ars memoriae". I conclude the article by exploring the further historical reception and development of Fludd's hermetic art of memory, showing the shift from mnemonics as a competency in Renaissance arts and sciences to mnemonics as an artistic subject and method in modern and contemporary fine arts.

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## 1. Introduction: Robert Fludd as hermetic theorist and practitioner

The British philosopher, physician, and alchemist Robert Fludd (1574-1637) based his major encyclopaedic work *Utriusque cosmi maioris scilicet et minoris metaphysica, physica atque technica historia* (hereafter *UCH*) on a traditional magical concept, distinguishing between macrocosm (the greater world) and microcosm (the lesser world: man), as Marsilio Ficino had previously done in the learned magic of Florentine Neoplatonism.[1] Even though Fludd claimed to represent the whole knowledge of his time, he nonetheless devoted himself to this hermetic knowledge of learned magic in particular. His claim that his "*demonstrationes*" (proofs or experiments) contributed to the new experimental sciences resulted in him becoming embroiled in a controversy with the German astronomer Johann Kepler, among others. Indeed, it was easy for Kepler to show that Fludd's "*demonstrationes*" did not accord with the new astronomical sciences, that he did not use astronomical measurement methods, and that his cosmology was rooted in outdated (geocentric) approaches.[2] According to Kepler, Fludd's use of images, in particular, made it clear that he was not arguing from an empirical basis.[3]

However, Kepler overlooked the fact that Fludd argued with empirically gained *alchemical* knowledge, which he also illustrated in "*demonstrationes*". In this respect, he experimented with a range of devices (including a *vitrum calendarium*, alchemical ovens, and mirrors as burning glasses) and had his theories visualised in copperplate engravings, as was common practice in the context of the ambitious art chambers of the royal courts and among Paracelsian scholars of the late sixteenth and early seventeenth centuries. Fludd used these "*demonstrationes*" to convince his readers of the validity of his theories, and indeed his overall success and popularity owed much to them. Although he did not succeed in persuading new astronomers, such as Kepler, he was, for instance, read by people with interest in medical alchemy (*chemiatria*).

As I shall demonstrate in this article, the pictorial programme of Fludd's "*demonstrationes*" resulted from his transcendental and didactic concept of *ars memoriae*, as well as from his practical skills in the art of drawing.[4] Indeed, his abilities relating to *ars memoriae*

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[1]   This study has been undertaken as part of the research project "The Materialisation of Robert Fludd's Alchemical and Theosophical Concepts: A Case Study in the History of Science on the Interaction between Author, Artisans, Artists, and Publishers" financed by the German Research Foundation (DFG), project number 508112724.

[2]   On differences as well as similarities in the natural philosophical views of the two authors, see Boner, *Kepler's Cosmological Synthesis*, 135-166.

[3]   On Kepler's criticism of Fludd's images, see Lüthy, "What Does a Diagram Prove That Other Images Do Not? Images and Imagination in the Kepler-Fludd Controversy".

[4]   For a discussion of Fludd's craftsmanship and geometric drawings, see Frietsch, "Robert Fludd's Visual and Artisanal Episteme: A Case Study of Fludd's Interaction with His Engraver, His Printer-Publisher, and His *Amanuenses*".

allowed him to focus his imagination on the metaphysical, physical, and technical dimensions of "both worlds", i.e. the world (macrocosm) and the human being (microcosm), and to create and explicate the impressive images of his philosophical system.

## 2. The systematic place of Fludd's Ars memoriae

Fludd's *UCH* is both extensive and complex. However, it makes a clear distinction by dealing with the world (macrocosm) on the one hand and the human being (microcosm) on the other. In this system, the traditional magic of macro- and microcosm, which had been criminalised in the 1600s, undergoes a remarkable transformation, becoming part of the history of technology. Accordingly, Fludd writes two histories of technology for his *UCH*: a technological history of the macrocosm and a technological history of the microcosm. The first consists of eleven separate parts: Universal Arithmetic, Music, Geometry, Optics, the Art of Drawing, the Art of War, Mechanics, Time Measurement, Cosmography, Astrology, and Geomancy.[5] The second consists of seven parts: Prophecy, Geomancy, *Ars memoriae*, Genethlialogy, Physiognomy, Chiromancy, and *Pyramidium scientia*.[6] Although Fludd's technological history of the macrocosm corresponds in part to our current understanding of technology (in particular, his depictions of machines in the part on Mechanics), his technological history of the microcosm follows the tradition of conveying secret mental practices.

As regards the systematic place of "Ars memoriae" as section and capacity, Fludd presents it as a link between the macrocosm and the microcosm.[7] In this respect, it corresponds to Geomancy, which constitutes own parts of both *UCH* histories of technology. Fludd's *ars memoriae,* at any rate, is on the one hand represented in the first chapter of the technical history of the macrocosm, in the part on Universal Arithmetic, where he explains how the places of memory should be organised.[8] On the other hand, his technical history of the microcosm dedicates a whole part on it. In this part on "Ars memoriae" in the technical history of the microcosm – the focus of my article – Fludd again takes up this arithmetical dimension, by comparing "natural" or sensory memory (*memoria naturalis*, *memoria sensitiva*) to counting on the fingers. By contrast, he considers "artificial memory" (*memoria artificialis*) as a process of mathematical calculation, which affords an arithmetical training.[9] According to Fludd, natural memory, which is something that

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[5]   Fludd, *Utriusque cosmi historia* (*UCH* I, b).

[6]   *Ibid*., (*UCH* II, a, 2).

[7]   Fludd, "De animae memorativae scientia, quae vulgo ars memoriae vocatur", in *UCH* II, a, 2, 47-70 (hereafter, "Ars memoriae"). My thanks to my student assistant Mareike Phoebe Wackerhagen for supporting me with a rough German translation of Fludd's "Ars memoriae".

[8]   Fludd, "De arithmetica memoriali", in *UCH* I, b, 153-157.

[9]   At the end of his "Ars memoriae", Fludd explicitly returns to the arithmetic of the macrocosm and points out that he has already dealt with the memorisation of arithmetic figures (addition,

humans share with animals, is constituted by the contraction of a worm-shaped piece of flesh in the middle of the brain. This natural memory, however, is artificially corrected and expanded through the imagination (*imaginatio*) of human fantasy (*phantasia*), which is like a pulsation for this cell of memory. Indeed, the constant exercise of the imagination causes the new artificial memory not only to form, but also to remain coherent and fresh. Yet, if the original natural memory has been completely damaged or lost, it can additionally be artificially corrected and restored, by means of medication.[10]

Fludd takes Plato's concept of ideas and expands the term to include all imagined things that have been memorised.[11] As Robert Westman – a historian of science and researcher of the works of Fludd – has already noted, Fludd considered knowledge to involve an act of remembering, in the sense of having already seen. Through imagination and fantasy, then, human beings are able to participate in the divine (i.e., in the ideas and in the origin of things in creation). As such, the capacity of *ars memoriae* constitutes a connection to God and the events of creation.[12] At the same time, artificial memory has to do with ideas or imaginations that can be specifically modulated and practically utilised by means of arithmetical methods. Accordingly, Fludd's own use of *ars memoriae* involves two complementary approaches, which are not merely didactic, but actually transcendental. Indeed, he presents himself to his readers with the self-confidence of a master who is not only able to teach the practice of *ars memoriae* but also to provide theoretical information about how it works. Fludd mentions a supernatural gift of memory, as mediated by divine favour,[13] which suggests that this gift enabled him to become a master. However, he also emphasises that (supernatural) magic – for example, the powers of magic rings, used by scholars of his time – is not useful to improve one's memory skills, because *ars memoriae* has to be exercised by virtue of the imagination. Instead of using magical means, it was in fact necessary to correct the imagination.[14] According to this, Fludd's supernatural divine gift of memory seems to have been no magical gift.

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multiplication, etc.) there, prompting readers to leaf back through Fludd's technical history of the macrocosm. Cf. Fludd, "Ars memoriae", 70. Here, they see that he also uses *specula* for arithmetic. Cf. e.g.: Fludd, "De arithmetica vulgari sive algorithmo", in *UCH* I, b, 49 (*speculum multiplicationis).*

[10] Fludd, "Ars memoriae", 49-50. The distinction between a natural and an artificial memory goes back to the pseudo-Ciceronian books *Rhetorica ad Herennium*; see Schmidt-Biggemann, "Robert Fludd's Theatrum memoriae",156.

[11] On Fludd's transformation of Plato's concept of ideas, see Fludd, "Ars memoriae", 50-51.

[12] On Fludd's concept of cognition, see Westman, "Nature, Art, and Psyche: Jung, Pauli, and the Kepler-Fludd Polemic", esp. 180-199.

[13] Fludd, "Ars memoriae", 50.

[14] *Ibid.*, 50-51.

## 3. *Yates's interpretation of Fludd's Ars memoriae*

Frances Yates, whose works *The Art of Memory* (1966) and *Theatre of the World* (1969) are considered to be her best, has made a particularly valuable contribution to the analysis of Fludd's *ars memoriae*.[15] Westman has pointed out that Yates's interpretation of this section of the *UCH* has resulted in a better understanding of Fludd's practical approach as an author.[16]

Yates examines the history of the art of memory from antiquity to the seventeenth century, beginning her account by focusing on the Greek poet Simonides, who, according to Cicero, invented the art of memory as a technique for linking places and concepts. Following a banquet that ended disastrously, with the building collapsing, Simonides remembered the seats of the guests who died in the accident, which enabled him to name the corpses that were otherwise unrecognisable. According to Cicero, this resulted in the development of the so-called loci method.[17] Yates shows that the Majorcan philosopher Raymond Lull transformed this method of assigning places and names in the thirteenth century, by coming up with turntables featuring different terms in order to practise *ars memoriae*.[18] Later, in the sixteenth century, Giordano Bruno replaced the traditional concepts of *ars memoriae* with images, retaining the use of turntables, in accordance with Lull.[19] In the same century, by contrast, the Calvinist logician and didact Petrus Ramus – whom Yates describes as an iconoclast – replaced the images, which he perceived as being medieval and Catholic, with binary conceptual diagrams, although his approach was thought to be superficial and merely to serve the purpose of learning by rote.[20] The Anglican Fludd, in turn, used images for his *ars memoriae* – and like the Italian scholar Giulio Camillo (1480-1544) in his work *L'Idea del Theatro* (published posthumously in 1550), he replaced the concept of the memory palace, which is still used in mnemonics today, with the concept of memory theatre.[21]

Yates analyses Fludd's *oeuvre* in terms of the history of the book and asks precisely the questions that still interest historians of science and knowledge today.[22] She rightly

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[15]  For Yates's analysis of Fludd's art of memory, see Yates, *The Art of Memory*, 320-367, and *Theatre of the World*, 42-189.

[16]  On Westman's recourse to Yates, see Westman, "Nature, Art, and Psyche", 181, 222. Yates's statements about the Rosicrucians, which overestimated their political significance, can be regarded as refuted. However, this does not discredit her entire research. For criticism, see, e.g., Vickers, "Frances Yates and the Writing of History".

[17]  Cicero, "De oratore II (351-358)", in *Cicero: De oratore libri tres*, 400-403; Yates, *Art of Memory*, 1-2.

[18]  Cf. Yates, *Art of Memory*, 173-198.

[19]  *Ibid.,* 199-265, 287-319.

[20]  *Ibid.,* 266-286.

[21]  On Camillo, cf. Yates, *Art of Memory*, 129-172.

[22]  On contemporary approaches to the history of science, such as historical epistemology, material and performative history of science, and history of knowledge, see Verburgt, *Debating Contemporary Approaches*.

assumes that not only the ideas for Fludd's images were his own, but that he also created some of the drawings.[23] In her pioneering work, however, Yates also ventured some risky arguments. For instance, Fludd explicitly points out that the theatre, as a place of the art of memory, should not be an invented place, but rather an existing one. In response, Yates felt compelled to identify Fludd's memory theatre – as well as his illustrations – with the Globe Theatre in London, an approach that has rightly been criticised and rejected for being concretistic.[24] What is more, Fludd does not present a single memory theatre in his text and images, but rather two round memory theatres (*theatrum rotundum*), in which spiritual themes are to be memorised and one square memory theatre (*theatrum quadratum*), for the memorisation of sensual objects. Fludd attributes the round theatres to the zodiac, apparently having been inspired to do so by the Roman architectural theorist Vitruvius (who lived during the first century BC), whose concept of the amphitheatre as an open-air complex was similarly based on the course of the sun and the zodiac.[25] Fludd envisaged his round theatres – which are ideal, intellectual-historical concepts – as being anchored in the ether; he also proposed that they should be viewed in the imagination as if through smoke.[26] In my opinion, Fludd's square theatre is similarly an intellectual-historical concept, again visualised only roughly by means of illustration. In this respect, Fludd's advice relating to existing concrete places appears to constitute an invitation to readers to assemble their own ideal theatres of memory from real places that they know.

## 4. Fludd's autobiographical framing of his "Ars memoriae"

However, one of the attractions of Fludd's *UCH* is that he repeatedly refers to "real", i.e. autobiographical, events that accompanied his writing. The books of the *UCH* are very extensive and Fludd worked on them for years before publishing them between 1617 and 1624. In the winter of 1601, for instance, he visited the small town of Nîmes (*Nemosiensis, Nemausensis civitas*, or *Nemausus*) in Provence to see its monuments that had been well preserved from the Roman Empire. The reference to Fludd's journey to Nîmes constitutes

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[23]   Yates poses the question: "Is it possible that Fludd himself was the artist behind some of [his illustrations]?" Her answer is: "He teaches perspective and figure drawing in the optics and painting sections [of the *UCH*], from which it would seem natural to follow that he could himself draw. Not very well perhaps, but well enough to be himself the artist of the illustrations in his books". She also emphasises that Fludd's diagrams were "remarkable [ … ] as Renaissance development of medieval schemata"; cf. Yates, *Theatre of the World*, 75. Cf. also Fludd, "De optica scientia", in *UCH* I, b, 293-316, and Fludd, "De arte pictoria", *ibid.*, 317-341.

[24]   Cf. Schmidt-Biggemann, "Robert Fludd's Theatrum memoriae", 159.

[25]   For the zodiac, cf. Vitruvius, "Book Five: Public Buildings, Chapter Six: Theater design", in *Vitruvius: Ten Books on Architecture*, 68-70, 247 (figure).

[26]   Fludd, "Ars memoriae", 55.

a prelude to his account of the "Ars memoriae",[27] but this framing has not yet been sufficiently analysed. Which monuments did Fludd see in Nîmes? And how did he orientate himself during his stay?

In 1559 and 1560, Jean Poldo d'Albenas (1512-1563) published a book in Lyon titled *Discours historial de l'Antique et illustre cité de Nismes*. The book presents architectural plans of the Capitole temple, popularly known as the "Maison Quarrée" (or Carrée) since the sixteenth century, and the "Amphitheatre", popularly known as "Les Arènes" (Figs. 1 and 2). In addition, the woodcut of the Arènes reproduces some of the images (a bull, a fight and a she-wolf, suckling the twins Romulus and Remus) that have been cut in stone in the amphitheatre.[28] When Poldo comments on the amphitheatre of Nîmes, he, like Vitruvius, refers to the zodiac, and in his descriptions of the traditional cock and bull fights, he even depicts a zodiac of the morning (*Mane*) as well as a zodiac of the evening (*Vespere*), with indications of the respective planetary positions for "our" hemisphere (Fig. 3). Poldo's explanations of the Greek and Roman history of this theatre, then, reveal that it was perceived as a place of drama as well as battle (in other words, as an arena). Wilhelm Schmidt-Biggemann, a philosopher and researcher of the works of Fludd, has also recognised this aspect of Fludd's "Ars memoriae", relating Fludd's *theatrum rotundum* to the scholar's Manichean world view and interpreting it as a theatre of battles between good and evil – and, therefore, as a reflection of the metaphysical structure of the world.[29]

Poldo's work was well received in Europe. The Italian architect Andrea Palladio, for instance, was inspired by the woodcuts, dedicating six illustrated plates to the "Maison Carrée" in his *Quattro libri dell'architettura* in 1570. Later, in the 1590s, Thomas Platter the Younger, a Swiss physician, also drew on the Poldo illustrations when describing his Grand Tour.[30] Later still, the scholars of the early seventeenth century, like Fludd, were inspired to visit Nîmes by these and other books and illustrations.

When Fludd arrived in Nîmes, he must have noticed a strong difference between the city's glorious past and its present. Indeed, at that time, Nîmes was one of the most important cities for French Calvinism, with a reformed academy. However, its population had been reduced by the religious struggles, famines, and plague of the sixteenth century.

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27  *Ibid.*, 48.
28  On the "Maison Quarrée", see Poldo d'Albenas, *Discours historial de l'Antique et illustre cité de Nismes*, 73-80. On the amphitheatre, see 62-67 and 119-148. In the 1560 edition, the woodcuts are no longer an appendix, but are bound into the text. For the historical reception of this book, see Lemerle, "Jean Poldo d'Albenas (1512-1563), un antiquaire 'studieux d'architecture'".
29  Cf. Schmidt-Biggemann: "Robert Fludd's Theatrum memoriae", 159 (without reference to Poldo).
30  Cf. Palladio, *I Quattro libri dell'architettura*, IV, 112-117; Platter the Younger, *Beschreibung der Reisen durch Frankreich, Spanien, England und die Niederlande, 1595-1600*, Part 1, 102-113 and 277-280; Lemerle, "Jean Poldo d'Albenas", 169-170.

L'Amphitheatre, dict, les Arenes.

Le Capitole, dict la maison Carree.
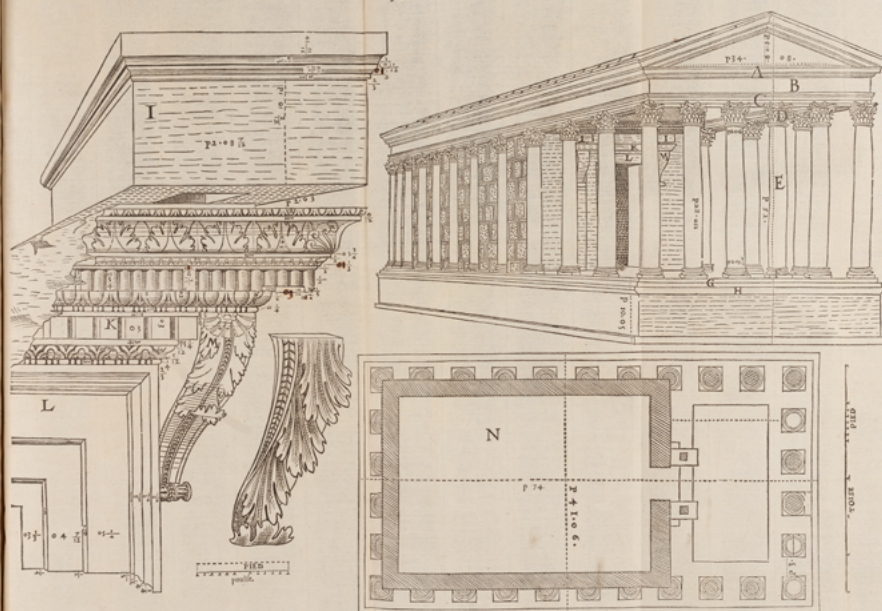
rieur : & ainfi des autres corps , & celeftes,& leurs intelle-
ctuels,felon les vertus,& facultés,que le Dieu excelfe Arche-
tipe leur a attribuees.Et ainfi l'entendoit le grand perfonaige,
qui difoit au Romain,que ne s'esbahit pas,fi ce ieune autre
Romain luy eftoit toufiours,& du tout fuperieur:car ton
Genius,difoit il,crainct,reuere,& donne lieu au fien:voulant
entendre,que l'vn Genius eftoit plus hautain,& au celefte,&
à l'intellectuel,que l'autre.Et de là aduient,continuant enco-
res noftre propos des coqs,que eftant le Soleil au Sagitaire,
qui eft dés le xj.Nouembre,ou enuiron,felon les annuelles
conuerfions,& introitz du Soleil és fignes,par les fupputa-
tions Aftronomiques,iufques à la fin du figne,& entree du
Soleil au Capricorne,le coq,oyfeau folaire,meffager,& pro-
gnofticateur du iour artificiel,& lumiere,chante à ces iours
là,fur la vefpree,& enuiron l'heure ix.Car de tant que le lion
celefte,c'eft à dire,ce vifaige,& potence celefte,qui a fouz foy
le noftre elementaire,& que le lion celefte eft domicile du So-
leil celefte,par la mefme Aftronomie,en ce temps eft aufi
fur noftre Horifon,dont le coq alors haulfe fa voix,& chan-
te.Et affin qu'on le puiffe mieux comprendre,la figure Aftro-
nomique a efté par moy icy mife,& excogitee,pour döner à
entendre la tradition des maiftres,biê qu'ilz ne la mettêt pas.



Ie n'adhere pas donc en cecy à l'opinion d'aucuns,qui font
profefsion des Augures,interpretans,à ce temps là le chant
des coqs vefpertin à bonne fortune,de tant que ceft oifeau,
vaincu,ne chante pas,mais lors qu'il eft vaincueur,il s'enor-
guillit,& esleue fa voix,ainfi que Themiftocles l'interpreta le

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Fearing the Catholics, the local population even destroyed the temple of Diana itself. Only in the 1620s did the early modern mechanical arts (crafts and technology) slowly become established in the city.[31] Fludd may therefore have been all the more impressed by the surviving monuments from Roman times, and it is plausible to draw a connection between the "Maison Carrée", the amphitheatre of Nîmes – the largest one surviving outside Italy – and Fludd's ideal locations of his round and square theatres. Like the famous Globe Theatre, these two buildings are likely to have influenced Fludd in the formulation of his concepts. Moreover, Fludd also linked his "Ars memoriae" with the technological history of the macrocosm (in this instance, the architecture of the Roman Empire) through his brief and general yet explicit reference to the Roman architectural monuments of Nîmes.[32] In this way, he (like Simonides or Cicero) was also referencing a moment of catastrophic history: the fall of the Roman Empire, whose technical expertise had, at the time, yet to be regained.

Although Fludd – a pretty self-confident author who was too old for a typical educational trip in the style of a Grand Tour at the time of his journey to France – does not detail the monuments he visited in Nîmes, he states that he met a scholar there, who introduced him to mnemonics, but refrains from naming him. Rather, he emphasises that he essentially taught himself the art of memory on his onward journey to Avignon, following this brief initiation, mastering it so well that he was soon able to teach it to his host and patron, the Duc de Guise, Charles de Lorraine, and his brother, François de Lorraine, as well as to the youth, both there, in Aix-en-Provence, and finally in Marseilles. Indeed, Fludd was so successful as a teacher of the mathematical arts, and especially the art of memory, that he ended up being called to Marseilles to teach in leading circles there.[33] Fludd concludes this passage of his narrative by informing his readers that he is teaching them, free of charge, in his published work, the very same knowledge that he had previously acquired at great expense and then demonstrated with great success on his travels.[34] In his preface to the technical history of the macrocosm, Fludd also mentions that he had written the part on the "Ars memoriae", as well as the part on Music (in the technical history of the macrocosm), for a certain Marquis de Orizon, Viscount de Cadenet (i.e., André II d'Oraison?, Marquis d'Oraison, Vicomte de

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[31]   Cf. Huard, *Histoire de Nîmes*, 145-197.

[32]   Fludd, "Ars memoriae", 48: "Cum ego in peregrinationibus meis regnum Galliae inter alia praecipue ultro citroque perlustrarem. *Nemosiensem* tandem civitatem, invitatus fama, extantium in ea antiquitatum petebam, ubi apud quendam ex arte sua memoriae satis famigerabilem coepi primum illius artis suavitatem degustare [ … ]".

[33]   Fludd returns to this in the introduction to his *Geomantia,* where he also mentions his initially conflictual but ultimately amicable contacts with Jesuits in Avignon; cf. *UCH* I, b, 718-720. Josten has translated these biographical passages into English as an appendix to his explanation of Fludd's *Geomantia*: Josten, "Robert Fludd's Theory of Geomancy and His Experiences at Avignon in the Winter of 1601 to 1602", 335.

[34]   Fludd, "Ars memoriae", 48.

Cadenet), as the marquis was enamoured with such *scientiae*.[35] Fludd may also have produced some of his teaching materials – for instance, pictures for his alphabets and numbers – during his time socialising in the aforementioned Catholic circles.

## 5. *Fludd's memory theatres and his artistic skills*

### 5a. The theatre as a distinguished place

Fludd conceived his *theatrum rotundum* and *theatrum quadratum* as places that required readers to develop their own individual narratives, playing them through repeatedly in order to memorise individual themes, concepts, and names. The doubling of the theatres mirrored the doubling of the macrocosm and the microcosm, but what aspect of the theatre distinguished it as a place for his technique of *ars memoriae*?

Around the year 1600, the theatre was regarded as a place that was strongly shaped by and bound up with the early modern concept of perspective. The area for the audience was initially constructed as a semicircle, which was modelled on ancient amphitheatres. At the beginning of the seventeenth century, however, a square stage was placed facing this area, running towards one or more vanishing points in central perspective. This frontal juxta-position (or opposition) of stage and audience was developed following the invention of opera. But although opera continued to follow the ancient model of the amphitheatre, the visual stage took on a life of its own as a square space.[36] This architectural development explains why Fludd used the zodiac as a model for the movement of his *ars rotunda* (Figs. 4 a and b) but illustrated the *theatrum rotundum* with two square stage spaces (Figs. 5 a and b, Figs. 6 a and b) that hardly differed in visual terms from the stage space of the square theatre that he also presented (Figs. 7 a and b).

The theatre of the seventeenth century was a public place where actions (*actiones*) were performed. A sovereign subject, characterised by the ability to act, was projected onto the vanishing points of the new perspective stage, shaping the space of action rather than being lost in the three-dimensional space of antiquity or the paratactic space of the Middle Ages. It is precisely the public nature of the theatre that qualifies it as a stage for Fludd's "Ars memoriae". Indeed, according to Fludd, the actions of the memorising subject are to be "demonstrated", just like the actions that occur in the comedies and tragedies.[37] Fludd thus conceptualises the images of "Ars memoriae" as "imagines agentes", acting images or

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[35]   Cf. Fludd, "Lectori Benevolo", in *UCH* I, b, 3. For the biographical details, see also Yates, *Theatre of the World*, 63-64.

[36]   On this radical change, which is realised in the architectural theory of Andrea Palladio (1508-1580) – in contrast to the Roman architect Vitruvius – see Haß, *Das Drama des Sehens*, 125-159.
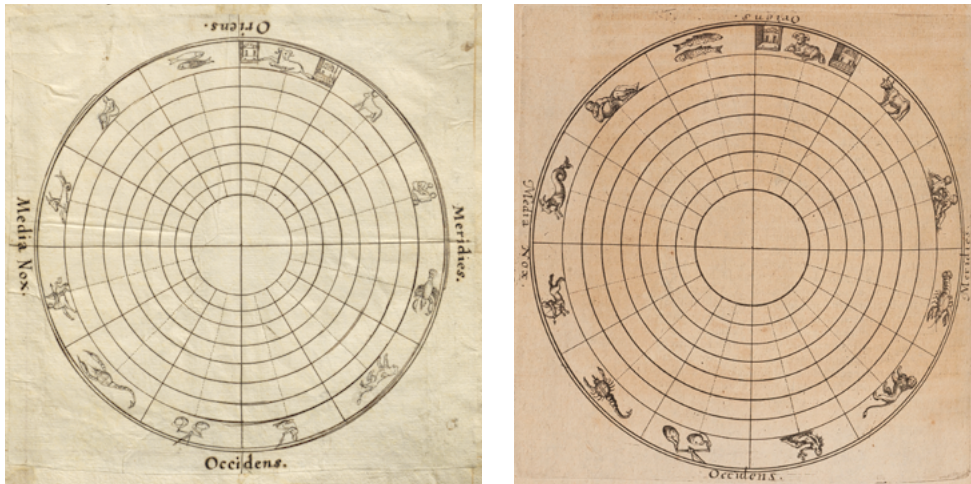
[37]   Fludd, "Ars memoriae", 55.

Fig. 4 a and b – Zodiac as a scheme of the *ars rotunda*, a) Johann Theodor de Bry and Workshop (?), pen and ink drawing, in: Fludd, *De technica microcosmi historia.* UB Frankfurt am Main, MS lat. qu. 15, fol. 66 recto, without annual details, b) Matthäus Merian the Elder (?), etching, in: Fludd, "Ars memoriae", UCH II,a,2. HAB Wolfenbüttel: A: 111 Quod. 2° (2), 54.

image acts, and also as "*demonstrationes*". What is more, the fact that the acts of *ars memoriae* are to be imagined as public acts means that they are also to be accompanied by strong – impressive and therefore memorable – emotions.[38]

## 5b. The print template of Fludd's "Ars memoriae"

A single print template of Fludd's technical history of the microcosm has been preserved in the Universitätsbibliothek Johann Christian Senckenberg Frankfurt am Main, as MS lat. qu. 15. This manuscript, written down by Fludd's scribe in italic hand with characteristic clubbed descenders contains Fludd's part on "Ars memoriae".[39] It is likely that some of the pen and ink drawings in this manuscript were prepared or even made by Fludd himself in cooperation with Johann Theodor de Bry, his publisher in Frankfurt, as well as by some likely amanuenses acting as Fludd's draughtspeople.[40] The ambitious au-

[38]    The concept of "imagines agentes" was coined by (pseudo-) Cicero in *Rhetorica ad Herennium*. On this concept and its strong emotions, see Berns, "Schmerzende Bilder", and Schmidt-Biggemann, "Robert Fludds Theatrum memoriae", 156. On the concept of the "image act", see Bredekamp, *Der Bildakt* (without reference to Fludd).

[39]    Fludd, *Utriusque cosmi historia, De technica microcosmi historia.* Universitätsbibliothek Johann Christian Senckenberg Frankfurt am Main, MS lat. qu. 15 (hereafter: MS lat. qu. 15). The whole manuscript corresponds to: *UCH* II, a, 2, 1-191.

[40]    For a detailed description of the template and its partly drawn-in, mostly glued-in pen and ink

thor provided his publisher de Bry with this illustrated master copy to achieve a close integration between text and image, as well as to "demonstrate" his erudite statements. In any case, Fludd was well aware of the artistic weakness of some of the pen and ink drawings in his meticulous template. Accordingly, he granted de Bry – and Matthäus Merian the Elder, the young engraver and etcher who worked for the publisher – a certain degree of artistic licence in producing the attractive copper plates and etchings of the printed books.[41] In this article, I show figures that appeared in Fludd's "Ars memoriae" in both manifestations – that is, as the pen and ink drawings of the print template as well as the final etchings of the printed book – to demonstrate his concrete work with images.

## 5c. Fludd's Theatrum rotundum and his Ars rotunda

Fludd's *theatrum rotundum* corresponds to the macrocosm, here meaning the spiritual world. Indeed, with its order of the zodiac, the twelve classical signs of planetary astrology, and its two stages of sunrise and sunset, the place of this round theatre is the ether.[42]

In Fludd's *theatrum rotundum*, the art of memory is to be practised as a round or circular art (*ars rotunda*).[43] Fludd orientates himself in relation to the movement of the sun: accordingly, the *ars memoriae* should take place as a movement from east to west, following its rising and setting. In Fludd's conception, memorising is to begin in the bright white theatre of the day and end in the deep black theatre of the night. In these two memory theatres of sunrise and sunset, readers – who are students of the art of memory – are intended to stage ideas (vocabulary, sayings, and parts of speeches, etc.) as actions. In the imagination, these two round theatres of day and night should each be equipped with five doors.[44] By imagining these doors, however, Fludd appears to be reverting to the older concept of the memory palace, because these doors are more characteristic of palaces than of theatres. Nonetheless, Fludd's theatres are generally conceived in the sense of stages.[45]

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drawings (in their different, partly lost versions), of which some geometric ones in particular appear to have been made by Fludd himself, see Frietsch, "Robert Fludd's Visual and Artisanal Episteme", 349-362.

[41] On the attribution of specific engravings and etchings from Fludd's printed work to Merian the Elder, see Wüthrich, *Das Druckgraphische Werk von Matthaeus Merian d.Ae.*, 80-84. On Merian's contribution to the iconography of the hermetic arts and sciences, see Wüthrich, *Matthäus Merian d.Ä.*, 210-242, Wagner and Gannon, *Opus Magnum*. On Merian's improvements to the print template's drawings in his own etchings, see Frietsch, "Das Manuskript". On Wüthrich's oral assessment of the print template, see Wagner "Trias der Bildideen", 64.

[42] Fludd, "Ars memoriae", 54-55.

[43] *Ibid.*, 51.

[44] *Ibid.*, 55.

[45] Yates has already pointed this out, although she links Fludd's stages to the ground plan of the Globe Theatre in a simplifying way; cf. Yates, *Theatre of the World*, 136-161.
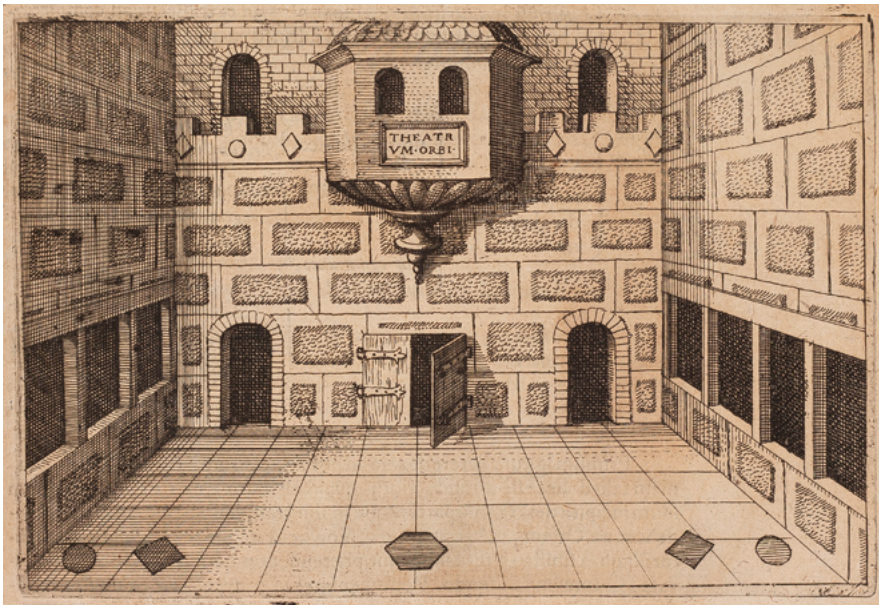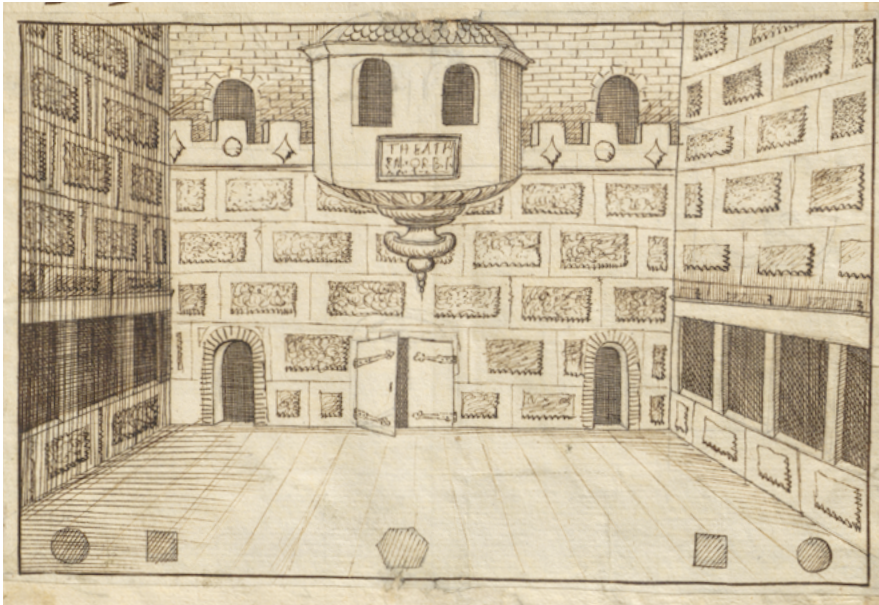
Fig. 5 a and b – Theatrum Orbi[s], a) Robert Fludd in collaboration with Johann Theodor de Bry and Workshop (?), pen and ink drawing, in: Fludd, *De technica microcosmi historia.* UB Frankfurt am Main, MS lat. qu. 15, fol. 67 recto, without annual details; b) Matthäus Merian the Elder (?), etching, in: Fludd, "Ars memoriae", UCH II, a,2. HAB Wolfenbüttel: A: 111 Quod. 2° (2), 55.

In the *ars rotunda*, the twelve signs of the zodiac (e.g., Capricorn), with their gods and planets (e.g., Saturn), and astrological attributes (e.g., wealth), constitute the main characteristics. Fludd offers an illustration of the beginning of the movement of memorising, which starts in the sign of Aries: in the characteristic round shape of the zodiac, Aries, which begins the astrological circle, is highlighted, sitting between the two stages of the oriental and occidental theatre (Figs. 4 a and b). Fludd continues to explain that Aries corresponds to the story of the Greek hero Jason, who won the Golden Fleece with the support of the king's daughter, the enchantress Medea, and he also states that the individual stages of this couple's tragic story are to be placed in the imagination behind the five doors.[46] This story is likely to have been particularly well known to readers from the high nobility, who may have aspired to join the contemporary Order of the Golden Fleece themselves. Based on this and other myths, Fludd's readers were then asked to memorise suitable images for the words and characters, as well as the individual names and their own newly invented storylines.

A second illustration shows the sunrise theatre of the "*Theatrum Orbi[s]*" (or Theatre of the Circle, i.e. of the World), with five columns – two of which are round, two of which are square, with the other one being hexagonal – and five doors, three of which are on the stage floor, with the other two being on a gallery (Figs. 5 a and b). The young artist Merian transferred the orthographic error in the "*Theatrum Orbi[s] [Terrarum?, illegible letters]*" from the print template to the etching. On the one hand, this error may have been made by Fludd himself, when he was labelling the pen and ink drawing, possibly because he was taking his cue from Pico della Mirandola's topos of the "Theatrum mundi".[47] On the other hand, though, the orthographic error – "*Theatrum Orbi*" instead of "*Theatrum Orbis*" – may also be interpreted as indicating that this pen and ink drawing of the master copy was made by one of Fludd's amanuenses or by a member of the de Bry Workshop.[48] Fludd had accompanied this depiction of the sunset theatre by a further illustration, showing five columns – three of which are round and two of which are square – and five doors (Fig. 6 a and b).

### 5d. Fludd's Theatrum quadratum and his Ars quadrata

Fludd combines the two round theatres with a *theatrum quadratum*, which serves to memorise physical objects, showing this square theatre in a further figure (Figs. 7 a and b). Moreover, he also calls the art of memory that is to be practised in this square theatre a square art (*ars quadrata*).[49] Fludd was aware that most of his contemporaries regarded this theatre as the most relevant one, because for them the sensual appeared – deceptively – as

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[46]  Fludd, "Ars memoriae", 60, 62, 65, 67, 68.
[47]  On Pico della Mirandola's concept of the "Theatrum mundi", the world as theatre, see Haß, *Das Drama des Sehens*, 201-217.
[48]  See also the correction of the fourth "i" in "Oculus imaginationis" in fig. 10 a, below.
[49]  Fludd, "Ars memoriae", 51.

Fig. 6 a and b – Form of the true theatre of *ars rotunda*, a) Robert Fludd in collaboration with Johann Theodor de Bry and Workshop (?), pen and ink drawing, in: Fludd, *De technica microcosmi historia.* UB Frankfurt am Main, MS lat. qu. 15, fol. 75 verso, without annual details, b) Matthäus Merian the Elder (?), etching, in: Fludd, "Ars memoriae", UCH II,a,2. HAB Wolfenbüttel: A: 111 Quod. 2° (2), 64.

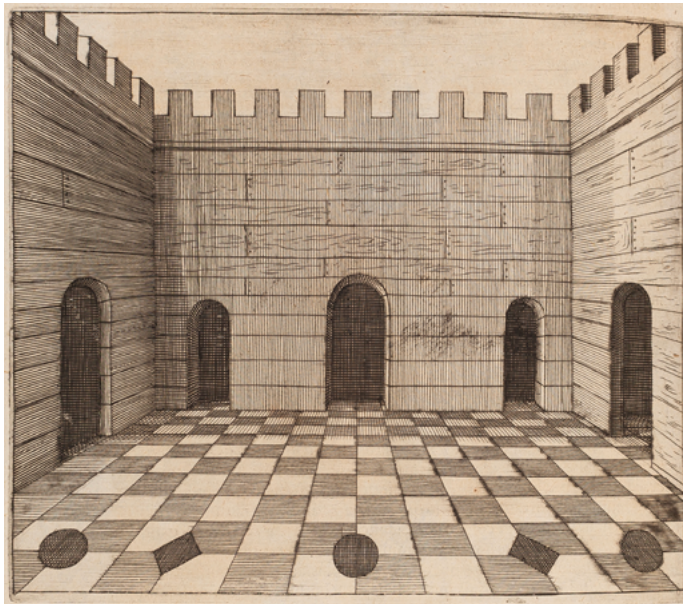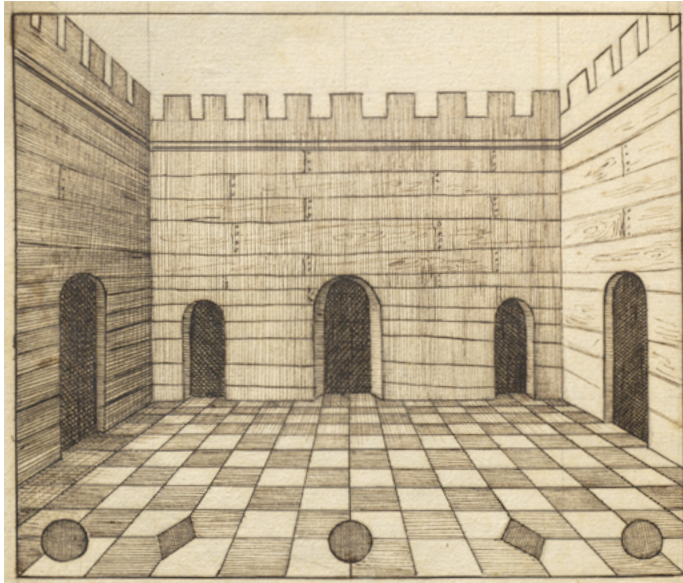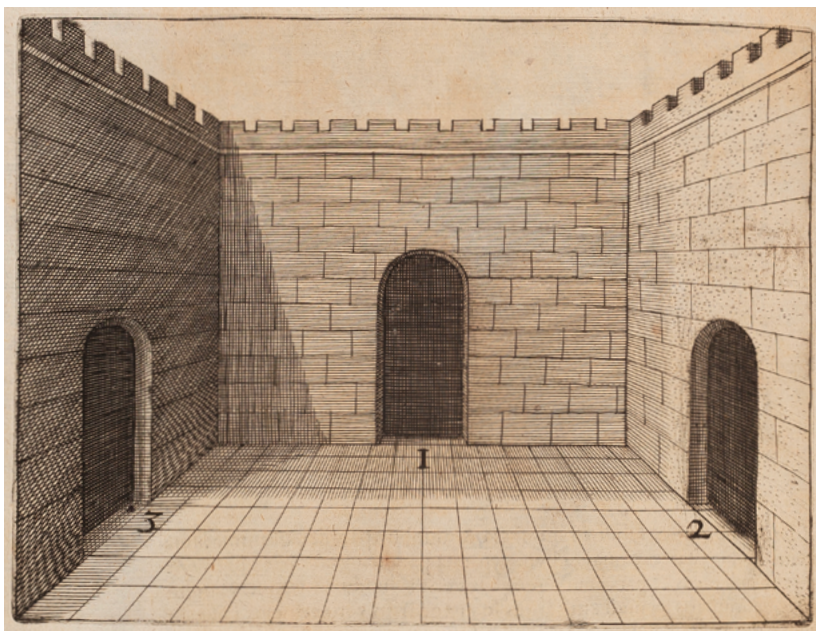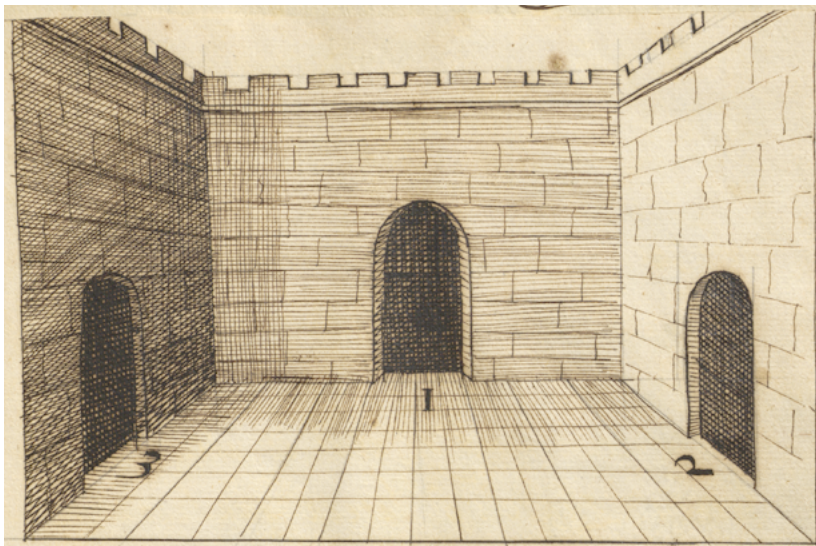Fig. 7 a and b – Form of the theatre of *ars quadrata*, a) Robert Fludd in collaboration with Johann Theodor de Bry and Workshop (?), pen and ink drawing, in: Fludd, *De technica microcosmi historia*. UB Frankfurt am Main, MS lat. qu. 15, fol. 69 recto, without annual details, b) Matthäus Merian the Elder (?), etching, in: Fludd, "Ars memoriae", UCH II,a,2. HAB Wolfenbüttel: A: 111 Quod. 2° (2), 58.

the real and only world.[50] He therefore explicitly advises against practising this square art by means of the fantasy of palaces, comparing the concept of a memory palace to a series of mirrors, whose images are not mutually amplified, but instead diminished and obscured. Fludd, being a doctor as well as a philosopher, also compares the memory palace to orally administered medicine for bladder stones, which continues to weaken on its long journey from the mouth to the bladder. Ultimately, though, he emphasises that the work of the imagination must begin with the real, and not with intentional things.[51]

In the same way that musicians prefer to practise their art using polychords rather than monochords, it is unsuitable for students of mnemonics to imagine empty places as settings.[52] By contrast, Fludd recommends imagining six rectangular rooms, with a floor and ceiling, as settings, each with five locations or fields. Each of these locations should have three doors, and above the centres of the doors a characteristic image should be placed. Behind the doors, one should then imagine the corresponding storylines, with main and secondary aspects. This square art should also be orientated towards the movement of the sun, because it is in this way that it imitates nature (rather than the movement of the Latin writing system). Accordingly, each room should be entered on the right-hand side, with the movement of the imagination then finally ending on the left-hand side. In this respect, Fludd's concepts of rooms and squares are reminiscent of horoscopes (magic squares) as well as astrological "houses", thus establishing a further connection to the zodiac, as well as his round art.[53]

## 5e. Fludd's alphabets and numbers

To memorise letters, Fludd suggests that his readers should use five alphabetical orders, in his round as well as his square art. They are further asked to combine the Latin alphabet with images of men, women, wild animals, birds, and fish, with Fludd providing suitable images in each case. For example, the men and women in the round art represented gods and goddesses, such as Apollo and Andromache, with the suitable wild animals including the ox, ibex, and goat. Fludd combines the animals with allegories of virtues and vices, such as ambition looking up at the sun or bestiality looking down with wild hair, to generate letters from A to X. In the square art, people such as Abraham and Penelope, wild animals such as donkeys, oxen, and camels, and birds such as eagles, owls, and crows are suitable for memorising letters. On the other hand, numbers should be memorised by images of inanimate objects, and animals and objects should always be combined with people to represent aspects of action. According to Fludd, a man sitting on the back of a

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[50]    On square art, also see Fludd, "Ars memoriae", 56-58.
[51]    Fludd, "Ars memoriae", 51-52.
[52]    *Ibid.*, 53. This comparison is surprising, because Fludd uses the monochord extensively in the *UCH* to illustrate his cosmology.
[53]    Cf. *ibid.*, 57. The illustration of the five places also takes up the depiction from the technical history of the macrocosm; cf. Fludd, "De arithmetica memorali", in *UCH* I, b, 153.

Fig. 8 a and b – Fludd's alphabets and numbers, a) Johann Theodor de Bry and Workshop (?), pen and ink drawing, in: Fludd, *De technica microcosmi historia.* UB Frankfurt am Main, MS lat. qu. 15, fol. 72 verso (detail), without annual details, b) Matthäus Merian the Elder (?), etching, in: Fludd, "Ars memoriae", UCH II,a,2. HAB Wolfenbüttel: A: 111 Quod. 2° (2), 61.

donkey with a lance, for example, represents the number ten ("10"), with the lance symbolising a "1" and the donkey symbolising a "0" (Figs. 8 a and b).[54]

### 5f. Colours and metals in Fludd's memory theatres

In the round theatre, Fludd specifies that one should imagine the images as being transparent, like shadows. In the sunset theatre, they should be imagined as black or brown in colour.[55] And in the square art, the images and their five locations should be differentiated by clear colours: the first place should be white like a snow-covered field, with the other places being red like a blood-soaked battlefield outside the theatre, green like a square with grass and trees in front of the entrance to the theatre, blue like the water from fountains pouring

[54]   Fludd, "Ars memoriae", 59-62.
[55]   *Ibid.*, 60, 62-63, 65, 67.
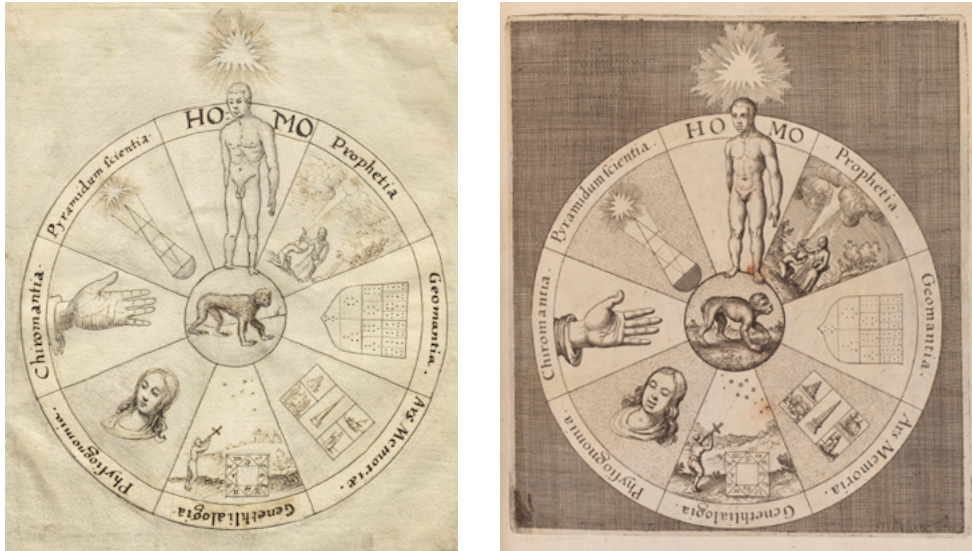
Fig. 9 a and b – Mnemonic wheel of the technical history of the microcosm, a) Robert Fludd in collaboration with Johann Theodor de Bry and Workshop (?), pen and ink drawing, in: Fludd, *De technica microcosmi historia.* UB Frankfurt am Main, MS lat. qu. 15, fol. 1 recto, without annual details; b) Matthäus Merian the Elder, etching, title page, in: Fludd, UCH II,a,2. HAB Wolfenbüttel: A: 111 Quod. 2° (2), 1.

out from everywhere in front of the entrance and black like a cave or underground grotto. These locations are also characterised by the shapes and colours of the five columns: the outer two columns are to be circular and have the opposite colour to the opposite door or the opposite place, while the centre column is to be hexagonal, with the two columns between them being square. Fludd also decorates this square theatre with various instances of metal. Attached to the columns are rings and chains for the animals, with these animals representing certain adverbs, conjunctions, prepositions, and interjections, according to the imagination of the reader. In addition, the white pillar was to be fitted with a silver ring and a silver chain, the red pillar was to be fitted with a copper ring and a chain made from a twig (i.e., a green chain), the blue pillar was to be fitted with a lead ring and corresponding chain, and the black pillar was to be fitted with a ring and a chain made from iron.[56] The five doors of the round art should also be imagined as white, red, green, blue, and black.[57]

The colours and metals mentioned by Fludd hint at his awareness of the importance of alchemy. Moreover, Fludd also names Raymond Lull, a figure from the history of alchemy,

[56]   *Ibid.*, 63.
[57]   *Ibid.*, 65.

Fig. 10 a and b – Imagination as a faculty of memory, image from the title page of the "Ars memo-riae", a) Johann Theodor de Bry and Workshop (?), pen and ink drawing, in: Fludd, *De technica microcosmi historia*. UB Frankfurt am Main, MS lat. qu. 15, fol. 57 recto, without annual details; b) Matthäus Merian the Elder, etching, in Fludd: "Ars memoriae", UCH II,a,2. HAB Wolfenbüttel: A: 111 Quod. 2° (2), 47.

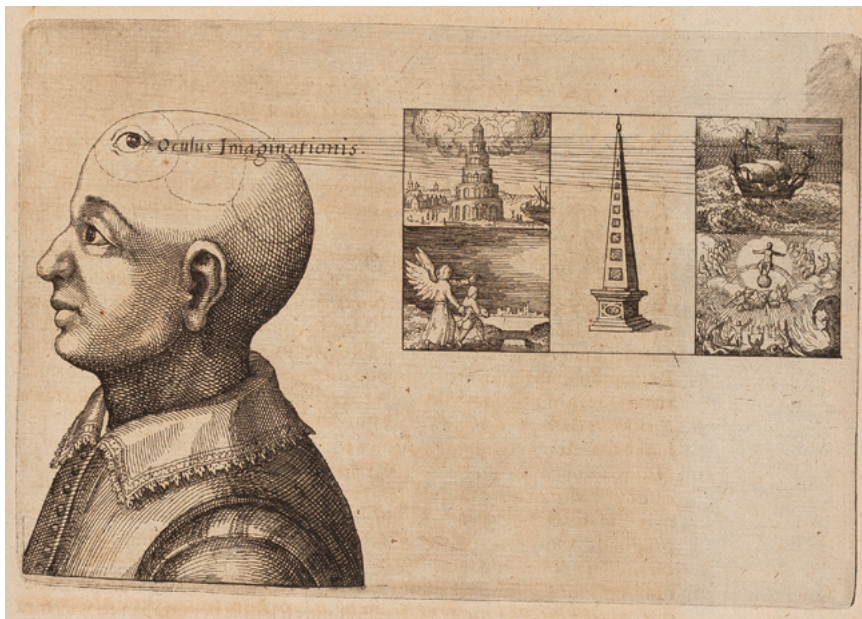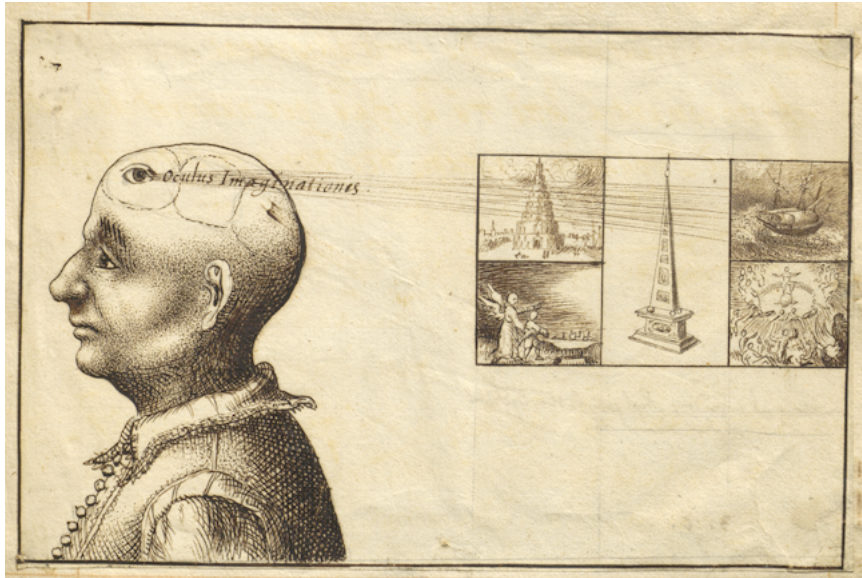who is one of the protagonists of the theatre, complete with vials and an alembic.[58] Fludd then imagines a female bear (probably in allusion to *Ursa major*, the Great Bear constellation) breaking Lull's vials, which prompts Lull to throw a mortar at her. The individual components (the bear and Lull) represent individual letters, with the scene as a whole working to memorise a name (in this case, the angel Uriel?). In any case, through this example, Fludd reveals the role that Lull plays in his own memory theatre.[59]

## 6. Fludd's interest in images

In addition to the images of the zodiac, the two theatre stages of the *theatrum rotundum*, the stage of the *theatrum quadratum*, and the various images of alphabets and numbers, Fludd also uses a range of other impressive images to situate the art of memory in the real as well as biblical worlds. For example, the title page of the "Ars memoriae" shows a bald protagonist, whose "Oculus imaginationis" (eye of imagination, or third eye) offers a view of five scenes from the Bible and history: the Tower of Babel, a forest or Tobiah with the fish, the archangel Raphael behind, an obelisk (as the main image), a ship on sea, and a prophet or the Last Judgement (Figs. 10 a and b). These five scenes are not discussed in the main text: Fludd's "Ars memoriae" provides readers with a repertoire of exemplary figures. They are, however, required to produce their own narratives, in order to develop and then train their own memory system.

Although Fludd was an Anglican, his relationship with images was unwaveringly positive, as can be seen in his explanations of the emblems with which he opens the *UCH*. Fludd explains that the materialisation of the world in Genesis goes hand in hand with a visualisation that can be represented and interpreted philosophically.[60] However, he also works with images in a very pragmatic and technical way, by conceptualising the *UCH* through the repetition of pictorial motifs in a uniform design. Describing the covers of the two histories of technology, Yates used the term "mnemonic wheel[s]",[61] making it clear that Fludd conceived both histories in a visually consistent manner, with their overall conception being related to his "Ars memoriae". In this respect, the spokes of the various "mnemonic wheel[s]" represent the topics (disciplines) of the respective parts (Figs. 9 a and b, fig. 11). What is more, in the illustration for the technological history of the microcosm, the individual disciplines are named (Fig. 9 a and b), with Fludd also including their images on the title pages of the parts. For example, the part on "Ars memoriae" has its own title page and image (Figs. 10 a and b), which quotes, with slight alterations, the images

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58   *Ibid.*, 68.
59   *Ibid.*, 69. This scene also reminds Giordano Bruno's rejection of astrological-magical imagery in his *Spaccio de la bestia trionfante*.
60   Fludd, *UCH* I, a, 7-8.
61   Yates, *Theatre of the World*, 44-45.

Fig. 11 – Mnemonic wheel of the technical history of the macrocosm, signed title page by Matthäus Merian the Elder, etching, in: Fludd, UCH I,b. HAB Wolfenbüttel: Xb 4° 8, without pagination.

that have already been used for "Ars memoriae" on the title page of the technical history of the microcosm (Fig. 9 a and b). The bald protagonist (Figs. 10 a and b; Fig. 12) is also a recognisable figure who guides the reader through the text.

As Westman notes, Fludd's images were not intended to act as illustrations, but rather as "ways of knowing, demonstrating, and remembering", which helped readers and viewers to direct their selves back towards inner unity with God, the Creator.[62] When he was constructing these images, however, Fludd did not rely exclusively on his intuition, since he

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[62]   Westman, "Nature, Art, and Psyche", 181.

Fig. 12 – Man with scheme of competences, etching by Matthäus Merian the Elder, in: Fludd, UCH II,a,1. HAB Wolfenbüttel: A: 111 Quod. 2° (1), 217.

also made use of arithmetical concepts. Indeed, his chapters on optics and the art of drawing make it clear that his geometric depictions – especially his triangular shapes – were heavily based on Albrecht Dürer's theory of proportions.[63]

The many discs and squares that appear throughout the *UCH* again suggest that Fludd designed many of these images with his *ars rotunda* and *ars quadrata* in mind. Beginning with the general title page of the *UCH* (Fig. 13), many of the images appear as if they had been memorised by Fludd, in accordance with his round and square arts (Figs. 14 and 15). Some images also demonstrate the different settings of day and night (Fig. 16), with others often forming pairs (pairs of images and letters or images and numbers, as well as pairs of recurring motifs). In this respect, Fludd's "Ars memoriae" is to be considered as a methodological key to the entire *UCH*, because it makes his approach to images more explicit. In terms of the history of ideas and the material history of science, it can also be added that

Fludd's mnemonic wheels are reminiscent of Lull's artefacts: it would have been easy to cut them out, reinforce them with cardboard, then attach a metal needle to them, in order to use them as turning discs or machines. The etching skills of Merian probably prevented readers for reaching for the scissors, while the book's publisher, de Bry, also produced some oversized images of the *UCH* as folded sheets, thereby fulfilling a need for haptics and three-dimensionality.

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[63]    *Ibid.*, 186-193.

Fig. 13 – Title page of *Utriusque cosmi historia*, etching by Matthäus Merian the Elder, in: Fludd, UCH I,a. HAB Wolfenbüttel: Na 4° 41, without pagination.

nempe *Capricornus*, genua. *Aquarius*, tibiam utramque, & *Pisces*, pedes ambos. Qui quidem signorum ad membra respectus tam sanitatem intuentur, si concordiis naturalibus à Planetis respiciantur, quàm morbos: nam si discordiis & antipathia cum pravis Planetarum dispositionibus concurrant, & per consequens naturæ humanæ dissonent, operationes contra naturæ institutum producunt, morbosque seu effectus corpori humano infestissimos pariunt.

*Demonstratio sequitur.*
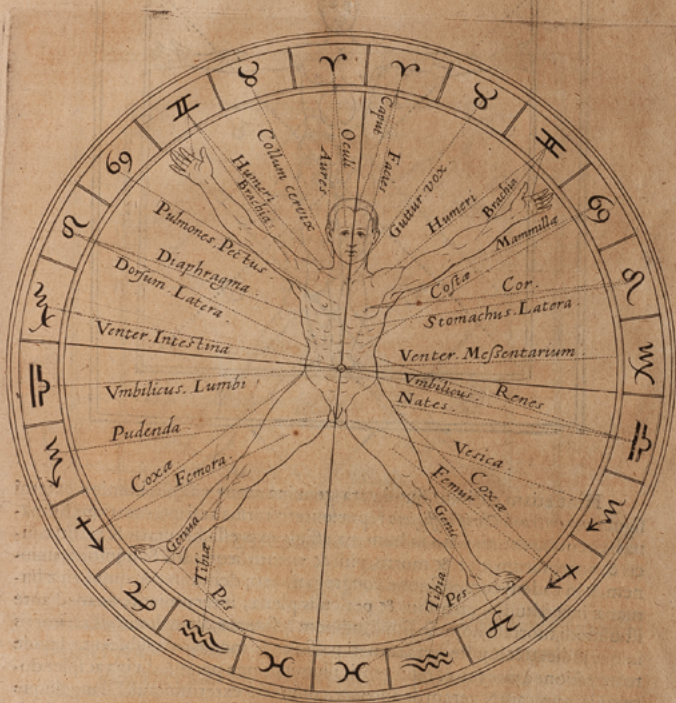


Est etiam compositio Microcosmi externi cuilibet alii figuræ regulari apta atque conformis, quatenus, pro diversa membrorum protuberantium positione, diverso modo constituitur. Nam in una ejus statione directa, tibiis nullo modo extensis, sed serratis, manibusque cum brachiis ad angulos rectos à corpore expansis, atque in longum ab utroque latere complete porrectis, denotabit verissimam quadrati æquilateralis proportionem. Hujus rei demonstratio inferius sequitur, in qua declaratur, quod hujus etiam quadrati centrum sit pudendorum seu genitalium punctus; quippe cum duæ lineæ rectæ seu diametrales, ductæ ab angulo uno quadrati ad ejus oppositum, faciant intersectionem

P                                                                   nem

Fig. 14 – Man in the zodiacs of the macrocosm and the microcosm (circular form), etching by Matthäus Merian the Elder, in: Fludd, UCH II,a,1. HAB Wolfenbüttel: A: 111 Quod. 2° (1), 113.

humanæ figuræ è regione explicatur secundùm nonnullorum opinionem,
quod Adam primus homo circa horam meridiei creatus fuerit;in cujus medio
cœlo,quoniam Aries inventus fuit,dominium in illud hominis membrum ha-
buit,quod cœli medii angulum respexit,videlicet caput.  Quod autem hujus fi-
guræ quadratæ centrum sit in umbilico,declaratur exinde,quod lineæ duæ re-
ctæ progredientes ab angulis quadrati ad angulos sibi oppositos,se invicem in
puncto seu centro umbilici intersecant, ut in demonstratione sequenti decla-
ratur.
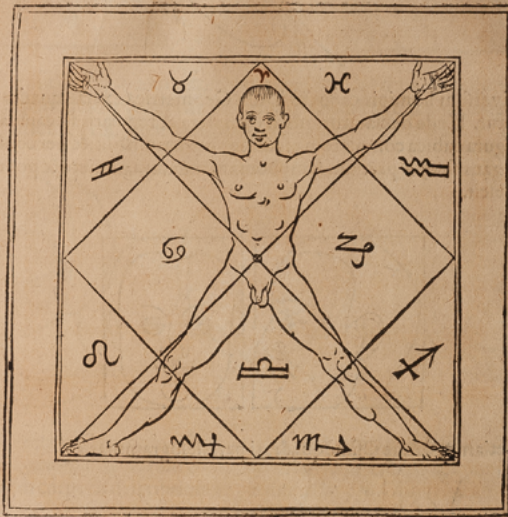


De nonnullarum corporis humani partium convenientia cum figuris Geome-
tricis;& primum quidem,quomodo in harmonia figuræ triangulari,
deinde in quadrangulari,& postea in ovali ac denique
in circulari conveniant.

Latus unicum faciei humanæ sub figura triangulari æqualium laterum
comprehenditur.  Ex quo luculenter demonstratur,quod regularis & confor-
mis sit faciei harmonia proportionibus linearum Geometricis:

P  2                    Uni-

Fig. 15 – Man in the zodiac, with the navel in the centre of the St. Andrew's cross (square form),
Workshop of Johann Theodor de Bry, in: Fludd, UCH II,a,1. HAB Wolfenbüttel: A: 111 Quod. 2°
(1), 115.
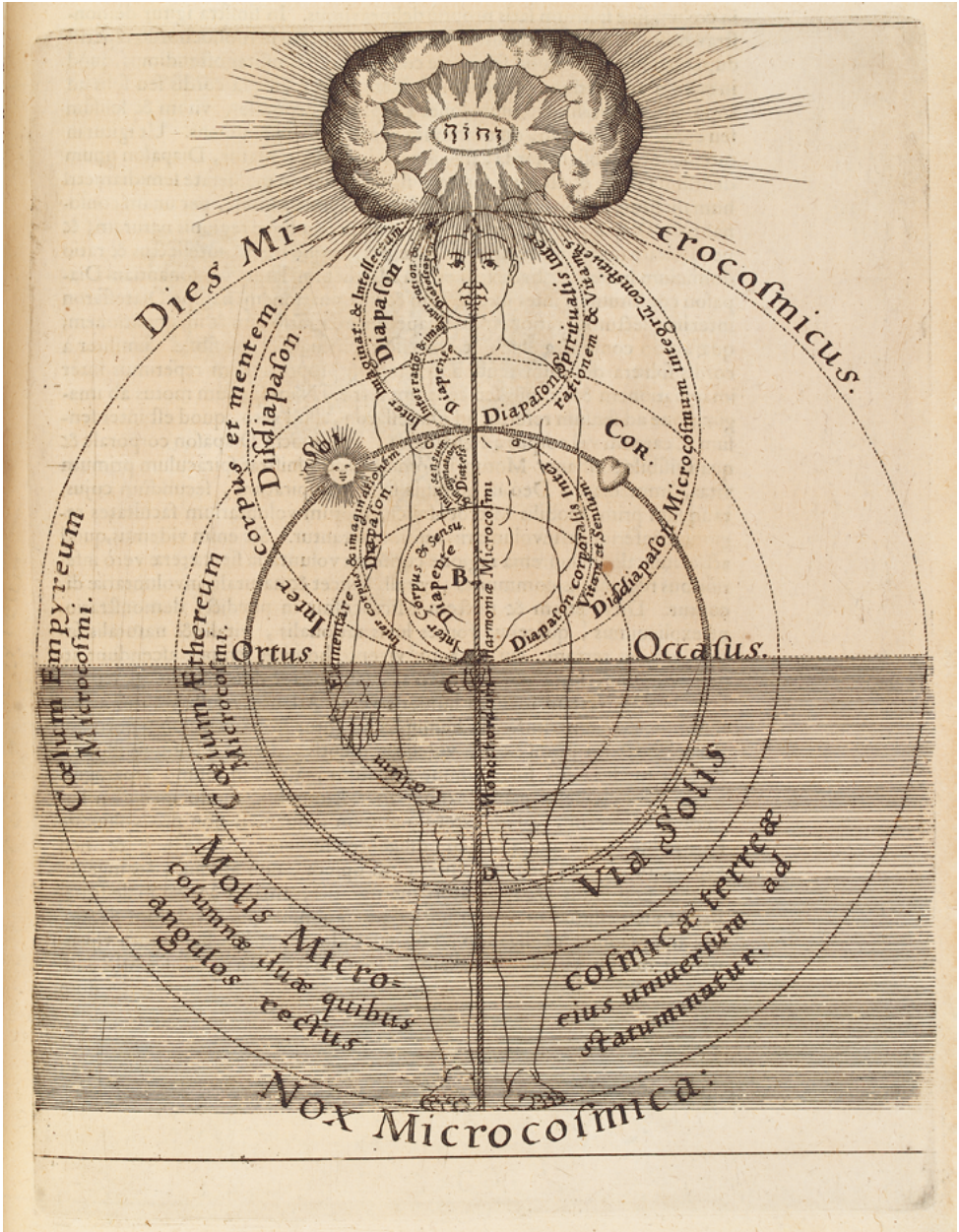
Fig. 16 – Dies Microcosmicus, Nox Microcosmica: Harmonies of man, divine proportions and their corresponding musical intervals, applied to the human body, etching by Matthäus Merian the Elder, in: Fludd, UCH II,a,1. HAB Wolfenbüttel: A: 111 Quod. 2° (1), 275.

## 7. *The arts as a systematic place of Ars memoriae*

### 7a. Fludd's UCH as a pictorial work of art

Fludd's overall artistic vision, as realised in the publication of his folios by de Bry and the manifestation of his images by the engraver and etcher Merian the Elder, resulted in the *UCH* constituting a pictorial work of art, despite the rather mediocre quality of the editing and the paper.[64] The edition of the *UCH* makes it clear that new possibilities in book art – such as the young Merian's expertise in etching – were opening up in the period around 1600, almost completely eclipsing the advantages of manuscripts. However, there was one limit to book art that continued to be encountered: colouring. Even though Fludd's pictures of Genesis could be very well realised in black and white, especially given that Merian enabled the printers' full use of the rich black tone, Fludd's theatres, with their doors, their alignment with the light of the sun, their columns, and their metals, actually called for colours. The publisher would only have been able to comply with this requirement by having the individual copies coloured by hand, but the pen and ink drawings of the manuscript are also uncoloured.[65] As a consequence, the various images of the theatres are somewhat disappointing. However, it is also in favour of Fludd's philosophy that his text stimulates the imagination of further possibilities of technical realisation.

In the remaining sections, I close my article with the reflections of some modern and contemporary approaches to the concept of *ars memoriae* which have been stimulated by hermeticism, and in particular by Fludd's hermetic image concepts.

### 7b. Aby Warburg's Mnemosyne Atlas of Images

Fludd's use of the zodiac – which is reminiscent of the divination boards that had already been used in antiquity as well as the astrological frescoes in early modern palaces – is illuminated by the tradition and material culture of astrology, which is reflected in the history and theory of architecture. In the twentieth century, Aby Warburg, the art historian and cultural scientist, called attention to the significance of these ancient zodiacal mar-

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[64]  On this lack of quality, cf. Yates, *Theatre of the World*, 72: "The De Bry books do not have the aesthetic appeal of the products of the great humanist presses. They are printed on bad paper which has badly discoloured with time; they are rather hastily printed with a good many typographical errors; the engraving is good but cannot compare with really first-class engraving. The De Bry books were poured forth in haste, as though to produce as much as possible before darkness [the Thirty Years war, U.F.] fell". With regard to the quality of Merian's etchings and engravings, I do not agree with Yates.

[65]  The manuscript contains only one coloured (washed) pen drawing. It is an illustration of chiromancy; cf. MS lat. qu. 15, fol. 170r.
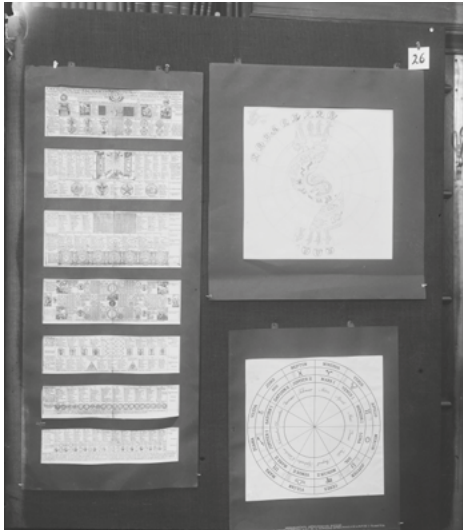
Fig. 17a – The Warburg Institute, Aby Warburg, Bilderatlas, 1929, Catalogue No. WIA, III.107.7, Panel 26.
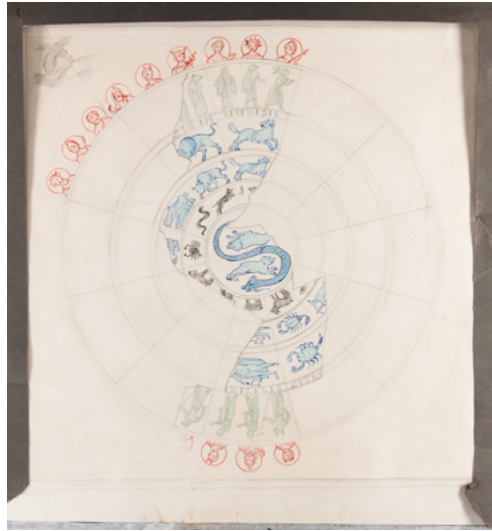
Fig. 17b – Mary Warburg: Schematic Drawing of the Tabula Bianchini, coloured, 1911, London. The Warburg Institute, Aby Warburg, Bilderatlas, 1929, Catalogue No. WIA, III.107.7, Panel 26, detail: No 2.

bles and early modern frescoes in relation to the history of ideas.[66] For his part, Warburg worked with the concept of the mythical goddess "Mnemosyne", beginning work on an atlas of images under the name of "Mnemosyne" in 1924 (which remained unfinished in 1929, the year of his death). In 1925-1926, this name was engraved above the lintel of the door to Warburg's new semi-public Hamburg library.[67] Plate 26 from the fragmentary version of his atlas of images reveals that Warburg perceived a historical relationship between the broader topic of memory and Renaissance astrology (Fig. 17a). The image shows seventeenth-century calendars on the left, with Mary Warburg's coloured schematic drawing of the "Tabula Bianchini" – an astrological divination board with zodiac and decans from the second century AD, in which the decans of Aries are emphasised

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[66] On the frescoes of the Palazzo Schifanoia, cf. Warburg, "Italienische Kunst und internationale Astrologie im Palazzo Schifanoja zu Ferrara (1912)": Bredekamp and Wedepohl, *Warburg, Cassirer und Einstein im Gespräch*, 13-44.

[67] After the Warburg Institute emigrated to London during the National Socialist era, this name was established on the lintel of the new library. It can still be found today at both institutes, in Hamburg and London.

– on the right (Fig. 17b), and a twentieth-century scheme of the four elements below.[68]

In his "Mnemosyne" atlas, Warburg analysed the afterlife of antiquity, in the form of historically recurring motifs of emotions and passions (pathos formulas), with a focus on the European Renaissance: Medici Florence was the starting point. Warburg's aim was to show that ancient depictions of passions had been transformed by artists working in different historical and cultural moments. According to Warburg, the West's cultural memory was structured by pathos formulas: not only did he work with images from the Renaissance, but also with images from his own time, featuring new technical developments, such as the Zeppelin, as well as advertising spreads and newspaper cuttings – for example, documents and photographs representing the modern relationship between church and state. Shortly before his death, he became acquainted with the work of Giordano Bruno on a trip to Florence, realising that Bruno's confrontation with (and eventual rejection of) astrological-magical imagery was similar to his own problems in dealing with astrology and magic.[69] Had Warburg lived longer, it may have been possible to place Bruno's Copernican rejection of astrology in historical relationship not only with Bruno's art of memory, but also with Fludd's later art of memory – which renewed astrological symbols in a, so to speak, reactionary way.

As such, Warburg's "Bilderatlas" transcends the Renaissance, in terms of content as well as method, by referring to his own time at the beginning of the twentieth century. With its concepts of scholarly magic and the hermeticism of the macrocosm and microcosm, the European Renaissance is an original point of reference for Warburg's exploration of "Mnemosyne", yet his fragmentary work and other works from the Warburg Institute – including the works of Yates – make it clear that the concept of *ars memoriae* can be further transformed in the present age. Indeed, the theme of *memoria* is ultimately a broad one, which connects different epochs.

## 7c. Anselm Kiefer's works "for Robert Fludd"

In the early twentieth century, it was not only Aby Warburg who drew on the concept of *ars memoriae*. At the same time, the hermetic pictorial concepts of the Renaissance were also being taken up by surrealists, such as Max Ernst,[70] and ended up experiencing a boom in the twentieth century. Contemporary artists, following the *Ars povera* and Jo-

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[68]  Warburg, *Der Bilderatlas: Mnemosyne,* 44-45; cf. Warburg, *Bilderatlas Mnemosyne – The Original*, 60-61. See also The Warburg Institute, *Bilderatlas Mnemosyne, Final version*, available online at https://warburg.sas.ac.uk/archive/bilderatlas-mnemosyne/final-version.

[69]  On Warburg's "Bruno journey", see Johnson, *Memory, Metaphor, and Aby Warburg's Atlas of Images*, 194-229.

[70]  On the historical context of the artistic works of Antonin Artaud, Yves Klein, Sigmar Polke, and Warburg, see Seegers, *Alchemie des Sehens*, esp. 209-224, and on Max Ernst, see Warlick, *Max Ernst and Alchemy*.

seph Beuys, among others, were particularly interested in the alchemy of the early modern period.[71]

What was initially conceived in the Renaissance by philosophers such as Bruno and Fludd has subsequently been transformed and further elaborated by artists and intellectuals in the modern and contemporary eras. Michel Foucault located this shift in the field of literature (poetry and fiction),[72] while it can also be perceived in performances, installations, and films today. As such, during the transition from the Renaissance to modernity, the entire complex of the art of memory, hermeticism, and alchemy has undergone a shift from natural history and natural philosophy to the fine arts and art history.

For instance, the work of Anselm Kiefer, the internationally renowned German sculptor, deals with collective cultural memory by citing events, myths, and symbols of National Socialism and Christianity, Judaism, and Gnosticism, among others. Through his work, then, which is dedicated to history in both its creative and destructive aspects, Kiefer is able to pursue his own art of memory, by artistically appropriating events, myths, and symbols from the past in order to transform them.[73] Since around 1985, Kiefer has used lead as a material for his increasingly monumental works, including "books".[74] What is more, he also uses lead "books" in *oeuvres* that obviously invoke the alchemical theme of transmutation, such as his installation *Nigredo*,[75] from 1998, as well as his installation *Athanor*, from 2007, which he created as a permanent exhibition for the Louvre in Paris.[76] In the alchemical-astrological context, lead represents both the god Saturn and the constitution of melancholy, as well as the beginning of the process of transmutation (from lead to gold). Kiefer has been impressed by Fludd's texts, especially by his kabbalistic statement that every plant on earth corresponds to a star in the sky. He has dedicated numerous works to Fludd since 1996, including books titled *Für Robert Fludd*,[77] and the cycle of works *The Secret Life of Plants, for Robert Fludd*.[78]

These works combine the materiality of lead with the motifs of the library, the starry sky, and the plant world. Kiefer often writes in and on his works by hand: for example,

[71]  Cf. Dupré, von Kerssenbrock-Krosigk, and Wismer, *Art and Alchemy*.
[72]  Cf. Foucault, *The Order of Things*, 48-49.
[73]  On Kiefer's art as an art of memory, cf. the English edition: Arasse, *Anselm Kiefer*, 64-95.
[74]  Arasse (English edition), *Anselm Kiefer*, 156.
[75]  Minssieux-Chamonard, *Anselm Kiefer*, 8, on Fludd see 166-167, 200-201.
[76]  See Musée du Louvre, *Anselm Kiefer au Louvre*.
[77]  For detailed images of Kiefer's "Für Robert Fludd", 1996, book, acrylic and emulsion on photographs on cardboard, 17 pages, 103.5 x 81.5 x 11 cm, see the German edition: Arasse, *Anselm Kiefer*, 254-257.
[78]  There exist different versions. For Kiefer's ensemble "The Secret Life of Plants, for Robert Fludd, 2001/02", 14 panels, mixed media and lead on canvas, 198 x 340 cm, 200 x 290 cm, 195 x 570 cm, see Kunst- und Ausstellungshalle der Bundesrepublik Deutschland, *Anselm Kiefer – am Anfang*, 86-119, 182.

Fig. 18: Anselm Kiefer: "Großer Bär (Great Bear)", 2001, panel, 193 × 338 cm. Oil, emulsion, acrylic, and chalk on lead, on canvas, with plaster-covered branch. Photo: Margrit Olsen. © Anselm Kiefer.

the title of his book *Für Robert Fludd* appears in his own handwriting. Otherwise, the multi-part cycle *The Secret Life of Plants, for Robert Fludd* combines microcosm (life on earth: plastered twigs, lead shirts, shoes, a hand, and a stuffed goose) with macrocosm (the starry sky), by presenting both in the same way, on a lead background which is covered with astronomical constellations from NASA. Here, though, a number of artistically remodelled astrological constellations stand out – such as [Wilhelm] "Raabe" (the German term for the raven is "Rabe", thus "Raabe" seems to allude to a historical person; cf. zool. raven, astron. Corvus), the goose or "swan" (astron. Cygnus) or the Great Bear. The plaster-covered branch of the Bear appears like a part of its skeleton and thus evokes absent hunters (zool. hounds, astron. Canes Venatici) (Fig. 18).[79] Kiefer thus manages to present both the current astronomical world view alongside a more individual, mythical form of appropriation, similar to the way that Fludd managed to confront the new Copernican world view with his own magical and geocentric one. In addition to lead and books, sunflowers are also very present in Kiefer's works. Sunflowers, by following the movement of the sun via their orientation, can demonstrate the power of heliotropism: in the early modern period, such a movement was explained as a form of similarity, or

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[79]   For the Cygnus and the Corvus, see Kunst- und Ausstellungshalle der Bundesrepublik Deutschland, *Anselm Kiefer – am Anfang*, 90-91, 114-115.

Fig. 19: Anselm Kiefer: "Jason", part of the oeuvre "Johannis-Nacht", 1990. Former stable, soil, lead, teeth, dresses and ashes. Installation at the Mönchehaus Museum Goslar, detail. Photo: Uwe Walter. © Anselm Kiefer.

sympathy.[80] In this respect, Kiefer's work with sunflowers represents a "*demonstratio*" of hermeticism – and in the various works "for Robert Fludd", these sunflowers can be interpreted as "*demonstrationes*" of Fludd's philosophy, given that the sun (an analogue for God) was at the centre of Fludd's attention.[81] Finally, both Kiefer and Fludd are drawn to some of the same myths, such as the myth of Medea, which Kiefer has staged in public space as his installation "Jason" (Fig. 19).[82]

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[80]  On the "four similitudes" – *convenientia*, *aemulatio*, analogy, and sympathy – as "episteme" of Western Renaissance thinking, see Foucault, *The Order of Things*, 19-28.

[81]  For the interpretation of Kiefer's works on Fludd, also see the English edition: Arasse, *Anselm Kiefer*, 256-265.

[82]  For Kiefer's "Jason" installation, which is a part of his oeuvre "Johannis-Nacht", 1990, at the Mönchehaus Museum Goslar, see Bastian und Ruhrberg, *Anselm Kiefer*,12-29.

## 8. Conclusion

The affinity of modern scholars and artists for Fludd's works testifies to a certain discomfort with the dichotomy between natural sciences and humanities or art: or, to put it positively, to an interest in approaches that preceded (or deviated from) this dichotomy. In terms of the history of knowledge, Fludd and other natural philosophers from the Renaissance remain relevant today, then, precisely because of their hermeticism. Indeed, modern and contemporary artists invoke spiritual as well as artisanal aspects of early modern hermeticism, which have been largely superseded by scientific progress from the seventeenth century onwards, but which have by no means lost their fascination. Thus, examining such aspects has an epistemological dimension, as it questions the development through which natural history and historical-philological knowledge have diverged into the so-called two cultures.[83] The art of memory is a suitable topic for this reflection. It is an object of visual and book art. As such, it reconciles art, spirituality, craftsmanship and entrepreneurship.[84]

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[83]   On the concept of the two cultures – literature and the natural sciences – see Snow, *The Two Cultures*.

[84]   For the reflection and reenactment of early modern craftsmanship, see Smith, *From Lived Experience to the Written Word*.

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# The *ars memorativa* and *ecfrasis*: Technical and exhortative descriptions to construct the great theatre of memory

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**Abstract**

The highly suggestive but also emblematic relationship between the art of memory and rhetorical ecphrasis has often been noted and investigated since the earliest studies devoted to *ars memorativa*. Indeed, the so-called *imagines agentes* require strong psychic representations capable of strongly mobilizing the passions of the memory artist, effects comparable to those that are provoked by ecphrastic descriptions (*enargeia*). However, there are few studies that deal in depth with *loci memoriae* from the perspective of ecphrasis. So this contribution aims to reconsider the relationship between the art of memory and ekphrasis through the rereading of a series of early modern mnemonic treatises focusing especially on their peculiar ways of illustrating the composition of architectural mental places, described in a clear, detailed and effective way so that readers can compose them by oneself. From such an approach I believe it is possible to thoroughly highlight the synergy of words, images and spaces. Main texts to be analyzed are chosen from mnemonic treatises that present compressed architectural mental places such as theaters, palaces, cities, gardens, including *Utriusque Cosmi, Maioris scilicet et Minoris* ( … ) by Robert Fludd, *Thesaurus artificiosae memoriae* by Cosma Rosselli, etc.

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## Introduction: digression, ecfrasis and the art of memory

In the *Istitutio Oratoria*, Quintilian introduces the famous episode ("vulgata fabula") on the birth of the *ars memorativa* when he discusses the capacity of memory indispensable to the ideal orator.[1] In particular, he recounts how the Greek poet Simonides, during a banquet at the home of a wealthy nobleman who was his patron, was invited to compose a *carmen* to celebrate him. However, contrary to the prearranged agreement, he was refused part of the fee because he had praised Castor and Pollux in a digression ("degressus in laudes Castoris ac Pollucis exierat"). As is known, this 'digression' saved his life.

The short but touching episode, inserted at the beginning of the argumentation, effectively summarises the arguments with which Quintilian illustrates the rules of mnemonics and explains how this *ars* works, based on place, order and images. By means of anecdote, the author summarises the essential parts of the mnemonic mechanism so that readers can prepare themselves to learn it. On the other hand, the description sounds 'ecphrastic' thanks to the use of vivid and singular images, capable of arousing strong emotions in the reader.

The combination of the history of invention and *ecphrasis* is reminiscent of a particular literary genre in the Greco-Roman tradition. These are the so-called 'technical treatises' teaching new sciences and engineering such as architecture, military strategies, hydraulics and medicine. From a certain point of view, the art of memory is nothing but a technique, or rather a multi-dimensional 'mechanism' composed of a series of detailed prescriptions.

Based on the new studies on *ecphrasis,* this short essay intends to 're-read' mnemonic treatises, especially those published during early modern period in Europe, as a literary-collective *corpus* characterised by a particular way of transmitting practical-theoretical knowledge. Such a perspective makes it possible to highlight an as yet unexplored relationship between texts, images and virtual spaces in the *ars memorativa*.

## Is it only imagines agentes? The art of memory and the various types of ecphrasis

Since the beginning of modern research on Renaissance mnemonics, the relationship between the *ars* and *ecphrasis* has been repeatedly emphasised. Fundamental appears to be the concept of *enargeia*[2] according to which images can be vividly represented in the mind, so that they become visible to the eyes of the reader or listener even in their absence.[3] The more intense and moving the mental figures are, the more effective the mnemonic system will be.

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[1]    Quintilianus, *Istitutio oratora*, 11.2.11-13; See also Cicero, *De oratore*, 2.86.352-354.
[2]    Quintilianus, *Istitutio oratora*, 6.2.31-32.
[3]    *Ibid.*, 6.2.29.

Most previous studies have focused on the analysis of *imagines agentes*.[4] However, the suggestive results of recent studies devoted to *ecphrasis* invite us to reconsider the relationship between description and mnemonics.[5] It should not be forgotten that the latter is composed of *loci* and *imagines*, and sometimes the two elements are so symbiotically united that they cannot be separated distinctly.

Already in the *Rhetorica ad Herennium,* written between 86 and 82 B.C., the anonymous author of ancient Rome advised his readers to place marks at each *locus:* the representation of a hand for the fifth *locus*, that of a person called *Decimus* for the tenth *locus*.[6] Basing themselves on classical authority, some 16th-17th-century treatise writers argued that mental *locus* should not be left empty;[7] instead, it is necessary to differentiate them by means of eye-catching signs or images, such as frescos, notable objects, or, in some cases, even human figures. For example, in the *Arte del ricordare* (1583) Giovan Battista Della Porta, when introducing the inhabitants of the *loci*, emphasises how they are only activated when the practitioners of the *ars* mentally wander through the mnemonic *loci*.[8]

The interpenetration between *imagines agentes* and mental places occurs in highly original architectural contexts. In mnemonic treatises, these descriptions appear 'ecphrastic', thus blurring the boundary between *imagines agentes* and *loci*. These are the so-called 'invented' or 'fantastic' places, suggested by some Renaissance authors despite the tenacious opposition of traditionalists against the excesses of imagination; a large group of theorists actually prefer *loci* based on real buildings. From a certain point of view, therefore, the memory artist is nothing other than an architect, since the act of constructing mental places so sought after belongs to the *res aedificatoria.* This comparison between architecture and mnemonics opens up a path that has not yet been trodden in our research.

[4]  On the relationship between ecphrasis and mnemonics see: Ernst, "Ars memorativa und Ars poetica in Mittelalter und Früher Neuzeit", 73-100; Bolzoni, "L'art de la mémoire et le travail de l'oubli", 145-157; Donia, "'Ut pictura lingua': ecfrasi e memoria nelle pagine di Vincenzo Borghini", 307-355.

[5]  We limit ourselves in general to: Webb, *Ecphrasis, Imagination and Persuasion in Ancient Rhetorical Theory and Practice*; Norton, *Aspects of Ecphrastic Technique in Ovid's Metamorphoses*; Elet, *Architectural Invention in Renaissance Rome*; Koopman, *Ancient Greek Ecphrasi*; Panagiotidou, *The Poetics of Ecphrasis.*

[6]  *Rhetorica ad Herennium,* III, 31.

[7]  For example, the leading memory theorists of the 16th century such as Pietro da Ravenna, Lodovico Dolce and Filippo Gesualdo. For bibliographic information on their work, see the footnotes below.

[8]  Della Porta, *Ars reminiscendi*, 68-70.

## Corpus mnemonicus: *technical manuals to illustrate how to construct mental places*

Treatises on memory are special texts: they not only describe the system, which functions like a machine, but also require readers to reproduce this mechanism mentally in order to achieve the desired goal. In other words, manuals of the *ars* invite 'active' reading on the part of their readers. In this regard, the sections devoted to the fabrication of complicated mnemonic *loci* are of considerable interest. Here, readers learn how to construct the mental edifices to house the *imagines agentes*. It is appropriate to apply to such texts the concept of 'technical ecphrasis' theorised by Courtney Ann Roby, in order to highlight the characteristics of ancient manuals dedicated to certain types of 'artefacts' such as buildings, military machines and aqueducts.[9]

According to Courtney Ann Roby, in addition to the actual *ecphrasis*, i.e. those devoted to the representation of any given artefact and the instructions for making it, there are also peripheral descriptions that can be called *parecphrasis*, since they serve to place the described objects in the broad cultural context in order to make it easier for less experienced readers to understand.[10] Examples cited include the history of the invention of a given artefact, the lives of previous inventors, historical episodes concerning the artefact in question, the personal experience of the author, the reaction of those who saw the artefact, etc.

These literary characteristics can also be found in numerous treatises on the art of memory printed between Humanism and the Renaissance. If a single treatise is not able to elaborate all the necessary precepts, it is instead possible to consider the set of printed texts on mnemonics as a collective *corpus*. In the ecphrasistic descriptions that illustrate place-based prescriptions, there also appear a series of *historiae* that belong to the domain of *parecphrasis*. These not only facilitate the understanding of those who intend to learn the *ars*, but also provoke the involvement of readers. Before turning to the analysis of texts that propose instructions on how to construct refined architectural *loci*, let us therefore take a brief look at the aforementioned literary inventions.

### History of invention

The well-known legend of Simonides, considered as the inventor of the *ars memorandi*, forms the essential part of most treatises, such as Ludovico Dolce's *Dialogo del modo di accrescere e conservar la memoria* (1562),[11] Della Porta's *Arte del ricordare*,[12] Filippo Gesualdo's *Plutosofia* (1592),[13] and Lambertus Schenkelius's *Gazophylacium artis memoriae*

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9    Roby, *Technical Ecphrasis in Greek and Roman Science and Literature*.
10   *Ibid.*, 104, 128-150.
11   Dolce, *Dialogo del modo di accrescere e conservar la memoria*, 13.
12   Della Porta, *Ars reminiscendi* aggiunta *L'arte del ricordare*, 61.
13   Gesualdo, *Plutosofia*, f. 11r.

(1610).[14] Of these works, Dolce's prescriptions are nothing more than a faithful translation into Italian of the Ciceronian version of the episode (*De oratore*, 2.86.352-354), while those proposed by Schenkelius copy the account reported by Quintilian almost verbatim.

### The wonderful results obtainable from *ars*

It is through the words that explain who the *ars is* supposed to serve that one can infer who the treatises are intended for. To cite one example, the Florentine Dominican Agostino Del Riccio, at the beginning of his manuscript *Arte della memoria locale* (1595), inserts a dedication entitled "Alla gioventù fiorentina studiosa di Lettere",[15] while numerous treatise writers list various professions, that of orator, theologian, philosopher, jurist, doctor, merchant, student and professor of the liberal arts and sciences. The authors highlight the remarkable results of learning these rules. We will limit ourselves here to quoting the words of the Florentine Dominican Cosmas Rossellius, according to whom, thanks to the miraculous power of mnemonics "movetur immobilis, mortua reviviscit", one can recall the past as if it had been written in letters or sculpted in marble ("tamquam literis exarata, vel in marmore sculpta").[16] It would be suggestive to imagine that the Dominican conceived such a metaphor inspired by the sculptural masterpieces found almost everywhere in his hometown.

### Lives of the illustrious masters of memory

Biographies of famous men of exceptional ability of memory also form an important part of the *historiae* of the *corpus*. Based on the popular literary genre of the time, such as eulogies of illustrious men,[17] historical figures such as Simonides, Metrodorus, Themistocles, Plato, Cicero, Caesar, Seneca, Hieronymus, St. Thomas Aquinas, Petrarch, Pico della Mirandola, etc. appear.[18] Of interest for our discussion is the fact that modern treatise writers are also mentioned in these lists: Peter of Ravenna, Romberch, Della Porta, Dolce, Rossellius.[19] This provides consistency and shows how a literary genre develops from the results of previous works.

### Recounting personal experiences

A host of authors choose the first person to report their personal experience and offer a 'model' to imitate. Among autobiographical narratives, the wanderings in search of the

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[14]   Schenkelius, *Gazophylacium artis memoriae*, 8-10, 273, 342.
[15]   Del Riccio, *Arte della memora locale*, f. 1.
[16]   "Epistola ad Candidum Lectorem". In Rossellius, *Thesaurus artificiosae memoriae*.
[17]   Giovio, *Elogi degli uomini illustri*. See also: Id., *Scritti d'arte*,
[18]   For the complete catalogue of this kind, see: Schenkelius, *Gazophylacium*, 10- 38. On Petrarch master of memory see Torre, *Petrarcheschi segni di memoria*.
[19]   Schenkelius, *Gazophylacium*, 29; Gesualdo, *Plutosofia*, f. 10v.

secret of the *ars* constitute a *topos* capable of increasing the authority of the treatise writer and engaging the readers.

The most famous example of this 'self- mythologizing ' is that of Pietro da Ravenna, founder of the literary mnemonic genre. In his best-selling booklet *Phoenix seu artificiosa memoria* (1491), in the opening part of the work (*Conclusio* I), the Italian jurist recounts how he, in his youth, had always wanted to be above any learned man, in the sphere of any discipline. This fury, as he calls it, drove him to compile more than a hundred thousand mental places inspired by the various cities he visited while wandering through the peninsula.[20] In the following pages (*Conclusio* III) he reveals the *secretum utilissimum* he discovered during his long wanderings: putting images of beautiful maidens in mental *loci,* since memory is influenced by the location of the girls, whose 'beauty', 'charm', Pietro da Ravenna emphasizes.[21]

As mentioned above, such 'inhabitants' in the *loci* act as catalysts that stimulate the fusion of *imagines agentes* and mental places.

Let us now move on to the analysis of *ecphrasis* that teach how to build places and realistic architectural scenographies, populated by well-characterised fantastic characters.

## The various ways of presenting loci

To explain how to accurately and effectively picture *loci* in the mind, the authors offer a wide range of rhetorical techniques. The impersonal form and the third person can induce a certain feeling of distance, arousing greater authority in the writer, to the detriment of the familiarity that might be installed with readers. The first-person singular contributes, according to Courtney Ann Roby, to producing a "'lived-in' space of construction", in which authors set a good example,[22] while in order to directly involve readers and exhort them to put into practice what they have read, authors resort to the imperative or the second-person form or the hortatory first-person plural subjunctive.[23] We should also not forget the central role played by the illustrations created through woodcuts or etchings, as they collaborate intimately to steer the readers' imagination in a certain direction. Again, it seems appropriate to compare these rhetorical techniques with those offered by ancient technical treatises as they share common characteristics: both attempt to produce vivid mental images by means of detailed descriptions of con-

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[20]  I consulted the following edition: Tommai, *Phoenix seu artificiosa memoria*, sig. B 4r.
[21]  "Secretum ergo habe utilissimum in artificiosa memoria, quod diu tacui ex pudore. Si cio meminisse cupis, virgines pulcherrimas colloca: memoria enim collocatione puellarum mirabiliter commovetur": *ibid.*, sig. C 1r.
[22]  Roby, *Technical Ecphrasis*, 204.
[23]  In this regard, see Elet, *Architectural Invention*, in which the remarkably interesting concept of "hortatory ecphrasis" is proposed.

crete artefacts.[24] Bearing in mind the aforementioned literary characteristics, we will continue by analysing some examples.

Most treatises propose *loci* according to a 'standard model': scale and measurements are 'relative' elements as they allow more flexibility in case the reader wants to make changes. Descriptions focus mainly on abstract theories, general principles, generic shapes of rooms, houses, buildings. This tendency also belongs to certain technical texts, especially works from the Hellenistic period, which deal with automata, gnomons or similar constructions.[25]

Among the mnemonic treatise writers mentioned so far, Gesualdo and Schenkelius present interesting examples. In the *Plutosophie*, Gesualdo proposes the idea of the "Libraria della Memoria".[26] Effectively using verbs of the subjunctive mode, the author exhorts the reader to fabricate in the mind large cities composed of a series of *loci*, in the form of palaces, to each of which a discipline is assigned.[27] As already mentioned, the size of the city and the individual palaces, the shapes, the colours, the ornaments, are left to the free choice of the "formatore".

Some similar, perhaps even more refined *loci* are elaborated in *Gazophylacium artis memoriae*. Using one of the buildings that make up the great city-*locus*, the author offers the image of a skyscraper of memory, whose floors reach up to 100. Each floor can comprise multiple rooms, from 20 up to 600, depending on the amount of information to be remembered.[28] Without any indication of the concrete shape of the buildings or the ornaments, the descriptions appear as a 'standard model' to be modified at will.

On the other hand, these two examples represent the so-called 'imaginary' *loci,* the creation and subsequent development of which was made possible by the authority of the *Rhetorica ad Herennium*. The anonymous author suggests creating imaginary *loci*, if not making do with the mental places already available.[29] With the rediscovery of the *ars* in the late 15th century and its gradual revival in the 16th century, it became possible

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[24] Roby, *Technical Ecphrasis*, Chap. 5.

[25] *Ibid.*, 87.

[26] Gesualdo, *Plutosofia*, ff. 55r-58v.

[27] "il formatore (...) giornalmente collochi il tutto nelli formati Luoghi (...)" (56v), "il formatore di questa Libraria vi ponga Quadri di Santi, eleggendosi un certo numero di Prencipi del Paradiso, Angeli, & Humani, (...)" (57r), "Dirimpetto a questi orienti e lumi debbe il formatore drizzar la sua Libraria" (*ibid.*).

[28] "Liceret etiam domum quandam accipere, in cuius lateribus 100 essent cubicula & in tota 400. deinde in primo tabulato 20, 40, 60, 80, aut 600 sumere cubicula, totidem in 2, 3, 4, 5, 6 & c. usque ad 100. aut ultra, ac tum una domus sufficeret pro omnibus necessariis": Schenkelius, *Gazophylacium*, 117.

[29] "Quare licebit, si hac prompta copia contenti non erimus, nosmet ipsos nobis cogitatione nostra regionem constituere, et idoneorum locorum commodissimam distinctionem conparare": *Rhetorica ad Herennium*, III. 32. Quintilianus also briefly mentions the possibility of inventing *loci*: "Etiam fingere sibi has imaines licet": Quintilianus, *Istitutio oratora*, 11. 2. 21.

to create some unforgettable *loci* to visualise in the mind through the expressive power of *ecphrasis*.

## The Memory of Inferno by Cosmas Rossellius

Among the countless treatises published in the 16th century, some lacking particularly original elements, the *Thesaurus artificiosae memoriae* (1579) by the Dominican friar Cosma Rossellius stands out.[30] In the text, he shows remarkable singularity in devising splendid cosmological *loci* inspired by Dante's journey. Starting from Inferno, the friar presents the *mundus mnemonicus* through elementary and celestial worlds, all the way to Paradise. Instead of a simple explanation on how to make *loci*, this section of the work constitutes a kind of travel 'diary'. The literary technique used is reminiscent of Frontinus' *De acquaeductu urbis* (1st century BC), a typical treatise in which the author follows the course of the aqueducts to illustrate Rome's water system.

It is also interesting to note the 'interchangeability' between *loci* and *imagines agentes*: in this mnemonic system, everything can become both image and place.[31] This is therefore a peculiar example of the aforementioned interpenetration between *imagines* and mental places.

Here we will focus only on the analysis of Rosselli's Inferno, as it represents the essential part of the work. After explaining the definition of the *loci* and their hierarchical structure (1v-2v), the author moves on to describe a series of *loci communi amplissimi*, the largest category of the mnemonic system, of which the Inferno is the starting point. The descriptions are divided into the following categories:

I. A summarised explanation of the general structure of Inferno. (2v-6r)
II. The importance of illustrations (7r-v)
III. Theological arguments on Inferno and further explanations on the damned placed here. (7v-11v)
IV. The illustration (woodcut) of the entire infernal *locus*. (12r)
V. A Carmine summarising in rhyme the composition of the *locus*. (13r-15r)

What characterises the description of the infernal *loci* is thus the complementarity of text and image. Although the illustration (Fig. 1) only appears in Part IV (12r), the author most probably intended to include it already in Part II, after having justified the use of physical images. Or at least he had the intention of having the readers observe the image on the

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[30] On this work see: Yates, *The Art of Memory*, 121-129; Keller-Dall'Asta, *Heilsplan und Gedächtnis*,149-184; Kuwakino, *L'architetto sapiente*, 243-284.

[31] "Nec mireris, quod eaedem res, quae pro locis serviunt in uno et eodem discursu minime alterato, ac in eodem tempore, etiam pro figuris deserviant. in consimilibus enim discursibus easdem res et figuras esse et loca non dedecet": Rossellius, *Thesaurus*, f. 78r.
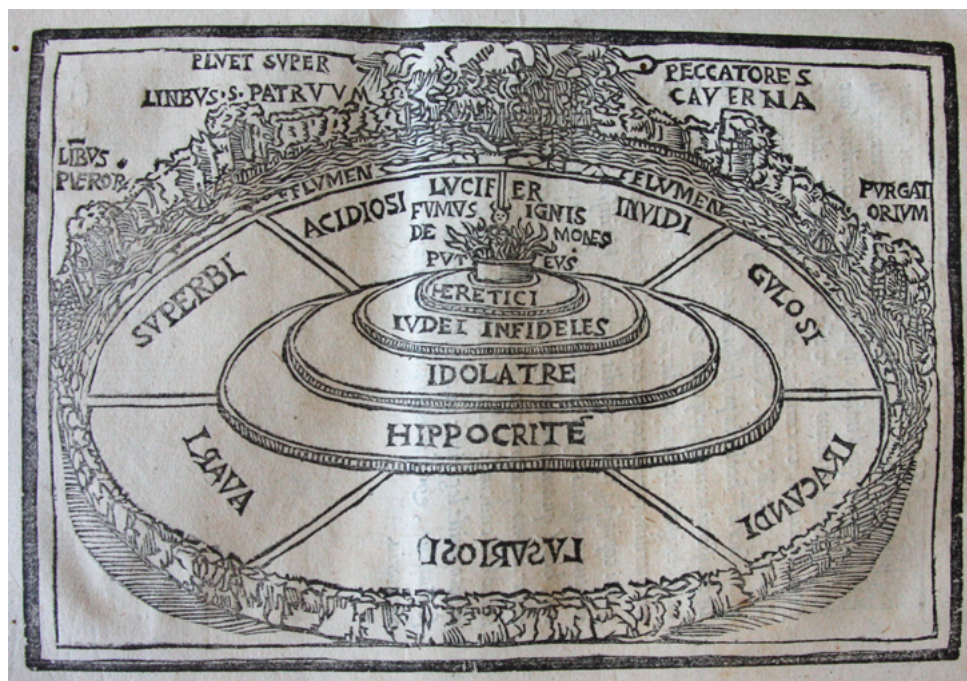
Fig. 1 – Inferno (Cosmas Rossellius, *Thesaurus artificiosae memoriae*, Venice, Antonio Padovani 1579, 12r).

following page. The subsequent, very detailed descriptions (III) in fact assume that readers have already memorised the image depicted in the woodcut. In other words, the ecphrastic texts do not simply constitute reproductions of the physical illustrations, but instruct on how to observe and interpret the image printed on paper. The same arguments can be found in the parts devoted to the *locus* of Paradise (29v-37r), in which the same illustration (Fig. 2) is inserted twice, after the generic explanation of the place (37v) and at the end of the additional descriptions, designed to explain the less clear parts of the figure (51r).

The creation of unique *loci* is possible thanks to the synergy between texts and illustrations. These *loci* are defined as 'complete structures' because they cannot be arbitrarily modified: size, shape, ornaments and inhabitants appear as fixed elements. Recall that this type of descriptive strategy is mainly adopted by ancient Roman treatise writers such as Vitruvius (odometer) and Varro (aviary).[32]

Let us move on to an analysis of the manner in which the author urges readers to construct original mnemonic *loci.*

[32]   Vitruvius, *De architectura*, 10.9; Varro, *De re rustica*, III.v. See Roby, *Technical Ecphrasis*, 87, 109.
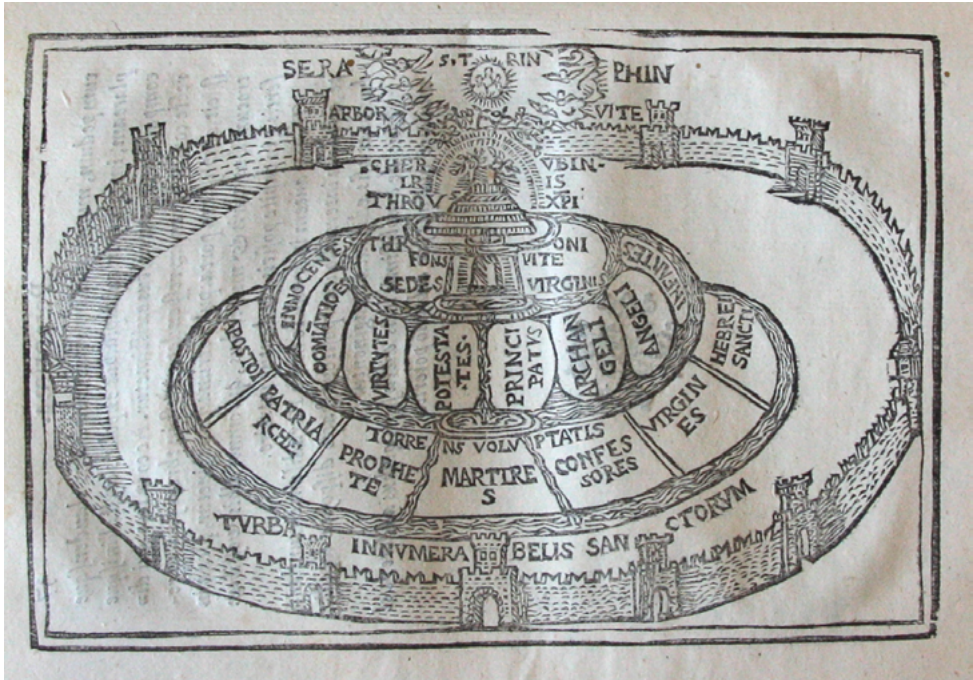
Fig. 2 – *Paradise*, Cosmas Rossellius, *Thesaurus artificiosae memoriae*, Venice, Antonio Padovani 1579, 37v).

## The 'technical' ecphrasis *and the infernal* mundus

Below we would like to analyse the relationship between ecphrastic texts, mnemonic *loci* and illustrations in the order in which they are treated.

### (I) Elementary structure of *loci*

After dividing the Inferno into eleven *gironi* (subdivisiones), Rossellius begins the description of the *locus* infernale from the single *girone*. In the centre of the structure he locates a well ("puteus [...] existimetur"). Starting from it, the Dominican's narrative develops centrifugally towards the periphery. Around the well extend four concentric circles that overlap to form a staircase, to which are added ("adijcimus") the other seven, thus obtaining the eleven subdivisions. Subjunctive mode verbs and the first-person plural are used effectively, the former to exhort readers, the latter to produce a collaborative space.

After a brief digression on the authority of the Bible and the infernal punishments, the Dominican resumes his description of the entire infernal *locus*, but this time using the subjunctive verbs in a more precise and detailed manner, as if attempting to paint

a picture from a series of previously drawn sketches. In other words, even before observing the physical illustration, the author tries to paint the exact mental image of the infernal *locus.*

It is here that he reveals how the infernal world is circular and gloomy. Within the eleven *gironi* appear for the first time the 'inhabitants', i.e. the damned and the demon-guards, who are introduced to differentiate the otherwise too homogeneous geometric *loci.* The measurements of each *girone* are indicated by precise numbers. The four stone ("lapideos") *gironi*, circling the central well, are each 3 or 4 *braccia* wide and about 2 *braccia* high. In the first circle are ("sint"*)* the heretics who tear up *the Holy Scriptures,* while in the second are ("sint") the Jews with iron faces, veiled eyes, and lowered napes. At the third are imagined ("imaginentur") the idolaters with their idols destroyed while at the fourth are placed ("ponantur") the hypocrites. Out of the well comes the fiery torrent where the hideous figure of Lucifer appears ("appareat").

With regard to the seven areas surrounding the central steps, the Dominican indicates that the walls separating each part are one *braccio* width, the height is 3 or 4 *palmae*, while the walls forming the outer circumference are 3 *palmae* high. The author uses the expression "te oportet confingere"[33] which suggests how the Dominican hopes that readers will construct the *loci* in the same manner as they are described.[34]

Within the seven sections appear the seven deadly sins represented by the figures of the damned and demons.

## (II) Illustration as a vehicle linking texts to the mind

After explaining the general composition of the *loci*, the Dominican inserts a brief yet significant annotation on the usefulness of the "picturae" (woodcuts) representing what is written on the *loci communi amplissimi* (Inferno, elemental and celestial worlds, Paradise). ※ここから再開

First of all, he emphasises how the 'viewer' can benefit greatly from this,[35] given the close link established between texts and images. The "inspector" should be the one who observes with the eyes of the psyche the mental *loci* outlined so far through words. The inherent power of the illustrations is so powerful and pleasing that it forces the readers' minds to examine them closely.[36] The reason why there are some additions, deletions and changes in the illustrations compared to the descriptions lies precisely in the difference between the texts and the images, and the need to insert further explanations ("declara-

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[33]  Rossellius, *Thesaurus*, f. 6r.
[34]  On this expression favoured by technical ecphrasis, see: Roby, Technical *Ecphrasis*, 109.
[35]  "Inspectori maximo essent emolument": Rossellius, *Thesaurus*, f. 7r.
[36]  "illis conspicientium animus oblectaretur, ac hisce studiis operam navare, vel utili, vel voluptate, vel certe utroque permotus pene compellerentur": *ibid.*

tionem") to make clear what the "picturae" illustrate.[37] In other words, the Dominican first describes the *loci* with words, in a second moment he prepares the illustrations, and finally he puts the explanations again to comment on the painted images. The difference between the text before and after the illustration is subtle but notable, as in the former case the mind has to construct the image from scratch, whereas in the latter it starts from an existing visual basis and the *ecphrasis* goes on to complete the image.

## (III) Ecphrasis to represent the *carcer apostatarum spirituum*

After emphasising the importance of the illustrations, short digressive descriptions follow in which the horrific visions of Inferno presented by the doctors of the Church are related. Listing the elements of torture such as thick smoke, red-hot flames, gnawing worms, screeching sounds, putrid stench, intolerable frost, etc., the Dominican defines Inferno as "the prison of apostate spirits".[38] After contextualising the *loci* to be fabricated in the mind, the author exhorts readers to devise other tortures appropriate to the faults of each condemned person themselves.[39] The sentence that closes this part is very suggestive:

> Idcirco qualibet hac in pictura data poena, damnatis quaedam singulis, sed longe maior erit excogitanda.[40]

The rough translation sounds like: "Therefore, whatever punishment is given to the damned in this image, it must be imagined to be even more intense". From these words it emerges how texts and illustrations are nothing more than the material with which to invent new and ever more effective *loci-imagines*.

The subsequent texts constitute a veritable ecphrastic 'exegesis' on paper illustration, instructing on how to develop initially crude paintings. If in part (I) the readers performed a simple act of placing the inhabitants within the architectural structure, in part (III) they must propose a grand synergistic theatre of Inferno, in which the 'actors' enact each individual punishment. Thus Lucifer, the only figure concretely depicted in the illustration (Fig. 3) represented in a primitive manner, must transform in the mind into the gruesome "prince of all demons" ("omnium daemonum principem") enveloped in smoke and

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[37]  "Et, ut eorum omnium, quae depicta fuerunt, notitia plenior haberetur, omnium praedictorum declarationem, ibidem a latere apposuimus : ut quae pictura includeret; scriptura declarentur": *ibid.*

[38]  *Ibid.*, f. 8r.

[39]  "Nam cogita si potes omnia atrocissima tormenta, asperrimasque poenas a mundo condito a diversis tyrannis hominibus inflictas etiam Christo domino, illas et omnes, quae humano inventu infligi possent, nec tamen parem ullam invenies, quae etiam minimae inferni poenae vel sensus, vel damni coaequari possit": *ibid.*, f. 8v.

[40]  *Ibid.*

Fig. 3 – *Lucifer*, Cosmas Rossellius, *Thesaurus artificiosae memoriae*, Venice, Antonio Padovani 1579, 12r.



Fig. 4 – *Lucifer*, Cosmas Rossellius, *Thesaurus artificiosae memoriae*, Venice, Antonio Padovani 1579, 12r.

flames, caught in the act of torturing the damned.[41] To activate the readers' imagination, the Dominican uses the imperative of the second-person singular (*consider*), while as regards the spaces dedicated to the seven deadly sins, he prefers the future form of the second person singular, in order to fill these spaces with images of the damned ("hos omnes variis poenis cruciatibusve diversis defatigatos cernere poteris").[42]

The annotations on the peripheral elements of Inferno offer as many interesting examples. On the boat, which is barely recognisable behind Lucifer in the river that surrounds the entire infernal area (Fig. 4), the author declares that he has painted "a ship guided by demons" ("actas a daemonibus navus") that carries condemned souls to different parts of Inferno.[43] From these indications, readers must reinvent their own personal ship crowded with demons and the dead.

In the illustration, to the right of the ship, there is a cavity where the inscription "PECCATORES CAVERNA" can be glimpsed. The Dominican explains the reason for this: "With this sign should be declared to the viewers" ("hoc signo inspectoribus declaretur") a tunnel that cannot be depicted in painting, through which the souls of the condemned fall into Inferno.[44] Here too, readers are urged to enrich a simple outline with vivid *imagines.*

To close the section on infernal *loci*, the Dominican leaves a suggestive message using verbs in the imperative:

[41]  *Ibid.,* f. 9r.
[42]  *Ibid.,* f. 9v.
[43]  *Ibid.,* f. 11r.
[44]  "attamen expostulabat ratio, ut illorum infoelicium animarum ad Infernum descensus, qui pingi non poterat, hoc signo inspectoribus declaretur": *ibid.,* ff. 11r-11v.

Quaeso vos omnes lectores inspecotresque viventes: ad inferni profunda, cogitatu vestro descendite, poenasque universas perpendite, ut cruciatibus praedictis admoniti.[45]

It is a prayer made to the reader-viewers to be able to descend, through the imaginative power of the mind, into the abysses of Inferno and to examine all the scenes of the various punishments so that the spectators are warned against aforementioned torments.

In this way, through texts full of expressive force, provoked by the use of *enargeia* and the presence of elementary yet captivating illustrations, "the prison of apostate spirits" will be realised in the minds of readers as an educational theatre.

## The scenography of the great theatre of memory: from Rossellius to Fludd

Compared to the detailed and abundant ecphrastic descriptions devoted to the *loci*, Rossellius spends few words on the use of the entire mnemonic system. Excluding the advice to place the images of *res* to be memorised in the appropriate places – so, for example, one should not use Inferno to memorise the names of the angels –,[46] he remains ambiguous about the relationship between the 'inhabitants' that are embedded in the *loci* and the *imagines agentes* to be placed in the places later. How then should mnemonic actors perform the memorable dramas?

Fortunately, there is a text that, despite being published almost half a century later, makes up for this shortcoming. It is Robert Fludd's *Utriusque cosmi maioris scilicet et minoris metaphysica, physica atque technica historia ( … )* (1617-21), a great encyclopaedic work in which, among the numerous *artes cosmi minoris*, the *ars memorativa is* treated. This treatment is highly original but also shares similarities with Rossellius' work.[47]

In the second tome that delves into the *historia Microcosmi*, the *ars memoriae* is discussed in one of the sections devoted to the various techniques and human sciences. Although it consists of only 24 pages divided into three *Books*, we can consider this part as an autonomous treatise belonging to the *corpus mnemonicus* that effectively exploits technical ecphrasis. The *incipit* of *Liber* I constitutes a true *parecphrasis*, as the author recounts in the first person his long wanderings in the south of France in search of the secrets of the *ars* (Chap. I). After discussing the definition of memory and the crucial importance of *phantasia* (Chap. II-IV), the author explains the functioning of the system of the *ars memoriae* and its rules, introducing the categories of the *ars rotunda* and the *ars quadrata*.

For reasons of space, we do not intend to deal here with Fludd's complicated mnemonic system, which has already been analysed in depth by Francis A. Yates.[48] Instead, we

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[45]   *Ibid.*, f. 11v.
[46]   *Ibid.*, f. 51v.
[47]   Fludd, *Utriusque cosmi.*
[48]   Yates, *The Art of Memory.*

Fig. 5 – Robert Fludd, *Utriusque cosmi maioris scilicet et minoris Metaphysica, physica atqve technica historia in duo volumina secundum cosmi differentiam diuisa, typis Hieronymi Galleri, Oppenhemii*, 1617-21, Tract. I, Sect. II, Port. III, Lib. I, 54.

would like to summarise the essential points in the order in which they are treated in *Liber* I. The *ars rotunda* deals with ideas, i.e. the spiritual and metaphysical *res*, whose *loci* are the celestial spheres, while the *ars quadrata* is dedicated to the physical and corporeal world, and uses the *loci* in the form of palaces and rooms. The author emphasises that these must be based on real existing buildings, known personally to readers.[49] He also criticises those who leave *loci* empty. In return, Fludd recommends inserting figures or pictures in the *loci* in order to distinguish them well from one another. As will be seen later, these rules, reminiscent of the 'inhabitants' of Rossellius' infernal *loci*, will be further elaborated in the following *Libri*.

The *ars rotunda* uses the eight celestial spheres organised concentrically around the central circle of the earth. The accompanying illustration is schematic and represents only the concentric circles, while the eighth sphere depicts the twelve constellations of the zodiac (Fig. 5). The author invites readers, using the first-person plural of the future ("imag-

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[49]  Fludd, *Utriusque cosmi*, Tract. I, Sect. II, Port. III, Lib. I, 53.

Fig. 6 – Robert Fludd, *Utriusque cosmi maioris scilicet et minoris Metaphysica, physica atqve technica historia in duo volumina secundum cosmi differentiam diuisa, typis Hieronymi Galleri, Oppenhemii,* 1617-21, Tract. I, Sect. II, Port. III, Lib. I, 55.

inabimur"), to imagine the eastern part of each sign occupied by the white theatre ("theatro albo"), and the western part by the black one ("theatro nigro").[50] This is followed by the famous perspective illustration depicting the theatre stage (Fig. 6) of which Yates had advanced the hypothesis that it might be Shakespeare's Globe Theatre.[51]

With regard to the *ars quadrata*, a 'standard model' for mnemonic places is presented: "erit conclave sive cubiculum, eius latera sint aequaliter quadrata aut parallela"[52]. In other words, readers must choose real such rooms as a model. On the other hand, the author introduces some changes in the realistic *loci*. On the entrance door are thus painted ("dipingatur"), as distinguishing marks, "historia aliqua insignis" such as the story of Medea killing her brother, Hercules slaying the Hydra, etc.,[53] while inside the room the four walls,

[50]   *Ibid.*, 54.
[51]   Yates, *The Art of Memory*, Chap. 16.
[52]   Fludd, *Utriusque cosmi*, Tract. I, Sect. II, Port. III, Lib. I, 56.
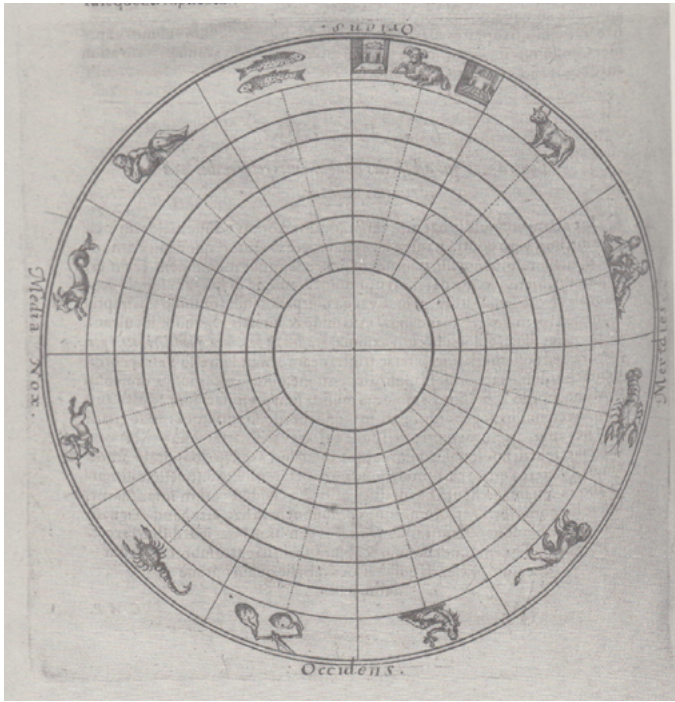[53]   *Ibid.*

Fig. 7 – Robert Fludd, *Utriusque cosmi maioris scilicet et minoris Metaphysica, physica atqve technica historia in duo volumina secundum cosmi differentiam diuisa, typis Hieronymi Galleri, Oppenhemii*, 1617-21, Tract. I, Sect. II, Port. III, Lib. I, 57.
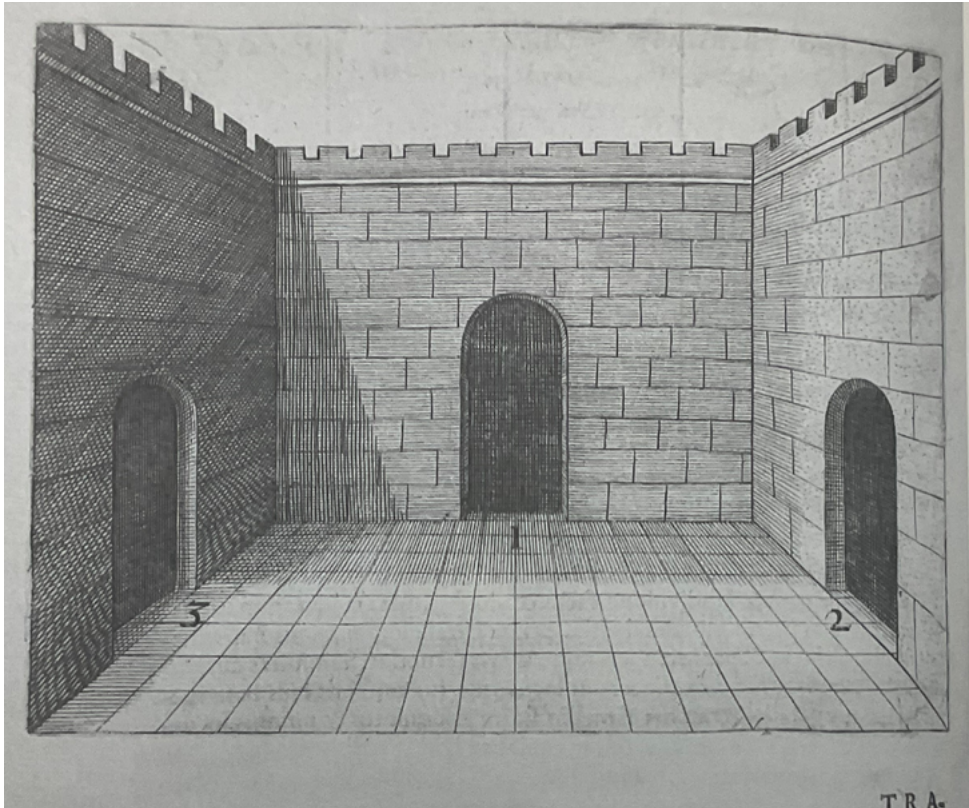


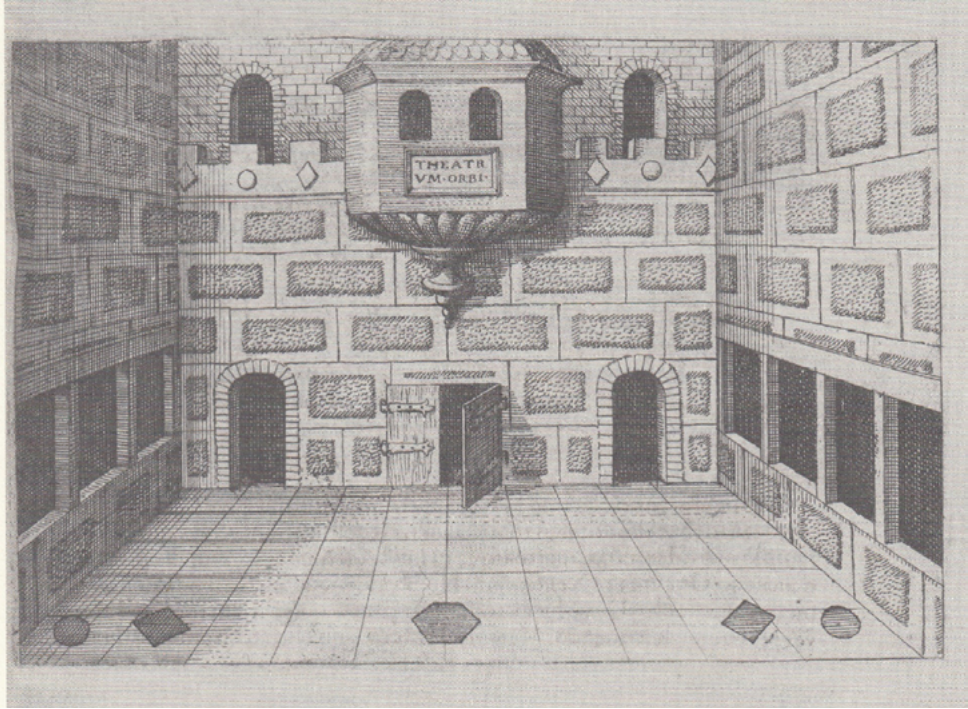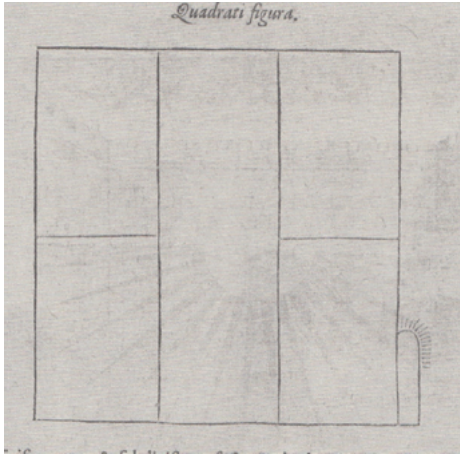Fig. 8 (below) – Robert Fludd, *Utriusque cosmi maioris scilicet et minoris Metaphysica, physica atqve technica historia in duo volumina secundum cosmi differentiam diuisa, typis Hieronymi Galleri, Oppenhemii*, 1617-21, Tract. I, Sect. II, Port. III, Lib. I, 58.

ceiling and floor are divided into five quadrangles (Fig. 7). Each subdivision is assigned the form of a theatre ("damibus [...] figuram theatri") with three doors.[54] With the illustration of the latter (Fig. 8), *Liber* I, the section devoted to the mnemonic *loci*, closes.

What characterises Fludd's mnemonic system is therefore the hierarchical structure of *loci*, similar to Rossellius', in which minor places are included in major ones (*Ars rotunda*: celestial spheres > theatres / *Ars quadrata*: building > rooms > walls > theatres).

## How to build theatres for the celestial sphere

### Liber I

In the following, we would like to analyse the characteristics of the *theatri caelestes* (white theatre and black theatre) where the performances of the inhabitants-actors are staged.

Chapter X of *Liber* I is dedicated to the discussion of the celestial theatres. It is a typical 'standard' description of the *loci* in which, using the future form (*habebit*),[55] only the five equidistant gates are mentioned, while the exact size, matter and proportion of the five columns is unclear. Readers must therefore imagine the other elements by resorting to the illustration at the end of the chapter (Fig. 5). There is no doubt that the latter was inserted to visualise the theatres of the celestial spheres (*orbes coelestes*) discussed in the previous chapter,[56] as it bears the inscription "THEATRVM ORBI" (the theatre for the sphere).

Contrary to the fascinating hypothesis put forward by Yates, we do not consider it plausible that the illustration can faithfully represent Shakespeare's theatre, since the rules introduced by Fludd on actually existing buildings only apply to the *loci* of the *ars quadrata* dedicated to the sublunar world. On the contrary, as mentioned earlier, the *locus*, which is presented here in the form of a theatre, should at first appear as an abstract model, of which some details are fixed while others can be modified by readers. Considering that this voluminous work was an international publishing venture, written in Latin and published on the Old Continent (Oppenheim), it seems inappropriate that the author wanted to present a particular theatre in London as a model for the *loci*, that were supposed to be well known to readers.

On the other hand, unlike the primitive illustrations in Rossellius' treatise, Fludd's are so realistic and expressive that they compensate for the chapter's reductive description. Indeed, as will be seen below, the parts where ecphrasis exerts its greatest influence are the representations of scenographies and dramas that take place on an empty theatre.

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[54]   *Ibid.*, 57.
[55]   *Ibid.*, 55.
[56]   "Locum communis artis rotundae est pars mundi aetherea, scilicet orbes coelestes, numerando ab octava sphaera & finiendo in sphaera Lunae": *ibid.*, 54.

## Liber II

After presenting, at the beginning of *Liber* II, a series of 'visual alphabets' useful for composing the *imagines agentes* (Chapters I-II), the author elaborates on the remaining *loci* for the *ars rotunda*, providing a detailed indication of their architectural composition and their respective images.

Within the two celestial theatres (eastern-white and western-black) are the images of the inhabitants-actors interacting with the *imagines agentes* (Chap. III). Only the figures for the eastern theatre of the sign of Aries are listed concretely in the texts, namely Jason, Medea, Paris, Daphne and Phoebus. All have to do with the sign of the zodiac connected to the world of Greek mythology. The same series of images is also used for western theatre, but 'we must imagine' ("debemus [...] imaginary") that these appear faded, because theatre is dark.[57]

Chapter V constitutes a true technical *ecphrasis* and concretely illustrates how to construct the interior of the theatre. It consists of five stage sets placed in front of the five doors of the theatre marked by different colours. In the first *locus* there 'shall be' ("erit") a snow-covered meadow (white), while the second 'should have' ("habeat") a meadow stained with blood to evoke the battle fought there (red). The third *locus* should represent a terrain with green grasses and trees (green), while the fourth a valley irrigated by springs (blue), and finally the fifth a dark underground cave (black).[58]

In front of these colourful scenes are five columns. They too must be clearly distinguished through shapes and colours.[59] With regard to the latter, the author recommends choosing the 'opposite' colour to that of the door: white, for example, will contrast with black. The outer columns are round, the one in the centre is hexagonal, the intermediate columns are square, as can be clearly seen in the illustration at the end of the chapter accompanied by the words "figura vera theatri" (Fig. 9). We can therefore interpret the images as a reworking of the previous figure (Fig. 5), which fits the ecphrastic descriptions. The *theatrum* presented in *Liber* I as an abstract *locus* is thus transformed into a 'complete structure', the main elements of which cannot be changed.[60]

Finally, through the power of imagination ("phantastico conceputu"), rings and chains are attached to the five columns, to which various animals are tied. These additional elements are used to represent the so-called "insertions" ("inserentes") such as adverbs,

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[57]   *Ibid.*, 62.
[58]   *Ibid.*, 63.
[59]   *Ibid.*
[60]   From this point of view, the hypothesis put forward by Yates cannot be completely denied, as some element of the Globe Theatre may be reflected in the first illustration, which on the other hand is not intended to instruct readers on how to construct the theatrum celeste but merely provides an approximate appearance of the theatre.
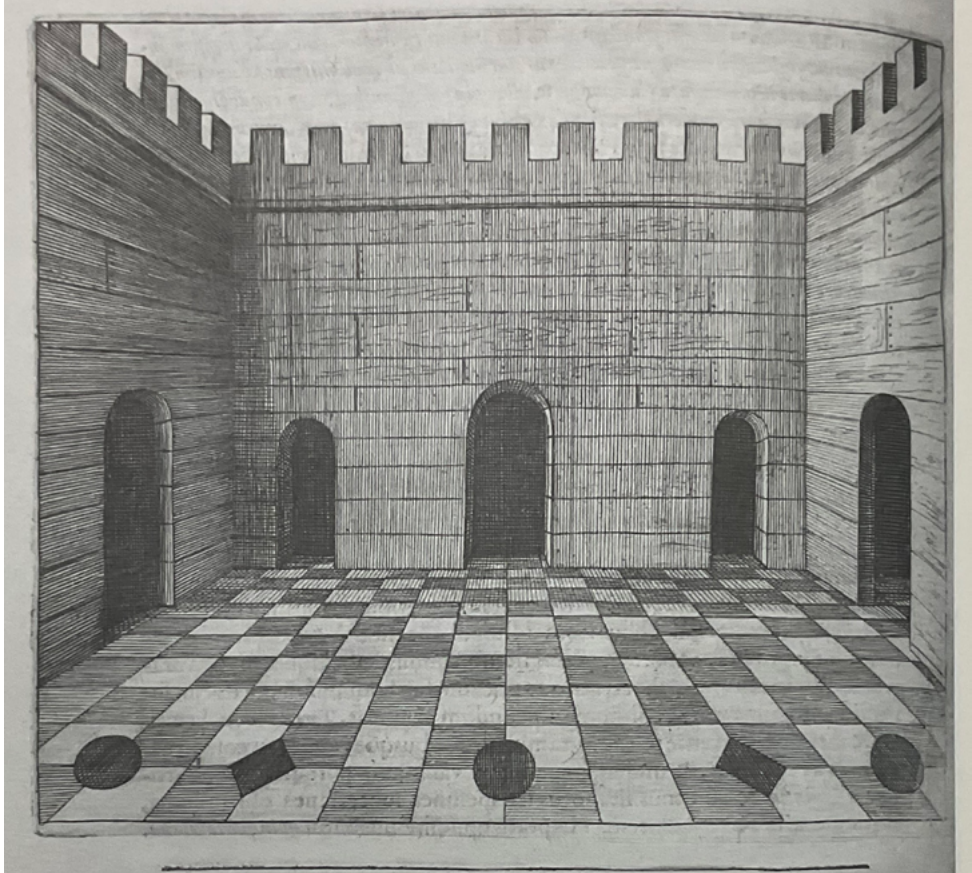
Fig. 9 – Robert Fludd, *Utriusque cosmi maioris scilicet et minoris Metaphysica, physica atqve technica historia in duo volumina secundum cosmi differentiam diuisa, typis Hieronymi Galleri, Oppenhemii*, 1617-21, Tract. I, Sect. II, Port. III, Lib. II, 64.

conjunctions, prepositions and interjections found in the arguments to be remembered,[61] while in order to memorise the most important and significant parts that are composed, for example, of verbs, adjectives or nouns, it is necessary to have the human figures perform some significant action within the previously constructed sets. In this way the curtain of the mnemonic theater opens.

[61]    Fludd, *Utriusque cosmi*, Tract. I, Sect. II, Port. III, Lib. II, 63.

**Medea, tragic protagonist or versatile actress in the *theatrum mundi***

In Chapter VI of *Liber* II, even before placing the *imagines agentes,* Fludd invites readers to imagine the stories staged by the inhabitants of the theatres suited to each zodiac sign (*locus*).[62] In other words, regardless of the *res* to be remembered, readers must determine the scenes of the play to be performed. The only concrete example mentioned in the texts is that of the sign of Aries, in which the legend of the Golden Fleece takes place. Among the many characters, the author's favourite figure is Medea.

The first scene, which takes place in front of the white door of the celestial theatre, depicts Medea on top of the snowy Atlas mountain, caught in the act of gathering magic herbs, while in the second the woman stands in front of the red door. Unlike ancient theatres, which avoided depicting bloody scenes, here Medea kills her brother and throws his limbs onto the grass. The third scene (green) depicts her gathering herbs again in Thessaria to help her beloved Jason, and the fourth (blue) depicts the scene in which Medea and Jason board the ship with the Golden Fleece. The fifth and last (black) shows the dark house in which the bull and the dragon, guardians of the fleece, are enclosed.[63]

All these scenes composed by the actors, the scenographies and the theatrical structure, embody 'dramatic' mental images, invented through the power of *phantasia*, and do not appear in the illustration of the theatre. The description devoted to the *histriones agentes* thus constitutes a veritable ecphrasis.

**Liber III**

*Liber* III deals with how the mythological actors interact with the *imagines agentes*, proposing precisely the explanation that Rossellius' treatise lacked. In Chapter II, the five tragic scenes presented in the eastern theatre of Aries are modified to fit the 'significant words' (*vocabuli significantes*) to be remembered.

When Fludd emphasises the importance of the scenes to be invented, which should be appropriate to the situation in each place, he demonstrates the examples using the first-person singular and plural:[64] "if I wanted to mark the word 'book' in the first place" ("si vocabulum (Liber) velim in primo loco denotarem"), "I would imagine" ("imaginabor") Medea in the white meadow intent on looking at a magic book. If the second word to be memorised were "exalted" ("exaltabat"), "we can imagine" ("imaginabimur") Medea looking down from the top of the tower, anxiously watching to see if her father is chasing her. Thus the third word 'pleased' is depicted in the third place, where Medea is cheerful because she has found the herbs useful for her purpose, while the fourth *vocabulum* 'knife' is used in the scene where Medea throws the fratricidal murder weapon into the sea. The

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[62]   *Ibid.*, 65.
[63]   *Ibid.*
[64]   *Ibid.*, 67.

last example, that of 'light', is assimilated to the spark that escapes from the cave where Jason fights the bull and the dragon. Thus we can move on in the direction of the western theatre, where the actions performed by Medea are glimpsed in the darkness. Of course, in the remaining zodiac signs there should be other great mythological actors, associated with their respective constellations, playing their main roles.

This wonderful versatility of Medea shows the elasticity required of actors in mnemonic theatres. In other words, in Fludd's mnemonic system, the *imagines agentes* are not simply placed passively in the *loci*, they are instead asked to perform an improvised skit together with the actors-inhabitants of the celestial theatres. It is worth noting that in Chapter VII of *Liber* I, following the rules of the 'real' *loci*, Fludd criticises those who only place images of animals in the *loci*: they are unable to express concepts related to human actions such as praying, teaching, reading, etc. In return, he recommends using human figures, because "there is no action that man cannot express clearly, either by imitating it or by practising it".[65] In other words, the inhabitants of Fludd's *mundus mnemonicus* must be polyvalent actors. This statement recalls the well-known *topos* of the *theatrum mundi*. If we can recognise the influence of Shakespeare in Fludd, it is precisely because of this literary-philosophical concept that compares the world to a theatre, human life to a stage, and every single man to an actor.

## Conclusion: the ecphrasis that realises the theatre of the mundus mnemonicus

In the *corpus mnemonicus* of the early modern age, it was taken for granted that readers knew how to implement a set of mnemonic rules in their minds. Some systems even required them to place a complex set of *loci* and *imagines* where improvised performances were to be performed, giving the inhabitants-actors directions on how to act. This explains why mnemonics are so compatible with the theatrical model. In addition to Fludd's examples, Rossellius' infernal-paradisiacal *loci*, which have the form of an amphitheatre, also suggest the same similarity. It is noteworthy that Cicero, an absolute authority on mnemonic theory, compared the *imagines agentes* to theatrical *personae* (masks/characters) capable of representing the *res* to be remembered.[66]

Dolce and Della Porta, both influential authors of mnemonic treatises, were also playwrights.[67] Their descriptions of mnemonic scripts are typically ecphrastic in that they succeed in vividly and movingly depicting mental scenes.

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[65]  "cum nulla sit actio sive belluina sive humana, quam non queat homo luculenter sua actione exprimere, sive imitando, sive partes suas proprias agendo". Fludd, *Utriusque cosmi*, Tract. I, Sect. II, Port. III, Lib. I, 53.

[66]  "rerum memoria propria est oratoris; eam singulis personis bene positis notare possumus, ut sententias imaginibus, ordinem locis comprehendamus". In Cicero, *De oratore*, 2.88.359-360.

[67]  Dolce recommends placing the inhabitants in *loci* in the form of Inferno, Limbo and Purgatory. Cf. Dolce, *Dialogue*, 36.

If we consider the *ars memorativa*, especially the one developed from the late 16th century onwards, as a psychic contraption composed of various intellectual techniques, we can then analyse it from a different point of view, i.e. that of 'technical ecphrasis'. In this sense, the 16th century mnemonic treatises appear as a creative reconstruction of the lost technical manuals of antiquity, where the *ars memorativa* was taught as a basic tool.

In ancient Greek and Roman times, various rhetorical figures were exploited to convey knowledge about architecture, civil engineering, medicine, etc., inviting readers to practise the theories by themselves or to construct the described objects in their minds. The same was true of the *corpus mnemonicus* in which, instead of explanations on the workings of gears, wheels and levers, the intellectual faculties were illustrated, considered as mechanical contraptions that guaranteed the efficacy of the *ars.*

By rethinking the relationship taken for granted between mnemonics and ecphrasis, we could interpret this cognitive system from a mechanical-technological point of view, although at the same time it is also a creative and intellectual practice. For this reason, it is important to introduce the idea of 'plural' ecphrasis, which not only serves to explain the *imagines agentes,* but also proposes the existence of other types of ecphrasis, such as those needed to illustrate *loci-imagines,* the 'technical' ecphrasis that invites readers to construct in the first person what is described in the treatises, and so on.

Through the analysis of the 'various' ecphrases, early modern mnemonic treatises thus reveal new and rich mental scenes.

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# Memorizing numerical data in the 17th and 18th centuries. Technical innovations and new practices

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**Abstract**

Because the classical art of memory was part of rhetoric, Latin authors did not develop detailed techniques for memorizing numbers. During the Renaissance, some methods for memorizing numerical data were added to the *ars memoriae*, partly due to the growing readership of memory treatises among merchants. However, the memorization of numerical data remained a marginal topic in memory manuals, and the available techniques were cumbersome when dealing with multiple long numbers. As numerical thinking became prevalent in the "outillage mental" of the time, a specific mnemonic technique was devised in the 17th century. By converting numbers into consonants and then forming words by adding vowels, mnemonists could employ mental images to represent these words and effectively memorize the corresponding numbers. This paper aims to trace the spread of this new technique from France to the Holy Roman Empire and, in the 18th century, to England. Additionally, it will show how new fields of knowledge were incorporated into treatises of the 17th and 18th centuries. Thus, this paper will shed light on how the Scientific Revolution led to the development of new mnemonics by practitioners with sociological backgrounds different from those of Renaissance humanists and orators.

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Thinking of a ram's testicles in order to remember how to talk about witnesses in a trial: this is one of the examples given by the anonymous author of the *Rhetorica ad Herennium* to explain how memory techniques can be used to retain discourses.[1] Here the mnemonic is based on the phonetic similarity between "testiculos" and "testes". To be more precise, the user of this "Ciceronian art of memory" must store images such as the ram's testicles in a mental building, into which he can enter to look at the images and retrieve the information they encode.[2] Since the Latin sources that refer to this *ars memoriae* are found in rhetorical manuals (the *Rhetorica ad Herennium*, Quintilian's *Institutio Oratoria*, Cicero's *De Oratore*), their authors focus on explaining how these techniques can help to memorize a speech. The scarcity of sources does not allow us to rule out the possibility that the Romans used the art of memory to retain numerical data, but there is no evidence that the *ars memoria* was ever used for this purpose.[3]

Two millennia later, the English vicar Richard Grey explained in his *Memoria Technica* (1730) how to memorize data such as the date of the creation of the world, the length of Mercury's revolution around the sun or the number of English feet in a Roman mile. Moreover, he doesn't rely on visualising mental images or on familiarity with a mental storehouse, but on learning and deciphering cryptic words such as "Ro-miloktu". Neither Richard Grey nor his followers explained how to memorize discourses.

The difference between the classical *ars memoriae* and the eighteenth-century *Memoria Technica* is a striking example of the transformation of European "outillage mental". Lucien Febvre, one of the two fathers of the French *Annales*, had the visionary idea of studying the intellectual tools of a given period. He set out to make a detailed inventory of the mental material available to the men of the era, because to understand what they thought, it was necessary to understand how they thought.[4] This paper aims to document how the so-called "scientific revolution" and the mathematization of human knowledge led to the creation of a new mental tool: the mnemonic substitution of numbers by letters. To do so, it will focus on three main authors: the mathematician Pierre Hérigone, the polygraph and cryptography enthusiast Johann Justus Winckelmann, and the pastor and Hebraist Richard Grey. The three of them seem to have discovered this method independently, by adapting cognitive patterns used in mathematics, cryptography, and Hebrew studies to mnemonics. Besides retracing the multiple origins of the numbers-letters equivalence technique, this article aims to suggest that the success of this method is rooted in the so-

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[1]   *Rhetorica ad Herennium*, III, XIX-XX.

[2]   The expression is from Yates, "The Ciceronian Art of Memory".

[3]   The author of the *Rhetorica ad Herennium* used images as ordinal numbers, e.g. visualizing a golden hand to indicate the fifth images (III, XIX).

[4]   Lucien Febvre called his readers to "inventorier d'abord dans son détail, puis recomposer pour l'époque étudiée, le matériel mental dont disposaient les hommes de cette époque". Febvre in Wallon, *L'Encyclopédie Française,* vol. 8, 8'12-7.

ciological backgrounds of its users, which were different from those of the Renaissance humanists and orators who used the *ars memoriae*.

## 1. Memorizing numerical data in the Renaissance

Medieval monks developed a "*craft* of thinking" which included several mnemonics based on similar principles to the Ciceronian art of memory.[5] When the *Rhetorica ad Herennium* was discovered in the 12th century, the ancient *ars memoriae* was considered an inferior method of memorizing information to the medieval techniques.[6] This position evolved in the 13th and 14th centuries, particularly under the influence of Albert the Great and Thomas Aquinas, but also to meet the demand of the mendicant friars for techniques to facilitate their preaching. The medieval monastic tradition and the ancient rhetoric tradition merged together in treatises such as the *Ars praedicandi* by Francesc Eiximenis (c. 1327-1409).[7] Hundreds of manuscripts from the 14th and 15th centuries explain how to use this new version of the art of memory. The invention of the printing press led to the publication of memory manuals included in rhetorical treatises or as stand-alone books. Dozens of these manuals included a chapter on memorizing numbers.

The most common technique is to associate a mental image with each digit from 0 to 9 and with the tens. The most famous Renaissance memory teacher, Peter of Ravenna, used to imagine a Guelph for the number 1, a Jew for the number 3 and a cross for the number 10. So, to remember 11.3, he imagines a Guelph holding a cross (10+1) which a Jew is trying to snatch from his hands. Although the images chosen by Ravenna were not necessarily adopted by other mnemonists,[8] the possibility of combining tens and units within the same mental scene to signify a number made up of several digits was a common practice from the early Renaissance onwards. The image could be chosen for its resemblance to the shape of the digit (a stick for 1, a snake for 3), for its symbolic relationship to a digit, or for its association with a letter whose alphabetical rank corresponds to the digit (Anna for 1, Barbara for 2).[9]

If the images associated with the numbers can vary from one manual to another, the techniques used continue from the late Middle Ages to the mnemonists in our corpus. The Franciscan Filippo Gesualdo (1550-1618) used a dagger for the number 1, a pair

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[5]   Carruthers, *The Craft of Thought,* 10.
[6]   Carruthers, "Rhetorical 'memoria' in Commentary and Practice", 223-224.
[7]   The manual is edited in Carruthers and Ziolkolwski, *The Medieval Craft of Memory*, 189-204. See also Rivers, "Memory and Medieval Preaching", or Rivers, *Preaching the Memory of Virtue and Vice*, 161-185.
[8]   I will use the word "mnemonist" to refer to the users of the traditional, rhetorical art of memory.
[9]   Matteoli, *Nel tempio di Mnemosine,* 158-159.

of scissors for 2, a triangle for 3, a pumpkin for 8, etc.[10] Similarly, the Dominican Juan Velázquez de Azevedo proposed a list based on the similarity between the shape of the object and that of the number, but he also gives a list of equivalences based on a symbolic relationship: the phoenix, a unique bird, refers to the number 1, shoes to 2, a glove to 5, and so on.[11] The association is sometimes based on the phonetic similarity between the name of the imaginary object and that of the number: the Franciscan Girolamo Marafioto suggested using a chair to remember the number 7, since the word "sedem" is similar to "septem". Similarly, an apple, which he calls "mila" in Italian, can represent the number 1,000.[12] The Theatine Paolo Arese suggests using people whose names evoke the number (the Count of San Secondo (near Parma) for 2, an "Ottavio" for 8, etc.)[13] It should be underlined that these techniques were not taught alone but alongside much more developed methods to retain concepts, words, sentences. Memory manual keep focusing on the memorization of discourses.[14]

Even if the techniques changed little, their use evolved in parallel with the role of numbers in the society. The Italian Renaissance is a perfect example of this phenomenon. The numerical mentality developed among the merchant and bourgeois elite, notably through the production of hundreds of handwritten or printed mathematical manuals, known as *libri d'abbaco*, which contained the mathematical know-how needed by merchants.[15] At the same time, several Italian memorization treatises explained how to memorize banking and commercial operations.[16] For example, a given price could be broken down into different coins: ducats in the right hand, lire in the left, sol (solidi) in the mouth and denarii on the head.[17] The change in mathematical practice by part of the audience for memorization treatises thus led mnemonists to provide techniques for memorizing prices, transactions, and so on.

Arithmetic practices kept evolving those of the 17th century were no longer those of the 15th century: mathematical recreations spread among the nobility and the urban elite; the use of numerical probabilities was developed at the end of the 17th century; the use of Arabic numerals became more widespread, in contrast to that of the abacus; the teaching

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10   Gesualdo, *Plutosofia*, 50r-51r.
11   Azevedo, *El Fenix de Minerva y arte de memoria*, 88r.
12   Marafioto, *Ars Memoriae,* 63.
13   Arese, *Arte di predicar bene*, 712.
14   Poupard, "La méthode des *loci*".
15   In *Practical Mathematics in the Italian Renaissance*, Warren van Egmond inventoried 300 manuscripts and 150 printed editions of *libri d'abbaco* written beteen 1476 and 1600. On the arithmetical practices of Italian merchants before the 15th century, see e.g. Swetz, *Capitalism and Arithmetic*.
16   For ex. Pack, "'Artes memorativae' in a Venetian manuscript".
17   Kemper, "*The Art of Memory as Cultural Transfer*".

of mathematics spread in Jesuit colleges, and that of history included more chronological data represented by Arabic numerals, etc. This new numeracy could perhaps explain the success of a new mnemonic device, the numbers-letters equivalence.[18]

## 2. *Pierre Hérigone and the substitution table*

The numbers-letters equivalence is a technique that is radically different from previous methods of memorizing numbers because it does not necessarily rely on mental imagery and memory construction. The first known occurrence of this method is in a mathematical manual, the *Cursus mathematicus. Cours mathématique* (published between 1632 and 1642, with a reprint in 1644). Its connection with the traditional art of memory seems to be non-existent. It is difficult to be more specific, because the author of the *Cursus mathematicus* is Pierre Hérigone, whose name is clearly a pseudonym, the attribution of which is problematic. He has sometimes been identified with Baron Clément Cyriaque de Mangin or Denis Henrion (or even both at the same time).[19] It is true that many of the figures used by Hérigone in his manual can be found in Euclid's *Quinze livres des Eléments géométriques*, published by Denis Henrion in 1632. However, as the title page of the latter work states that these books were sold by the widow of the said Henrion, it seems that Henrion was not Hérigone.[20] Whatever the identity of Hérigone, he invented an "aritmetique memoriale" based on the substitution of numbers for letters.[21] He thought that names were easier to remember than numbers and and "that it would not be useless to make an alphabet by means of which any proposed number could be changed into easily pronounced names. For this change could be of some use in memorizing more easily the great numbers of epochs, & other things".[22]

As shown in Fig. 1, this technique is based on a table of equivalences between numbers and letters. Each digit corresponds to a consonant and a vowel. This double equivalence

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[18]   On these topics, see respectively Budnik, "Plaisir et récréations mathématiques en France au XVIIᵉ siècle", 57-67; Hacking, *The Emergence of Probability*, 2013; Schärlig, *Du Zéro à la virgule*, 2010; de Dainville, "L'enseignement des mathématiques dans les Collèges Jésuites de France du XVIᵉ au XVIIIᵉ siècle"; Romano, *La Contre-Réforme mathématique*, 187-206; Bruter, *L'Histoire enseignée au Grand siècle*.

[19]   O'Connor and Robertson, "Pierre Hérigone", https://mathshistory.st-andrews.ac.uk/Biographies/Hérigone/.

[20]   These books "se vendent en l'Isle du Palais, à l'Image S. Michel, par la veusve dudit Henrion".

[21]   Hérigone, *Cursus mathematicus*, 136-141.

[22]   "Ce ne seroit chose inutile de faire un alphabet par le moyen duquel on peust changer tout nombre proposé en des noms faciles à prononcer. Car ce changement pourra avoir quelque utilité à retenir par cœur plus facilement les grands nombres des epoches, & d'autres choses", Hérigone, *Cursus mathematicus*, 136. By "grands nombres", Hérigone refers to numbers with several digits.

Fig. 1 – Hérigone, *Cursus mathematicus*, 2, 137.

allows the user to form sounds similar to French words for any number. This technique makes it possible to memorize numerical data specific to mathematics (as indicates the author, 3,14159, i.e. pi approximated to the first five decimal, is memorizable through the word "catador"), as well as chronology (the conquest of Rome by the Gauls in 389 is transformed into "ilor"). These examples did not prove that this technique has actually been used by the readers of the book or by Hérigone himself – who did not use it in the part of the Cursus devoted to chronology.[23]

The lack of reliable biographical information makes it impossible to study the genesis of his mnemonics. Nevertheless, I would like to propose a hypothesis based on Hérigone's mathematical practice. The *Cursus mathematicus* was part of the "symbolic revolution" that took place at the end of the sixteenth and the beginning of the seventeenth centuries, which saw the codification of unknown measurements by letters and the introduction of symbols to denote algebraic operations.[24] In this context, Hérigone introduced a symbol-

[23]   Hérigone, *Cursus mathematicus*,159-254.
[24]   Serfati, *La Révolution symbolique*; Dhombres, "De l'écriture des mathématiques en tant que technique de l'intellect", 157-197 (page 171 focuses on Hérigone).

ic language that could be used in all branches of mathematics, and regularly used letters to represent unknown numbers.[25] It is possible that his habit of using letters instead of numbers gave him the idea of creating a mnemonic system based on the equivalence of numbers and letters. If this hypothesis is correct, Hérigone created a new intellectual tool without being influenced by the traditional, rhetorical art of memory.

## 3. The numbers-letters equivalence in memory manuals

Despite Hérigone's wide reception among French, Italian and English mathematicians, his "aritmetique memoriale" does not seem to have convinced his readers. In any case, it does not appear in the memory treatises of these countries. On the other hand, a similar technique appeared in the Holy Roman Empire, in the manual of Johann Justus Winckelmann (1620-1699 – not to be confused with the art historian). Winckelmann may have been introduced to mnemonics at an early age, as his father knew about the art of memory (he attended an exhibition of mnemonics held in Marburg in 1602 by the famous memory teacher Lambert Schenckel).[26] Otherwise, Winckelmann discovered the *ars memoriae* at the University of Marburg, which he entered in 1634. There, he studied history and rhetoric under Johann Balthasar Schupp, the author of a memory treatise.[27]

After completing his studies by travelling around Europe, Winckelmann published a manual under the name of Stanislaus Mink von Weinsheun entitled *Relatio novissima ex Parnasso de Arte Reminiscentiae* (1648), in which he set out both the memory palace method and a system of numbers-letters equivalence or, more precisely, number-consonant equivalence, as indicated in Fig. 2. The mnemonist, using this system, chose the vowels that enable him to form the words best suited to memorize the desired information.

| Numbers | Letters | Numbers | Letters |
|---------|---------|---------|---------|
| 1 | B, P, W | 6 | M |
| 2 | C, K, Q, Z | 7 | N |
| 3 | F, V | 8 | R |
| 4 | G | 9 | S |
| 5 | L | 0 | D, T |

Fig. 2 – Winckelmann, *Relatio novissima ex Parnasso de Arte Reminiscentiae*, s.l., s.n., 1648, 122.

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[25]   Esteve, "Symbolic language in early modern mathematics".
[26]   Paëpp, *Schenkelius detectus*, 38.
[27]   Schupp, *Mnemonica Ciceroniana*. It was published by his son in 1660. See Strasser, *Emblematik und Mnemonik*, 99.

Winckelmann illustrated this technique by explaining that we can remember that the University of Leipzig was founded in 1409 by Frederick I of Saxony thanks to the phrase "der Leib ziehet und WaGeTS wegen des Friedens". The sentence itself is difficult to understand. It can literally mean "the body draws [something towards itself] and dares to do so because of peace". If "ziehet" is considered metaphorically and poetically, it is also possible that the phrase means that "the body dies [literally: goes away, separates] and dares to do so thanks to peace", which could be a proverb reminding us of the need to live in Christian peace and warning us against temporal vanities. Anyway, the technical process behind this phrase is much easier to understand. The word "Leib" phonetically recalls the name of Leipzig and "Friedens" the name of Frederick ("Friderico"). "WaGeTS" indicates the date 1409 according to the table of equivalences above. Other examples do not use phonetic similarity but rely on the meaning of the phrase to provide the information. For example, Winckelmann explains that it is possible to remember the founding of the University of Strasbourg by the city council in 1538 by learning a sentence that says that angry bourgeois (the inhabitants of the city) shot at the city hall using "PuLVeR" (powder). The last word indicates the year, while the story involves both the inhabitants and the representatives of the city authorities, reminding us that the University (then Jean Sturm's *Haute École*) was founded by the Free City of Strasbourg.[28]

Was Winckelmann inspired by Hérigone's "aritmetique memoriale"? Nothing is less certain. Although the German author does not hesitate to cite numerous bibliographic references, he says nothing about the *Cursus mathematicus*.[29] The plot of the *Relatio novissima ex Parnasso* may offer a clue to the origin of Winckelmann's figures-consonants equivalence. The protagonist of the novel, Stanislaus, complains to his friend Memoratus about his health and his memory. Memoratus informs him of the existence of the art of memory and advises him to go to Mount Parnassus to learn it. Stanislaus travels to Greece, persuades Appolon to take him into his palace, meets divinities, plays chess, solves riddles and, three quarters of the way through the book (page 106 out of a total of 140), Mr Puschthom, a memory teacher, finally agrees to teach him mnemonics.

The choice of Mount Parnassus is, of course, symbolic, since "the mountain of the chosen ones of letters, like the land of the shepherds [Arcadia], is reserved only for disinterested and contemplative spirits who have turned their backs on the world of passions and vulgar interests and have devoted themselves to the *otium literatum*".[30] Given the limited space devoted to technical instruction, it is clear that Winckelmann's aim was not just to explain memory techniques – although this is emphasized in the full title of his book.

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[28]  Winckelmann, *Relatio novissima ex Parnasso de Arte Reminiscentiae*, 124-126.
[29]  *Ibid.*, 90 and 111-113. It is possible that the authors did not read all the authors cited and only gave their name to impress his readers by accumulating a large number of references to prove his erudition.
[30]  Fumaroli, *L'École du silence,* 38.

He also wanted to entertain his readers with a motley collection of intellectual ingenuity, playing a full part in the "aesthetics of technè" inherited from the sixteenth century.[31] To this end, he explained a number of cryptographic techniques.

He refers to Trithemius (from whom he reproduces a cipher table) and Gustavus Selenus, the pseudonym under which Duke Augustus the Younger wrote his *Cryptomenytices*.[32] Winckelmann might have found the idea of an equivalence between letters and numbers in one of these two authors. This technique can be found in the *Cryptomenytices*.[33] In fact, this idea is so fundamental to cryptographic methods that it can be found everywhere, for example in the explanation of the functioning of combination padlocks by Jean Borrel (also known as Butéo, c. 1492-c. 1572), an explanation reproduced by Duke August and by authors of books of secrets.[34]

Because of its narrative form, it is difficult to know whether the readers of the *Relatio novissima ex Parnasso* used it as a manual for practical purposes or simply as an entertainment. Only one of the seven copies I have studied presents traces of reading that can reasonably be dated to the early modern period.[35] It is no exception: Ian Maclean has shown that philosophical fiction is an inconsistent literary and publishing category, with texts used by a diverse readership.[36] Although its reception by the general public is uncertain, Winckelmann's book enjoyed great success in the mnemonic tradition. His method of numbers-consonants equivalence became part of the common baggage of the mnemonists.

When Christian Knorr von Rosenroth described the memory palace method in his pedagogical treatise *Anführung zur Teutschen Stats-Kunst* (1672), he included this method to remember numbers. As showed in Fig. 3, his explanation differs a little from Winckelmann's as he added the letter "X" and the sound "Sch". Futhermore, unlike Winckelmann, who did not specify exactly how to learn the phrase signifying the number to be memorized, von Rosenroth explicitly used mental images. For example, he indicated that the number 930 can be replaced by "SaFT", i.e. juice, "und stelle mir an einen Ort ein Glaß mit Safft" (placed in a mental place as a glass with juice in). Similarly, 325 becomes "FaKeL", a torch to be visualized.[37]

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[31]  Klein, *L'Esthétique de la* technè.
[32]  Winckelmann, *Relatio novissima ex Parnasso...*, 130. On this way to encrypt a text by Trithemius, see Strasser, *Lingua Universalis*, 53-55.
[33]  Augustus II The Younger, *Cryptomenytices*, s.l., s.n., 1624, 316-320, 426-427. About Augustus II the Younger's cryptography, see Strasser, "Herzog August Handbuch der Kryptographie" and Strasser, "Die kryptographisches Sammlung Herzog Augusts", 83-121.
[34]  Augustus II The Younger, *Cryptomenytices,* 489-493; Schwenter, *Deliciae physico-mathematicae*, 548. About these padlocks, see Coumet "Un texte du XVIᵉ siècle sur les cadenas à combinaison".
[35]  The copy of the Bayerische Staatsbibliothek, 4 Paed.pr. 46, shows pen strokes in front of bibliographical references relating to mnemonics.
[36]  Maclean, "The Readership of Philosophical Fictions", 7-15.
[37]  Rosenroth, *Anführung zur Teutschen Stats-Kunst*, 36-37.

| Numbers | Letters | Numbers | Letters |
|---------|---------|---------|---------|
| 1 | B, P, W | 6 | M |
| 2 | C, K, Q, X, Z | 7 | N |
| 3 | F, V | 8 | R |
| 4 | G | 9 | S, Sch |
| 5 | L | 0 | D, T |

Fig. 3 – Rosenroth, *Anführung zur Teutschen Stats-Kunst*, Nuremberg, Johann Hofmann, 1672, 36.

The court preacher (*Ober-* and *Hofprediger*) Michael Wiedemann (? – 1719) adopted von Rosenroth's system but made slight changes to the equivalence table (see Fig. 4). Wiedemann, too, stressed the importance of choosing words that refer to things that can be perceived by the senses.[38] The same applies to the German memory teacher Johannes Henricus Döbel, who quoted Wiedemann several times, and whose table of equivalences is almost identical, except that he transforms the number 4 into both "G" and "J".[39]

| Numbers | Letters | Numbers | Letters |
|---------|---------|---------|---------|
| 1 | B, P | 6 | M |
| 2 | C, K, Q, X, Z | 7 | N |
| 3 | F, V, W | 8 | R |
| 4 | G, J | 9 | S, Sch |
| 5 | L | 0 | D, T |

Fig. 4 – Wiedemann, *Nützliche Gedächtniß-Kunst*, 74-75.

To sum up, the numbers-letters equivalences technique circulated throughout the Holy Roman Empire from 1648 until the early 18th century.[40] Despite the popularity of this technique, memory manuals authors continued to describe more traditional ways of memoriz-

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[38] "Etwas sichtbares bedeuten": Wiedemann, *Nützliche Gedächtniß-Kunst*, 74-75. This advice, common in the mnemonic tradition, hints that Wiedemann did create mental images to memorize numbers (unlike, maybe, Winckelmann).

[39] Döbel, *Collegio Mnemonico*, 88, 89, 95.

[40] In addition to the examples already cited, Leibniz copied a table of this type, corresponding to Winckelmann's but removing the letter "T", Rossi, *Clavis Universalis*, 272. The memory teacher Erich Christoph Lübbern proposes the same table as Winckelmann›s, but without the W and Z. Huldrich Sigmund Rothmaler, *Kanzleidirektor* of Stolberg, copied Lübbern's manual including the equivalences table. Lübbern, *Artificium memoriae, d. i. eine Gedächtnis-Kunst*, 18; Rothmaler, *Stolbergischer Garten-Bau*, 526.

ing numbers. This is particularly true of Winckelmann who, probably to astonish his readers with the sheer number of tricks he knew, presented no less than ten methods for memorizing numbers.[41] Similarly, Döbel suggested that if a reader finds that the table of equivalences does not suit him, he can use mental pictures, each of which represents a particular number. He then provided the reader with a traditional list of such pictures (a candle or knife for number 1, a fork for number 2, a triangle for number 3, a hand for number 5 and so on).[42]

In this way, the numbers-letters equivalences table is presented alongside, and even used in conjunction with, more traditional ways of memorizing numbers. Moreover, the memory manuals in which it is included contain lengthy explanations of how to memorize discourses and other textual information. If Hérigone developed the numbers-letters equivalence as a new tool for a readership interested in mathematics, the German authors presented this method as a tool that can be used in a variety of contexts and did not link it to a specific branch of knowledge.

## 4. The replacement of the Ciceronian art of memory by the numbers-letters equivalence in 18th century England

A radical break in the use of the table of equivalences occurred in 18th century England. This innovation was the work of the pastor Richard Grey (1696-1771). Secretary to Lord Crewe, Bishop of Durham, until his death in 1721, he then became rector of several parishes. A Hebraist, he became interested in the numerical values assigned to each letter of the Hebrew alphabet and transposed this system to the English language. It therefore seems that he invented a table of numbers-letters equivalences independently of the continental mnemonists. The only source documenting the creation of this technique is Grey's own account in his manual, *Memoria Technica* (1730), and should therefore be taken with a grain of salt. He explains that his method differs from the rhetorical memory technique and seems to have consulted English treatises on memorization, whose jargon he uses ("places", "images" and, a term peculiar to English, "repository" to mean a large place).[43] There is no evidence that he read German treatises or the *Cursus mathematicus*. Since his method is closer to rabbinical mnemonics than to Winckelmann's, it is likely that his account is true.

Grey not only transposed the Hebrew numbers-letters system into English, but also modified it to memorize numeric data. While "the Representation of Numbers by Letters of the Alphabet hath been a Thing in Practice, more or less, almost in every Language", the

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[41]  Winckelmann, *Relatio novissima ex Parnasso...*, 112-129.
[42]  Döbel, *Collegio Mnemonico*, 13-14.
[43]  Grey, *Memoria Technica*, XII-XIII. I will use the 1732 edition as a reference, as successive reeditions are based on it.

substitution of letters for numbers was often lacking "in such Manner and Proportion, that any Number might be form'd into a Word capable of being articulately pronounced, and consequently more perfectly remember'd". [44] This innovation led him to create the table of equivalences given in Fig. 5.

| Numbers | Letters | Numbers | Letters |
|---------|---------|---------|---------|
| 1 | A, B | 6 | AU, S |
| 2 | E, D | 7 | OI, P |
| 3 | I, T | 8 | EI, K |
| 4 | O, F | 9 | OU, N |
| 5 | U, L | 0 | Y, Z |

Fig. 5 – Grey, *Memoria Technica*, 1732, 1-2.

As with Hérigone, the equivalence of each number with a phonetic vowel (formed by one or two graphic vowels) and a consonant allowed Grey to mechanically form words whose pronunciation resembles the sounds of his native language. [45]

Grey combined this equivalence with another technique he discovered while studying Hebrew: the use of what he called "Artificial Words" such as "*Rambam* for R-abbi M-oses B-en M-aimon". He understood how to organize information by means of acronyms, and precised, "I am not certain whether I owe not to Observations of this Kind the first Hint of this Method, which I have carried so far". [46] In fact, it was by combining the acronyms with the equivalences table that Grey gave shape to his system. For example, he took the date of the Flood, set at 2348 B.C., and transforms it into "etok". He then combined the numerical data (etok) with the qualitative information (it is the date of the Flood) and synthesized the two into a single "artificial word", "Del*etok*". [47] Anyone who knows the equivalence table and remembers Del*etok* can deconstruct this word and retrieve the thematic (the Flood) and numerical (2348) information it contains.

These two mnemonics are well known to Kabbalists. Numbers-letters equivalence, or "gematria", makes it possible to assign numerical values to words in the Torah (by adding the numbers corresponding to the letters of which they are composed) and to exchange them for other words of the same value, while "notarism" consists in transforming a word

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44  *Ibid.*, XII-XIV.
45  This double equivalence gives rise to polysemy, since 325 can be written as "tel" as well as "idu", *ibid.*, 4.
46  *Ibid.*, XV.
47  *Ibid.*, 6.

into an acronym whose letters form the initials of the words to be found.[48] These exegetical techniques have existed since antiquity, and as the reading of Hebrew developed in the early modern period, it is possible that other scholars had already developed methods similar to Grey's.[49] Nevertheless, the Englishman was the first to have his memory manual printed. The book was reprinted many times because it met a relatively widespread need: it provided a key for easily memorizing a large number of numerical data.

Most of this data consists of dates. Grey made it clear on the first page of his preface that "men of reading" complained that they do not retain everything they read, and that "in no Part of Literature is there greater Room for this Complaint than in *History*", the study of which requires "a distinct and accurate Knowledge of *Chronology* and *Geography*". The first part of his textbook is therefore devoted to memorizing chronology, beginning with the sacred history, various ancient dynasties, the kings of England, and so on. When Grey wanted to remember that Tarquin the Superb ("Tarquinius Superbus") reigned from 532 (i.e. "lid"), he condensed this information into "Superlid".[50] He sometimes explained the choice of dates to memorize. For example, he specified that he dated the beginning of Caesar's reign from the death of Pompey, and that of Augustus from "the full Establishment of his Authority by the Senate and People".[51] He also gave dynastic indications when a title or succession is in question, for example, noting that "Darius the Mede" is also called "Cyaxares" and is the uncle of Cyrus.[52] Each chronological table is followed by "Memorial Lines" which are a few lines of text containing all the "artificial words" that indicate the dates to be memorized. The example of the table of the judges of Israel (Fig. 6) shows how the page layout structures the various pieces of information.

The chronology is the most annotated part of the textbook. Of the 19 annotated copies of the *Memoria Technica* that I have consulted, 12 bear reading marks in the chronological section. Some readers corrected one or several "artificial words" distorted by typographical errors, such as the owner of the copy now in the Wellcome Library under the shelfmark EPB/A/25735/1, who corrected "Ibcake" to "Ibzake" (to refer to the judge of Israel Ibzan, 1182). A reader of the copy in the JJ Memory Systems box at the Bodleian Library corrected what he believes to be a factual error regarding the date of the invention of printing, stating that "printing was discovered Anno 1440, or rather invented then, and kept secret till 1449". This kind of factual corrections is the most common type of reading annotation, appearing in five of the examined copies.[53] This type of annotation is much

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[48]  Busi, *La Qabbalah*. In Jewish tradition, the creation of acronyms also exists as a mnemonic device. Gerhardsson, *Memory and Manuscript,* 155-156.

[49]  Neusner, *The Memorized Torah;* Gerhardsson, *Memory and Manuscript*.

[50]  Grey, *Memoria Technica*, 38.

[51]  *Ibid.*, 40.

[52]  *Ibid.*, 27.

[53]  Toronto, Thomas Fisher Rare Book Library, B-11 09271 (2); BoL, 70 b.45; BoL, JJ Memory

TABLE IX.

*The Judges of* Israel *from the Death of* Moses *to* Samuel.

|  | Bef. Chr. |
|---|---|
| Moses moritur [Mof-mola] | 1451 |
| Joshua [Jóshfol] | 1445 |
| Othoniel [Othózu] | 1405 |
| Ehud [Ehutel] | 1325 |
| Deborah [Debodeil] | 1285 |
| Gedeon [Gedol] | 1245 |
| Abimelech [Abmets] | 1236 |
| Thola [Thlett] | 1233 |
| Jair [Jaïdaz] | 1210 |
| Jephta [Jephtakk] | 1188 |
| Ibzan [Ibzáke] | 1182 |
| Elon [Eloboil] | 1175 |
| Abdon [Abdonafo] | 1164 |
| Eli [Elibup] | 1157 |
| Samuel [Sambap] | 1117 |

*The Memorial Lines.*

Mof-mola Jóshfol Othózu Ehutel Debodeil Gedol
Abmets.
Thlett Jaïdaz Jephtakk Ibeáke Eloboil & Elibup.
Abdonafo Sambap ——

Fig. 6 – Grey, *Memoria Technica*, 1756, 21.

rarer among manuals of the Ciceronian art of memory.[54] English history is of particular interest to readers. For example, the annotator of the copy of the 1732 edition now in the Bodleian Library, shelfmark 70 b.45, numbered the English rulers from William the Conqueror onwards and indicated that Henry II was a "Plantagenista" - he was indeed the first king of England from the House of Plantagenet.

Many readers added the year of the coronation of George III (1760-1820). Since *Memoria Technica* was published during the reign of George II (1726-1760), it is logical that George III (1760-1820) does not appear in the chronology of the Kings of England. Thus, the owner of the copy now in Manchester University Library, Spencer Collection 4165, added a line below that of George II. He gave the date of the coronation and the artificial word he used to commemorate it. He also added the latter to the "memorial line" at the

Systems 1; BL, 1030.c.20; Cambridge University Library, 7180.d.121.

[54]   There are some counterexamples, such as the copy of De Azevedo's *Fenix* held at the Biblioteca Nacional de España, R/21921, which contains the rectification of a quotation from saint Augustine.

bottom of the page. Subsequent editions of the manual, up to and including 1799, do not include George III's name along with a mnemonic to help remember 1760.[55] However, I have found no other record that can be reasonably dated to the 18th century making up for this omission. For example, the user of a copy of the 1790 edition, whose spelling suggests that his notes date from the late 18th or early 19th century, added contextual information on Roman history but left the incomplete list of English rulers untouched.[56] His interest was solely in ancient history. Sometimes the lack of interest seems to concern George III alone. For example, the annotator of 7180.d.121 in the Cambridge University Library (1781 edition) corrected the biographical data for Sophocles (p. 37) and Mary Stuart (p. 15) but did not add the date of George III's coronation.

When readers of the *Memoria Technica* decided to update Grey's chronology, they were not so much concerned with the addition of George III as they were with the correction of dates they considered erroneous. Thus, a blank page at the beginning of copy 1030.c.20 in the British Library contains a note on the chronology of the Maccabees written by a certain "S. Wilton" in 1769, while an anonymous reader, dating his note to June 1790, summarizes the table of equivalences in two lines and added that he has corrected Grey's dates on the basis of John Blair's *Chronology and History of the World*. For example, he changed the date of the destruction of Troy (1184 instead of 1183), the artificial word ("Troyabeif" instead of "Troyabeit") opposite the date, and in the "Memorial Line" at the bottom of the page. The date corrections are accompanied by a capital "B", clearly indicating that the new date comes from Blair's chronology.[57] Despite this interest in Grey's mnemonics (the corrections continue on subsequent pages), the unknown annotator did not add George III to the list of English monarchs. He clearly did not wish to memorize the history of European dynasties, but only sacred and/or ancient history.[58]

Not every copy contains such interesting *marginalia*. Indeed, I have also consulted 41 copies with no reading marks datable for sure from the early modern period, and librarians I contacted through mail assured me that 24 others included no traces of reading. Moreover, some marginalia remain difficult to interpret: a copy in the Thomas Fisher Rare Book Library, B-11 09271 (2), Toronto, contains chronological corrections probably made by an 18th century reader. This reader did not change the corresponding artificial words. Did this reader use Grey's method, or did he prefer to use the *Memoria Technica* as a chronological table to consult when needed? It is impossible to answer this question definitively.

[55]  Grey, *Memoria Technica*, 1799.
[56]  BoL, (OC) 260 g.364.
[57]  See Grey, *Memoria Technica*, 1737, copy of the BL, 1030.c.20, 9. For the date of Troy's destruction, see Blair, *The Chronology and History of the World,* C1v.
[58]  On the importance of classical erudition in early modern Europe, see the numerous works by Anthony Grafton and Scott Mandelbrote.

The second part of the *Memoria Technica* is devoted to geographical information. With 45 pages, it is also an important part of the manual, although it has received less attention from the annotators than the chronology.[59] It contains no figures and is based entirely on the acronym principle. Grey suggests learning three acronyms to memorize French geography: P Nor-I-cham, Bret-O-BuL, Gui-La-DaP, meaning "P-icardy, Normandy, I-sle of France, and Champagne" for northern France, "Bretagne, O-rleanois, Bourgogne, and L-ionnois" for central France, and "Guienne with Gascony, Languedock, Dauphiny, and P-rovence" for southern France.[60] It includes a few numerical data, such as the distance of major English cities from London, but mostly relies on the acronym method.[61]

The last three parts, devoted to memorizing astronomical dates, weights, measures and coins, and miscellaneous information, seem to have been of much less interest to readers.[62] The indications on how to memorize the diameter of the moon, the distance of the earth from the sun, the table of revolutions around the sun, etc., did not generate any notes.[63] It is true that the practical application of astronomical data is the subject of special manuals containing other mnemonic devices, such as "zodiac songs".[64] Weights, measures, and coins are rarely more popular, perhaps because most of the figures given concern units used in antiquity and not in the 18th century. However, at least one reader was sensitive to this section, and in a copy bequeathed to the College by David Hughes, Vice-President of Queen's College, Cambridge, on his death in 1777, several marginal notes indicate and/or organize information to be memorized. An artificial word is also corrected.[65]

Chronology and geography represent the lion's share of the manual, which can be ex-

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[59] It is difficult to date the reading marks on the National Library of Wales copy BF383 G84, as they consist of red lines underlining certain names in the chronological and geographical sections. As this copy of the 1732 edition belonged to a certain William Miles Junior from 1735 or 1736, it is likely that they date from the 18th century. Though the copy in the National Library of Ireland, J.154.GRE, contains a cross near the memorial line for learning the geography of Libya and Palestine, but since this is a copy of the 1796 edition for which we have no ownership mark, it is safer to assume that it dates from the 19th century.

[60] Grey, *Memoria Technica*, 1732, 54-55.

[61] *Ibid.*, 74.

[62] A possessor of the copy now preserved at Indiana University, The Lilly Library, BF383. G84 1732, underlined "Geography" and "Astronomy" on the title-page of the *Memoria Technica*.

[63] Grey, *Memoria Technica*, 1732, 99-109.

[64] Gent, "Het Sterrenlied in het Hollandse Zeevaartonderwijs"; Schotte, *Sailing School,* 56-57.

[65] Grey, *Memoria Technica*, 1732, the copy is in the Old Library of Queen's College, Cambridge, A.19.11, 117-137. A "1" added in a margin resembles the "1" on David Hughes' bookplate ("Col. Regin apud Cant. Socii 1734"). While this is a rather weak paleographical clue, the proximity of the date of the bookplate to that of the textbook's publication suggests that the annotations were indeed made by David Hughes (or by a member of Queen's College after Hughes' death). It should be noted that Hughes also owned the *Mnemonics delineated in a small compass and easy Method* from Salomon Lowe, today held in the same library with the shelfmark P.129(12).

plained by the audience Grey had in mind when writing his textbook. He stressed the importance of accustoming "Young Minds" to his mnemonics, which would give them "no small advantage in the Course of their future Studies". The youth of the students to whom Grey disseminated his technique implies that his real audience was "those who have the Education of young Students in the Universities and Public Schools".[66] In other words, Grey was addressing teachers who needed to give their students a classical background.

## 5. Teachers' view of the Memoria Technica

During the 18th century, this classical education – and the way it was taught – came under increasing criticism. Although grammar schools varied in status (completely free, private or semi-free, depending on the background of the pupils), they all offered a broadly similar education until the second half of the 17th century.[67] Pupils were usually divided into eight classes.[68] The most basic lessons were reading, catechism, and psalms. Grammar (Latin) was taught, followed by simple texts (dialogues, fables, collections of epigrams). Only the oldest students learned to read classical Latin prose, poetry, and occasionally Greek and Hebrew.[69]

Teachers and educators who wanted to change the curriculum often combined the acquisition of grammar and ancient culture with rote learning. Memory overload became a negative *topos*, while the importance of knowing how to think rather than memorize was frequently emphasized.[70] The lack of practical usefulness of traditional teaching was highlighted.[71] In this context, the ubiquitous memory exercises are seen as tedious and unhelpful, and some teachers, such as John Clarke, Master of Hull Grammar School, believed that the strength of memory depended solely on nature and not on training, making these exercises even more useless.[72]

The information contained in the *Memoria Technica* was part of the teaching that requires a great deal of memorization. For example, J. Girrard, who insisted on the usefulness of memory, explained the importance of teaching children "in the Parts of Knowl-

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[66]   Grey, *Memoria Technica*, 1732, [A]2, X.
[67]   Watson, *The English Grammar Schools to 1660*. This uniformity is due in particular to the state control exercised over teachers and part of the curriculum from Elizabeth 1 onwards. Lawson and Silver, *A Social History of Education in England*, 100-101.
[68]   Tompson, "Classics and Charity: the English Grammar School in the 18th Century", 57.
[69]   On the content of the teaching provided in the *grammar schools*, see Watson, *The English Grammar Schools to 1660.*
[70]   For ex., respectively, Butler, *An Essay upon Education*, 42-44 and Evans, *An Essay on the Education of Youth*, 31.
[71]   For instance, Stevenson, *Remarks on the Very Inferior Utility of Classical Learning*. The book's title sums up its thesis perfectly.
[72]   Clarke, *An Essay upon the Education of Youth in Grammar-Schools*, 52.

edge of such Things [...] which require little more than Memory, such as Geography, Astronomy, Chronology, and History".[73] Similarly, historical dates, in addition to Greek and Latin, were sometimes considered a burden on children's memory.[74] In other words, whether teachers were for or against teaching the classics, there is a consensus that history, chronology, and geography were subjects that required memory.

From then on, some moderate reformers found in the *Memoria Technica* a way to teach classical, historical knowledge more easily than by imposing rote learning on their students. This was the case of George Croft, a teacher at Beverley Grammar School from 1768, who defended the classical curriculum (including basic Hebrew) while wanting to open it up to the rudiments of algebra and geometry.[75] He noted that "if the pupils could be made to repeat Gray's *Memoria Technica*, it would be of great service, but I have heard of few instances where this was practicable".[76] The polymath Joseph Priestley, who taught modern languages and rhetoric at Warrington for several years, was enthusiastic about pedagogical innovations that promoted the learning of history. The *Memoria Technica* was one such method, and he found it so useful that he considered "all persons of liberal education inexcusable who will not take the little pains necessary to make themselves masters of it". Only its application to geography seemed to him "unnatural and useless", perhaps because it did not rely on memorizing numerical data.[77]

Several authors compared the traditional *ars memoriae* to Grey's novelty. Some were convinced by the innovation, such as John Holmes, master of the grammar school at Holt (Norfolk) and author of a treatise on rhetoric, who criticised the Ciceronian art of memory and cited Grey's and Lowe's manuals as improvements.[78] Others, such the philosopher and educator Isaac Watts, concluded that whichever mnemonics are of little use.[79]

As *Memoria Technica* became a long-seller (it was republished in 1732, 1737, 1756, 1778, 1781, 1790, etc.), works derived from its content were also published. Thus, Solomon Lowe (? – 1750), "master of a private academy at Hammersmith, and an accurate grammarian" published a *Mnemonics delineated in a small compass and easy Method* (1737) based on Grey's manual.[80] Lowe was a prolific educator in the 1720s and 1730s, and his *Mnemonics* is one

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[73]  Girrard, *Practical Lectures on Education, spiritual and temporal*, 169.

[74]  Turnbull, *Observations upon Liberal Education*, 273.

[75]  Tompson, "Classics and Charity", 90.

[76]  Croft, *A Short Commentary*, 189.

[77]  Priestley, *Lectures on History and General Policy*, 156-157.

[78]  Holmes, *Art of Rhetoric Made Easy*, 4.

[79]  Watts, *The Improvement of the Mind*, 274-275. Watts He explained the classical art memory, supposedly based on the treatise of Marius d'Assigny (1643-1717), as he precised how to use animals as a spatial structure to store information and give similar examples of images as in Assigny, *The Art of Memory*.

[80]  *The Gentleman's Magazine*, 580.

of many treatises he published to summarize a discipline for his students or to promote his pedagogy.[81] This short manual (14 pages, 18 including paratext) gives the equivalence table of Grey's system without explaining how it works, which prevents readers from using it independently. In addition, Lowe condenses a lot of information from the *Memoria Technica*, making his mnemonics much denser and less readable than the original version. It's possible that he used his booklet as a means of advertising: the narrow lines filled with cryptic words were intended to attract the reader's attention, who would then discover the wide range of teachings Lowe offered, from mathematics to chronology, astronomy, geography, and some physical experiments. The addition of the lunar and epact cycles, as well as the solar cycle and the Sunday letters, orient the astronomical section toward more detailed information.[82]

The publication of *Selected Parts of Grey's Memoria Technica* (1786) confirms the importance of the school audience in the publishing history of Grey's textbook. Indeed, the title page states that this book is "for the use of the GRAMMAR-SHOOL at WOLVER-HAMPTON", where it was published. The circumstances of its publication are rather vague, since the *Selected Parts* were published at a time of crisis: the Board of Directors was renewed on October 13, 1784, but its members had no teaching experience. The beginnings were inglorious, the organization debated by disgruntled parents, and the situation stabilized only with the arrival of Professor William Lawson in 1778.[83] During this period of uncertainty, it's possible that the publisher, Joseph Smart, decided to publish this book on his own initiative to sell to the students of Wolverhampton Grammar School. It is also possible that he was commissioned by the school's trustees.[84]

Smart explained his approach to making the textbook more suitable for grammar schools: "the probable Reasons why Grey's *Memoria Technica* has not been more generally received in Grammar Schools [...] are, that it abounds with Matter which has not strict Relation to Classical Authors, and that it is extended to Branches of Knowledge, such as Geography, Astronomy, &c where the Necessity of the Art is not so evident, and the Difficulty of Application is much greater".[85] He therefore lightened Grey's examples, retaining only ancient history and that of the kings of England and the United Kingdom, as well as

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[81]  This was common practice in his day. See Tompson, "Classics and Charity", 91-93. Three of the six copies I was able to consult are bound with at least one other of his treatises (BL, 1568/1298 (1); BoL, Johnson e.705 (1); Cambridge Queen's College, P.129(12)). Copy 95 of the Fondo Young in San Marino has lost the list of books published by S. Lowe. This is the only salient material feature I was able to observe. None of the six treatises consulted contains any trace of reading.

[82]  Lowe, *Mnemonics delineated in a small compass*, 6-7.

[83]  Mander, *The History of the Wolverhampton Grammar School*, 199-205.

[84]  The local nature of production explains the small number of manuals I have found (only three of them): National Library of Scotland, Mf.134, reel 11219, no. 08; Biblioteca Pública Municipal de Santa Cruz de Tenerife, Biblioteca Central, TF-BM, 37-4-9; BL, 9008.a.15.

[85]  Smart, *Select Parts Grey's Memoria Technica*, π2r.

geography.[86] The addition of extracts from Johannes Sleidan's *De quatuor summis imperiis* reinforces the importance of ancient history in this textbook.[87]

Having discovered the publishing potential of the *Memoria Technica* through the publication of the Select Parts, Smart participated in the republication of Grey's Manual with W. Lowndes in 1790.[88] The last page of the manual is used to advertise the other books printed for Lowndes. These include dictionaries, Italian and French grammars, manuals for learning arithmetic, Latin literature and grammar, etc. In short, the books advertised are aimed at a school market, another indication that *Memoria Technica*'s audience is made up of teachers, tutors and parents of students, as well as self-taught learners.

As is often the case, the analysis of ex-libris and reading traces complicates the situation, as the signs of ownership reveal a readership far removed from the academic world. Several nobles owned a copy of this book, such as John Baker Holroyd, first Earl of Sheffield, or George John (1758-1834), second Earl Spencer.[89] So did several members of Parliament, such as Richard Hopton and John Weyland.[90] These four are among the thirty or so individuals who left ownership marks on copies of the *Memoria Technica* published between 1730 and 1790. At least two of them were women. On the other hand, I have found no ownership marks that allow us to associate copies with grammar school teachers, probably because their books were less well preserved than those of England's political or economic elite.

Although the contours of Grey's audience are difficult, if not impossible, to define, the fact remains that all his readers share the same numerical mentality. The spread of Arabic numerals in England seems to have reached the mass of the literate population by the end of the 18th century. The increase in the use of Arabic numerals therefore seems to have been caused by the rise in literacy, as well as the proliferation of practical mathematics textbooks written in English.[91] By the end of the 17th century, textbooks were focusing less on the basics of arithmetic and more on specific applications of mathematics. This development shows that knowledge of basic arithmetic had spread throughout society

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[86]  Smart always proceeds by subtraction: he removes whole sections of Grey's manual but never adds new data to memorize, not even the date of the beginning of George III's reign.

[87]  About Johannes Sleidan's *De quatuor summis imperiis,* see Kess, "Johann Sleidan and the Protestant vision of history".

[88]  The collaboration between Smart, listed as printer, and Lowndes is probably more complex than a simple printer-publisher relationship. In addition to Smart's familiarity with *Memoria Technica*, it is notable that his name, and that of his city, are printed in larger type than those of Lowndes and London. Grey, *Memoria Technica*, 1790.

[89]  Respectively, Barcelone, Biblioteca de Catalunya, R(1)-8-95 and Manchester University Library, Spencer Collection 4165.

[90]  BL, 08311.h.125 and BoL, JJ Memory Systems 1.

[91]  Otis, "'Set Them to the Cyphering Schoole': Reading, Writing, and Arithmetical Education, circa 1540-1700". See also James, "Reading numbers in early modern England".

and was no longer considered interesting enough to justify the purchase of a book.[92] Nevertheless, the mentalities changed only slowly: the association of mathematical symbols with diabolical devices can be found well into the 17th century.[93]

This greater penetration of Arabic numerals into society was largely the result of extracurricular or technical teaching, but it began to affect grammar schools as early as the second half of the 17th century.[94] As arithmetic was often considered a secondary subject to Latin, it was often taught on Saturdays or in the evenings, or even as an optional subject for a fee. Given the limited choice of free schools, private alternatives were set up.[95] The situation improved over the next century. Of 162 schools that changed their curriculum in the 18th century, Richard S. Tompson counted 88 that added arithmetic and ten that added mathematics, while sixteen abandoned Latin. These trends accelerated towards the end of the century.[96] The widespread use of Arabic numerals in society explains the diversity of *Memoria Technica*'s reader profiles and its success.

This situation was not unique to England. Continental Europe was familiar with Arabic numerals before they arrived in Albion and, as explained hereabove, German authors instructed their readers how to use the equivalence between numbers and letters.[97] Twenty years before Grey explained how to learn the first seven decimal places of pi (3.1415929) using the word "ta-fal-oudou", Döbel had his readers memorize 35 decimal places.[98] The main difference between the German authors and Grey lies in their audience. While the continental mnemonists taught the Ciceronian art of memory to adults who wanted to remember numerical data as well as discourses, the Englishman tailored his technique to students in a country where memorizing discourses was less and less important.[99]

Grey's techniques, and therefore the cognitive processes they relied on, were no longer those of the classical art of memory. No imaginary buildings were used, nor mental imag-

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[92] Otis, "'Set Them to the Cyphering Schoole'", 471-472. For specific examples of applied mathematics in England and elsewhere, see for example the collection of essays in Beeley and Hollings.

[93] Feingold, "Reading Mathematics in the English Collegiate – Humanist Universities", 130-131.

[94] Watson, *The English Grammar Schools to 1660*, 8; Tompson, *Classics or charity?*, 49.

[95] Vincent, *The Grammar Schools*, 74, 201-204; Tompson, *Classics or charity?*, 4, 44, 47-49.

[96] Tompson, *Classics or charity?*, 121.

[97] The absence of French, Italian or Spanish treaties exposing this technique can be explained by the declining interest to the art of memory in the second half of the 17th century, and by the languages in which the variants of the equivalence table are presented (German and English being little understood outside the Holy Roman Empire and England, it limited the diffusion of the new mnemonic).

[98] Grey, *Memoria Technica*, 1732, 141; Döbel, *Collegio Mnemonico*, 130.

[99] On the decreasing importance of mnemonics as a rhetorical tool used by English preachers, see Poupard, "La méthode des *loci*", chapter 12.

es. The inheritance of the old *ars memoriae* seems to consist only in the vocabulary, as this is reflected in the title of the *Memoria Technica: or, a New Method of Artificial Memory*. In addition to this reference to "artificial memory" and "artificial words", Grey also used the word "figure", typical of mnemonic jargon. However, these terms no longer have the same meaning as they did on the continent at the same time. These two arts of memory are no longer concerned with the same objects: the same vocabulary is used to signify completely different things. Whereas in continental *ars memoriae* a "figure" could signify a phrase or a commonplace, Grey uses it to designate a memorized number transformed it into a group of letters.[100]

## Conclusion

Hérigone, Winckelmann and Grey seem to have discovered the mnemonic utility of numbers-letters equivalence independently.[101] These discoveries can all be linked to the practice of another discipline requiring the use of mental patterns similar to those required to employ the equivalence table. Hérigone uses alphabetical notation to signify unknown measurements, Winckelmann transforms letters into numbers and vice versa to encrypt and decrypt messages, while Grey encounters this principle during his Hebrew studies. The greater familiarity with Arabic numerals on the part of the literate is both necessary for the invention of the technique and, above all, for its reception: the equivalence table only appears when potential pupils and readers of mnemonic manuals show an interest in memorizing numerical data.

In 18th century England, this new numerical mentality led to the specialisation of mnemonic tools. The Ciceronian art of memory was no longer used to memorize numbers, while the new *Memoria Technica* did not explain how to memorize texts.

## Addendum on the material history of the *Memoria Technica*

As shown in the fourth part of this paper, the study of the materiality of the surviving copies of the *Memoria Technica* helps to better understand the audience and uses of the book. This appendix is intended for readers who want to know more about the material history of the *Memoria Technica* and the methodology used to approach reading practices.

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[100] Grey, *Memoria Technica*, 1732, 4.
[101] Robert Alan Hrees doubted the bona fides of Grey and Lowe. However, it seems reasonable to assume that both authors were unaware of the German textbooks (only one surviving copy can be found in England, and it is not a stand-alone textbook but a copy of the *Dreyfache Kunst-Schnur,* which is a compilation of manuals published by Winckelmann, at BL, 1043.b.27.(2.)), and of the *Cursus Mathematicus* which is, after all, a one-century old mathematics manual, not a memory treatise. Hrees, "*An edited history of mnemonics from antiquity to 1985*", 659, 689.

Studying reading practices is a difficult task. First of all, traces of reading in copies of the *Memoria Technica* are difficult to date.[102] I counted 19 out of 84 copies with annotations that probably date from the 18th century, i.e. about 22%.[103] This proportion is slightly higher than that of the classical mnemonic manuals (17.7%).[104] It is possible that this greater use of the *Memoria Technica* as a writing medium is due to its role as a catalogue of dates, distances and other facts to be learned. Whereas Ciceronian art of memory manuals explain a technique but rarely, if ever, list information to be memorized, the *Memoria Technica* contains the data its readers need to acquire in order to excel in school and society.

As pencil traces are more difficult to date than ink traces, especially if they do not contain *marginalia* but only lines or crosses, I have chosen not to include them in our statistics. For example, I have not counted the crosses in the margins of British Library copy 72.B.16 on pages 10-11. The same applies to the numbering of the prophets in copy Vet. A4 e.3062 (p. 24). When the copy contains marginal notes, the spelling sometimes allows us to date the pencil notes to the 19th century without too much doubt.[105] In addition to the problem of dating, some copies show traces that are more likely to have been caused by dirt than by a reader, although this possibility has not been ruled out.[106]

Sometimes the biographical information known about an owner suggests that he or she did not necessarily want to use their copy of the *Memoria Technica*. For example, that of William Vesey (1677-1755) is associated with Grey's *Method of Learning Hebrew* and Richard Parker's *An Essay on the Usefulness of Oriental Learning*.[107] It also contains the words "Donum Authorii" on its title page.[108] It is therefore likely that Grey gave this copy to Vesey, as the two knew each other through their shared interest in Hebrew. On the other hand, the absence of any trace of reading may indicate that Vesey did not share Grey's enthusiasm for mnemonics.

This is not the only donated copy. Cardiff University Library copy BF370.D2, for example, mentions that this book was given by "Mr Lee" to the "Revd. Mr Morris". Similarly, the copy now in the National Library of Wales, Aberystwyth, BF383 G84, was given by "the Right Hon[orable] Stephen Poyntz Esq[r] one of his Majesty's most hon[orable]

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[102]  As I tried to analyze the practices of 18th century readers of the *Memoria Technica*, all the numbers given in this paper do not include *marginalia* from the 19th and 20th centuries.
[103]  The percentage is the same for books I have consulted personally and for those for which I have obtained information via e-mail exchanges with librarians. The 19 copies in question do not include those bearing only a bookplate or personal reading notes on blank sheets. Only those with annotations in the text and/or paratext are included.
[104]  Poupard, "La méthode des *loci*".
[105]  Vrije Universiteit Library, XF.02372.
[106]  For ex. BL 51.b.14, 69.
[107]  Parker, *An Essay on the Usefulness of Oriental Learning*.
[108]  Oxford, Lincoln College Senior Library, O,8,24(1).

Privy Council" to a certain William Miles Junior in 1735 or 1736. This copy was subsequently donated to the National Library of Wales by the great-nephew of the bibliophile Henry Hey Knight.

These donations provide us with snapshots of the biography of RAREWK 153.14 G8697M from the State Library Victoria. A said Harricot Smith received this book from a Mrs Ravenscroft in London in March 1794. At some point, the book arrived in Australia. There, a certain Peter Bell gave it to a said C. Evans on 26 June 1992 "on the occasion of his departure from Australia for the Antipodes".[109] Evans must not have been interested in mnemonics, because the manual is still kept in Melbourne. Such intercontinental movements are rare, but not surprising. 25 of the 84 textbooks used in this survey are located in former British colonies.[110]

As was the case with the classical art of memory manuals, and ultimately with all early modern books, copies of the *Memoria Technica* were more likely to be found in institutional libraries or the libraries of wealthy collectors than elsewhere. This phenomenon of gradual accumulation began as early as the eighteenth century: William Vese, mentioned above, bequeathed his copy to Lincoln College. It accelerated in the modern period and continues to strengthen the influence of institutional libraries, which partly explains the presence of *Memoria Technica* outside the British Isles. For example, RAREEMM 822/11, which has been in the State Library Victoria since 2015, was acquired by the bibliophile John Emmerson around 2010.[111] The same is true of the eight examples (out of the 84 examined) that belonged to the American collector Morris N. Young before his collection was acquired by the University of San Marino.

Most of the movements outside the UK that I have been able to document are recent. However, one copy had already left Britain in the 18th century to reach European shores. Copy Ph.o. 825 in the Würzburg University Library bears an ex-libris from the 'Würzburg Benedictine Abbey of St James'. The limited circulation of the *Memoria Technica* in early modern time is probably caused by the English language: rarely understood outside England and its colonies, it hinders any kind of books export.

While I have paid attention to the history of Grey's treatise in order to understand the evolution of the "numerical mentality" led to the divergence between mental tools used to memorize numbers and texts in 18th century England, I have not studied the numerous reeditions of the *Memoria Technica* in the 19th century. The material is abundant and, as with the whole of modern memory manuals, unexplored by historians. To analyze it would be beyond the scope of this paper. I would simply like to point out that, while the tools of modern book history are rarely employed for the contemporary period,

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[109] It simply written "26.6.92", but the handwriting and ink suggest that it was written recently.
[110] Thirteen in the United States, eight in Australia, three in Canada and two in Ireland.
[111] We would like to thank the State Library Victoria for providing us with this information.

they would probably be useful in this particular case. Indeed, copies of eighteenth-century copies continued to be annotated in subsequent centuries, which sometimes leads to a stratification of marginalia when readers from different eras leave their notes in the margins of the same copy.[112] Moreover, copies produced in the 19th century are also annotated, such as this copy of the 1812 edition in which a reader has added the names of the dynasties opposite the English kings.[113] At the same time, a study of the editorial history of the *Memoria Technica* reveals that several authors took advantage of Grey's method (and his name) when they published adaptations of the manual focusing on the memorization of history.[114] Thus, it seems that interest in memorizing chronology was even stronger in the 19th than in the 18th century, while the other information contained in the *Memoria Technica* was of less interest to readers, but this provisional conclusion should be validated by further studies about 19th century mnemonics.

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[112] For instance, the copy held at Toronto, Thomas Fisher Rare Book Library, B-11 09271 (2). While the 18th century handwritten only corrected chronological data, the modern hand has also modified the artificial words associated with the dates it corrected.

[113] BL, 8305.aaa.5.

[114] A few titles : [Anonymous], *Wilcongsau or Mnemonic Hexameters after the method of the Memoria Technica of Dr. Grey*; [Anonymous], *The historical Lines of Dr. Grey's Technical Memory*; [Anonymous], *Regdol or Mnemonic Hexameters after the method of the Memoria Technica*; Thring Phipson, *Chronology; with a Brief Outline of History and a Memoria Technica on Dr. Grey's System.*

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## Abbreviations in footnotes

BL = British Library
BoL = Bodleian Library

# The *Olympic Competition* of Thomas Digges: The measurement of parallax and the development of observational methods in astronomy

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**Abstract**

A few months after the appearance of the supernova SN1572, Thomas Digges wrote a Latin book entitled *Alae seu Scalae Mathematicae…* in which he presented new methods for measuring small parallax angles like those expected for planets and other objects at similar distances. On the basis of our new translation into English of some sections of this book, we point out several relevant innovations developed by Digges. These concern the accuracy of astronomical measurements and a discussion on the origin of observational and computational errors. Furthermore, Digges introduced a simple but effective method for the falsification of observational results, which was useful for disproving some incorrect claims reported by other observers. It is also clear that Digges is completely disinterested in the astrological implications of this unexpected celestial phenomenon.

"Who, therefore, wants to participate in the Olympic Astronomical competition, must convince himself [ … ] that the Senses can never precisely aim to satisfy the demands of Reason".

<div align="right">Thomas Digges</div>

## 1. Introduction

The sudden and unexpected appearance of a very bright New Star in November 1572 prompted the European astronomical community to resume study of the nature of celestial objects. In 1543 in *De Revolutionibus Orbium Coelestium*, Nicholas Copernicus had published the heliocentric structure of the known universe which in 1540 in *Narratio prima de libris revolutionum Copernici* Georg Joachim Rheticus (1514-1574) had described in summary form. M. Boas Hall describes the impact that the new system of the cosmic world and the New Star of 1572 had on the culture of the time:[1]

> By the last quarter of the sixteenth century, the Copernican system, though it had gained few adherents, was widely known; after thirty years of discussion and debate, non-scientists were familiar with the fundamental problem [ … ] Indeed, events in the heavens – a new star (nova) in Cassiopeia in 1572, [ … ] – naturally called everyone's attention to astronomy and to the heated discussion ranging among astronomers.

Johnson describes the reception of the Copernican system in England, which was mainly outside of Universities.[2] In 1556 John Field (Felde or Field; c. 1520-1587) published the *Ephemeris anni 1557 currentis iuxta Copernici* in which he revised for the London meridian the Prutenic tables calculated on the assumption of heliocentrism. The Preface of Field's book was written by John Dee (1527-1609), a leading advocate of Copernican theory, who declared that he asked Field to prepare these new ephemerides because the old ones were not sufficiently precise. In the same year the mathematician Robert Recorde (c. 1510-1558) published the *Castle of Knowledge* in which a teacher describes the Copernican heliocentric system to a young pupil.

Thomas Digges (c. 1546-1595) attempted to measure the diurnal parallax of the New Star, but it was undetectable and Digges reached the conclusion that this phenomenon was at least at the same distance as stars and was not a comet or similar nearby body. (Diurnal parallax is the apparent angular displacement as seen by an observer resulting from the Earth's rotation. It uses the Earth's radius as a baseline, and is not to be confused with annual parallax whose baseline is the Earth's orbital radius.) Digges reported his measure-

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[1]    Boas Hall, *The Scientific Renaissance 1450-1630*, 101.
[2]    Johnson, *Astronomical Thought in Renaissance England*, 13, 137-138, 196-197.

ments of the angular distances between the New Star and other known stars in the book *Alae seu Scalae Mathematicae…* (hereafter simply *Alae*) printed in London by Thomas Marsh in February 1573 (Fig. 1), while the *Parallaticae Commentationis…* by Dee (1573) followed about a month later and was printed by John Day, also in London. These works appeared when the New Star was still shining brightly in the night sky. Digges wrote that the problem of measuring such small parallaxes was discussed with Dee and both developed observational and computational methods based on new theorems of spherical trigonometry and modes of data collection, which they published independently.

In *Alae*, Digges proposed new and robust mathematical methods to derive diurnal parallaxes of planets, from which he hoped to decide between the geocentric and the heliocentric models of the Universe. Digges proposed new methods that differed from that of Regiomontanus (1436-1476) which at the time was the most accurate way to determine the diurnal parallax of nearby comets. The greatest deficiency in the old approach was inaccurate measurements of time that elapsed between measurements owing either to the practical difficulty of performing nearly simultaneous observations or to the inaccuracy of mechanical clocks which introduce errors so large as to provide completely erroneous results. Digges considered his own effort as the most important for the astronomy at that time. He likened this challenge to an 'Olympic competition', and he used this term at the end of *Proemium* and several times in the Conclusion.

Digges asserted his Copernican conviction, but he published only numerical examples of his methods. Nevertheless, he added sections on the accuracy of measurement and the propagation of uncertainty without which the determination of small parallax angles provided incorrect values. The considerations by Digges reveal a modern approach. For instance, he discussed repeating observations to improve accuracy, but did not express using any averaging procedure. We stress that at that time statistical approaches were completely lacking and that the methods of algebraic calculations were still in their infancy.

Curiously, only some relatively short pieces of Digges's book have been translated into English and none deal with error analysis. We therefore decided to make available the translation of some passages selected for their historical and philosophical content. In the following we first describe the structure of the book, which resembles a compilation of several papers some of which very likely were written before the appearance of the supernova. The main section is written in a traditional style and its organization is similar to that of Dee's booklet.

## 2. *The structure of* Alae

Digges's book *Alae* appears as a collection of different works with different typefaces. We distinguish the following sections, with the number of pages and page identifications given in parentheses:

*72. J. 130.*

# ALÆ SEV SCALÆ

Mathematicæ, quibus visibilium re-
motissima Cœlorum Theatra conscendi,
& Planetarum omnium itinera nouis &
inauditis Methodis explorari : tùm huius
portentosi Syderis in Mundi Boreali plaga
insolito fulgore coruscantis, Distantia,
& Magnitudo immensa, Situsq; pro-
tinùs tremendus indagari, Deíq;
stupendum ostentum, Terrico-
lis expositum, cognosci
liquidissimè possit.

THOMA DIGGESEO, CANTIENSI,
Stemmatis Generosi,
Authore.

¶ *Londini.* ᴄ*Anno Domini.*
1573.

Introductory section:

  Title (1p.; no sig. <u>A.i</u>$^r$).
  Astronomical map of the Cassiopeia constellation with SN 1572 (1p.; no sig. <u>A.i</u>$^v$).
  Coordinates of Cassiopeia stars and angular distances to SN 1572 (1p.; sig. A.ii$^r$).
  Emblem of William Cecil, Lord Burghley (1p.; sig. A.ii$^v$).
  Dedication letter to William Cecil (4pp.; sig. A.iii$^r$-A.iiii$^v$).

Main section:

  Author preface (9pp.; sig. A1$^r$-B1$^v$).
  Introduction / Proemium (4pp.; sig. B1$^v$-B3$^r$). Definitions (3pp.; sig. B3$^v$-B4$^v$).
  Basic theorems / Protheoremata (4pp.; sig. C1$^r$-C2$^v$).
  Problems, Canons, revision of the Regiomontanus method (42pp.; sig. C2$^v$-H3$^v$).
  Short Practical Preface (2pp.; sig. H4$^r$-H4$^v$).
  Supplement on the Astronomical Radius, in 10 chapters (15pp.; sig. I1$^r$-K4$^v$).

Closing section:

  Conclusion (6pp.; sig. K4$^v$-L3$^v$).
  Erratum (1p.; sig. L3$^v$).
  Emblem of Digges family (1p.; sig. L4$^r$).

The Appendix gives translations of sections marked in different font in which some general astronomical and technical topics are summarized and discussed. These help to understand the methodological and philosophical concepts that Digges adopts.

## 3. *The precision of astronomical measurements and the nature of observational uncertainties.*

The first modern study of *Alae* is likely that of Johnson which includes translations into English of a few short passages.[3] This author focuses mainly on Digges's support of the Copernican system and on his concept of an infinite universe. He states clearly the problem of accurate measurements of small parallaxes like those expected for the New Star, but does not discuss the new methods developed by Digges and the practical problems involved. A new and more detailed analysis of Digges's work is that of Goulding[4] who presents an accurate analysis of the new methods that Digges developed to avoid some practical flaws in the approach of Regiomontanus. Goulding points out that Digges's algorithms were generally not

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[3]   *Ibid.*, 158-159.
[4]   Goulding, "Wings (or Stairs) to the Heavens, The Parallactic Treatises of John Dee and Thomas Digges".

accepted by astronomers because of their complexity and in particular not by Tycho Brahe (1546-1601) (herein simply 'Tycho') who studied the parallactic problem extensively.

The historical treatment of observational data and of their accuracy in astronomy can be traced back to the Hellenistic epoch,[5] and in the Renaissance it became a relevant subject. According to the picture given by Chapman,[6] up to the middle of the sixteenth century the typical accuracy of astronomical measurements was between 6 and 10 arcminutes, and in the second half it improved to about 1 arcminute and continued to increase thereafter. A widely accepted opinion is that Tycho, who had exceptional financial support in building the greatest observatory of the time, was the first astronomer to develop new precision tools for increasing the accuracy of the measurements of astronomical coordinates and for understanding the occurrence of instrumental errors.[7] We will show that Tycho was not the only one to follow this approach and that in *Alae*, Digges independently had a clear idea of errors incurred in making astronomical observations.

Digges had two main objectives: The determination of the distances of planets and the verification of the heliocentric system, as he wrote in the dedication letter to William Cecil and in the last part of the Conclusion, and the detection of the parallax of the New Star of 1572 now known to have been a Type 1a supernova (SN1572).

In seeking the parallax of SN1572, Digges measured the angular distances between this star and five other stars in the Cassiopeia constellation. Digges reported ecliptic Longitudes and Latitudes for some of these stars with the poor precision of 10 arcminutes (or 5 arcminutes in only a couple of values); these values are clearly included not for their astrometric value but just as an aid to identify stars in the associated map with those reported in other work. One of these coordinates is wrong by 1 degree and it is likely a typographical error that was probably corrected by Tycho.[8] A handwritten corrigendum can be seen in the page A.ij of the copy considered by us, here reported in Figure 2. Note that the angular separations of SN1572 from the five stars are reported with a much higher precision. Fractions of a degree are given in 'scruples' which correspond to the smallest amounts of a considered quantity, and it is easy to verify that in this context they are the same as arcminutes. For five of the six stars, distances are reported in degrees and arcminutes, and for the sixth star, the accuracy is 1/2 arcminute = 30 arcseconds. In the Conclusion (see the attached translation in [*App* vii-4]) it is clearly stated that an accuracy of 1/2 arcminute is Digges's goal. This is the highest resolution normally expected for human vision[9] and could have been reached either by

[5]  Sheynin, "The treatment of observation in early astronomy".
[6]  Chapman, "The accuracy of angular measuring instruments used in astronomy…".
[7]  Christianson, "Tycho Brahe's Earliest Instruments", 131-144.
[8]  Green, *Assessment of early-modern observations of comets and supernovae…*, 122.
[9]  Usher and Massaro, "The Sixteenth-Century Empirical Disproof of Ptolemaic Geocentrism: Paper II", 68-69.

increasing the size and quality of the instrumental scales or by reducing the uncertainty due to observational errors.

The analysis of Digges of the origin of observational errors is surprisingly modern and indicates that he studied this subject deeply. In the Conclusion, Digges considers three main sources (see the attached translation in [App vii-2]): (*i*) When a datum is obtained by means of several measures, the accumulation of errors during data reduction increases the uncertainty of the final value which could be much different than the true value; (*ii*) if some observations must be made in a short time, a small error in time can affect subsequent readings and produce a large deviation; (*iii*) errors in reading instrumental scales, even when accurately calibrated, owing to limitations in visual acuity. Digges added a fourth cause of error originating in mathematical calculations [App vii-5], particularly of trigonometric functions and of square roots, which generally are irrational numbers, which cannot be evaluated with a very high precision. These unavoidable mathematical approximations may be a further source of uncertainty, particularly for very small parallaxes.

Another topic that Digges discusses briefly is the possibility of repeating a measure several times to obtain reliable observational data. As noted above, Digges did not report any averaging method, but it is possible that he computed a mean value, for instance, when he gave in the first page of the book the angular separation between the New Star and star numbered 11 (κ Cas) as 1° 28.5′ which has an accuracy of 1/2 arcminute (see Fig. 2) that may not have been achieved visually. Apparently, Digges did not know the statistical nature of errors, but it appears that he realized that owing to the propagation of errors, the final uncertainty can be greater than the value itself.

The use of an arithmetic mean for computing the best estimate of a measure was already recognized in the work of Hellenistic scholars, and in particular of Hipparchus (190-120 BCE),[10] despite a few other ancient historical and literary indications.[11]

According to Plackett, the first use in an astronomical context is reported in Tycho's *Astronomiae Instauratae* completed in 1588 where Tycho appeared to have applied arithmetic means to a couple of stellar data to eliminate systematic errors, but Buchwald has shown that actually Tycho applied a recursive averaging mean between couples of observational data ordered chronologically.[12]

Digges placed a high value on technical innovation in the fabrication of instruments to increase their sensitivity. He considered the matter so important that he added a Supplement to *Alae* in which he describes the use of the Astronomical Radius, the term he uses for the cross-staff. This instrument is described by Petrus Apianus (1495-1552) in *Instru-*

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[10]   Plackett, "The principle of the arithmetic mean", 130-135.

[11]   See for istance Bakker and Gravemeijer, "An Historical Phenomenology of Mean and Median", 149-168.

[12]   Buchwald, "Discrepant measurements and experimental knowledge in the early modern era", 565-649.

## CASSIOPEÆ
### Stellarum

*Ad has longitudines addi
Processionem ad finem
Anni 72, 27 Aÿ 8 ha
bubÿ tum stellam cûÿ apparenti
æquinoctio.*

| | Nomina. | Longitudines. | | | Latitudines. | | | Magn |
|---|---|---|---|---|---|---|---|---|
| | | ♈ Gr. | 10 MI. | | 45 Gr. | 20 MI. | | |
| 1 | In Capite. | | | | 45 | 20 | | 4 |
| 2 | In Pectore. | 4 | 10 | | 46 | 45 | | 3 |
| 3 | In Cingulo. | 6 | 20 | | 47 | 50 | | 4 |
| 4 | In Coxa. | 10 | 0 | | 49 | 0 | | 3 |
| 5 | In Genu. | 12 13 | 40 | | 45 | 30 | | 3 |
| 6 | In Crure. | 20 | 20 | | 45 | 30 | | 3 |
| 7 | In Extremo pedis. | 25 | 0 | | 48 | 20 | | 4 |
| 8 | In Sinistro brachio. | 7 | 40 | | 45 | 0 | | 5 |
| 9 | In Sinistro Cubito. | 8 | 0 | | 44 | 20 | | 4 |
| 10 | In Dextro Cubito. | 357 | 40 | | 50 | 0 | | 6 |
| 11 | In Sedis pede. | 8 | 20 | | 52 | 40 | | 4 |
| 12 | In Ascensu medio Cath. | 1 | 10 | | 51 | 40 | | 3 |
| 13 | In Extremo. | 357 | 0 | | 51 | 40 | | 6 |

*Quicheu qt 8, apud Ce prevai cum est 9.*

| | | | Gradus. | Scrupuli. |
|---|---|---|---|---|
| | Pectore | 2 | 7 | 47 |
| | Coxa | 4 | 4 | 58 |
| | Genu | 5 | 8 | 5 |
| | Crure | 6 | 9 | 45 |
| | Sedis pede | 11 | 8 | $28\frac{1}{2}$ |
| | Ascensu medio | 12 | 5 | 55 |

*Phænomeni cælestis insoliti, Distantia à Stellis in Cassiopea*

A.ij.

Fig. 2 – The lower part of page A.ij of the copy of *Alae* with some notes written by a contemporary astronomer. Coordinates of Cassiopeia stars and their angular distances from SN1572 as measured by Thomas Digges are reported in the two tables. See the correction in the longitude of a star (13 degrees instead of 12) that can be originally attributed to Tycho, but who was not the author of these notes because the calligraphy looks different from that in Tycho's notebook.

*ment Buch* (1533), Gemma Frisius (1508-1555) in *De radio astronomico…* (1545), and Leonard Digges the Elder (c. 1520-1571?) in his book *Tectonicon* of 1556 on land surveying methods, and its use was well-known in England.[13] In *Alae* (*Supplementa,* Chapter IX, K3[r]) Digges writes words of admiration for Richard Chancellor (Richardus Chancelerus; c. 1520-1556), to whom he attributed the adoption of the transverse scale (Fig. 3) for increasing the precision of measurements. The history of this useful device is ancient and pos-

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[13]    Roche, "The radius astronomicus in England", 2-3.

sibly it was independently developed by various people. It was known and likely invented about a couple of centuries before by Levi ben Gerson (1288-1344) (also known as Gersonides).[14] The books of ben Gerson are generally written in Hebrew and were not largely known in the astronomical community.[15] Christianson reported that transverse scales were also adopted by the young Tycho in 1564,[16] when he was aided by Bartholmæus Scultetus (1540-1614) in constructing a cross-staff. Scultetus had studied with Johannes Hommel or Homelius (1518-1562), professor of mathematics at the University of Leipzig and instrument maker, also known by Tycho who assisted at his lectures.[17] In turn, this idea seem to be suggested to Homelius by the poorly known Richard Cantzlar in 1552 or 1553.[18] Other astronomers who used this tool were Paul Wittich (c 1546-1586), considered however to be a poor observer,[19] and Christoph Rothman (c. 1550/1560-later than 1590) from the town of Kassel, both visitors to Tycho's Uraniborg. Furthermore, in the *Supplement*, Digges analyzed in detail sources of error owing to misalignments of the eye during observation.
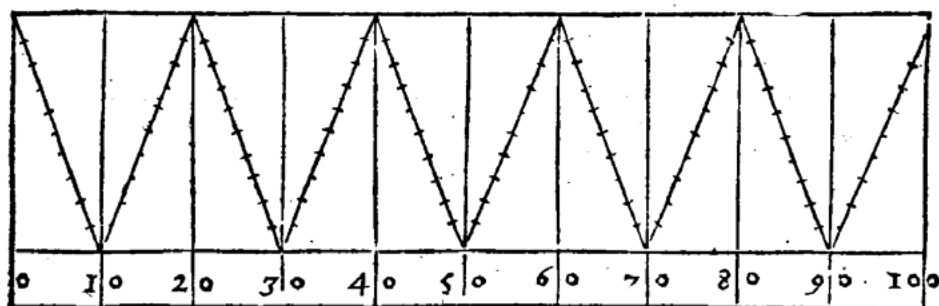


*Qui verò Radio liberè sine Machina vti affectauerit, pinnulam illam extremitati oculo propinquiori ad motam, integram habeat, quadratæ formæ, et in eius medio ( æqualis altitudinis cum Transuersarij acie superiori) foramen exile fiat: cui oculum applicare licebit, et solito more ad libitum baculo vti, absque hallucinatione aut visus parallaxi vlla. Mirum in modum hæc baculi rectificatio Nautis proderit, qui maximè ex oculi eccentricitate in Po-*

Fig. 3. The transverse scale described by Thomas Digges in the Chapter V of the *Radii Astronomici Supplementa* (page I4ᵛ) of *Alae*. Note the use of decimal divisions.

[14]   Goldstein, "Levi ben Gerson: On Instrumental Errors and the Transversal Scale", 102.
[15]   Rudavsky, "Gersonides: Levi ben Gerson".
[16]   Christianson, "Tycho Brahe's Earliest Instruments", 135-136.
[17]   Helfricht, *Astronomiegeschichte Dresdens*, 29.
[18]   q.v. Krisciunas, "Observatories", 5n1. Note added in press: The name Richard Cantzlar could refer to the German "Kanzler", meaning "Chancellor", suggesting the name Richard Chancellor.
[19]   Mosley, *The Biographical Encyclopedia of Astronomers*, 1234.

## 4. The scientific approach of Thomas Digges

Digges's approach to SN1572 is free of astrological conviction. He believed that the event is due to the action of God, like everything in the Universe, and that it belongs to the natural world in the remote region of stars, but it would not affect human events at all. By contrast, Tycho devoted about half of his book *De Nova stella* to a discussion of possible connections between SN1572 and astrology.[20] Next, Digges excluded the possibility that this unusual and rare Phenomenon - which is the term that he used frequently to describe the new star possibly to underline its material nature - was a comet. This is clearly affirmed in the Dedicatory Letter to William Cecil [*App* ii-1] where he wrote about the starlike appearance and the absence of any coma or tail, and in the closing sentence of the Conclusion that it does not resemble the star that guided the Three Wise Kings [*App* vii-7]. Furthermore, the changes in brightness are not explained by any miraculous action but by means of a variation of its distance, without consequences for humankind [*App* iii-1].

A possible consequence of this hypothesis is Digges's change of the size of the Universe. *Alae* was written about three months after the appearance of SN1572 when it continued to be very bright, and as a firm believer in heliocentrism, Digges expected to see some modulation in its brightness owing to variations of distance due to the motion of the Earth around the Sun. But SN1572 started to decline in brightness steadily and disappeared from view in March 1574. If this fading is explained by a receding motion of the new star [*App* iii-2], then this very far object could not be fixed on a solid sphere but it could move in space. A possible consequence is that this motion could happen only if a solid sphere of fixed stars does not exist. Consequently, stars could be dispersed within an infinite space and their number could be extremely large, or potentially 'infinite' which according to the Oxford English Dictionary means 'having no limit or end (real or assignable); boundless, unlimited, endless; immeasurably great in extent, duration, or other respect', and with an apparent brightness of distant ones too faint to be detectable visually. Digges presented this model of the Universe three years later.[21] William Gilbert (1544?-1603) later accepted this revolutionary view.[22]

Thus, in *Alae* in 1573, Nature and the Universe are considered topics for research and exploration to be carried out with the aid of more refined instruments [*App* vi-3], together with the support of Mathematics to ensure results by means of correct demonstrations. It is interesting that in the same context Digges suggested, according to the Copernican system, the possibility of searching for parallax due to the orbital motion of the Earth. Furthermore, Digges adopts an innovative approach for investigating celestial objects and

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[20]   Håkansson, "Tycho the Apocalyptic: History, Prophecy and the Meaning of Natural Phenomena", 211-236.
[21]   Digges, *A Perfit Description of the Caelestiall Orbes*, f. 43.
[22]   Gilbert, *De Mundo Nostro Sublunari Philosophia Nova*, 202.

refuses to consider any interpretation in ancient and Middle-Ages books that is founded on philosophy or religion. He is free from any mystical approach to knowledge, unlike his mentor John Dee.

According to Digges, a scientist must observe and perform measurements, and the procedures used must be correctly planned and executed [*App* v-1]. An observational result can be wrong and can lead to misinterpretations if the errors are not properly considered. Theory should be based on mathematics and geometry and the results verified by observations. The fundamental role of mathematics is frequently mentioned by Digges as in the letter to Cecil, where he considered it "the most worthy of all sciences for any intellect" [*App* ii-2]. Digges is arguably one of the first "modern" scientists.

The research methods applied by Digges distinguish clearly between the verification of a theory (or a mathematical model) and the falsification of a wrong result. A clear example can be found in Chapter X of the Supplement on the Astronomical Radius, where Digges writes that some astronomers (without mentioning names) reported for SN1572 an erroneous value for the diurnal parallax of about 1 degree and so they concluded that it should be located in the sublunar world. Digges then proposed a simple test for disproving this large value based on finding an alignment of SN1572 with a couple of stars and on the searching for a displacement of the new star from this line in the course of the night [*App* vi-1]. This effort was aided by the fact that SN1572 is circumpolar at typical European latitudes. A deviation of 1 degree would be clearly detectable even to an inexpert observer and thus the claim for the sublunar origin of the Phenomenon could be safely disregarded since its parallax was too small to measure reliably.

## 5. *Final remarks*

Thomas Digges was not a philosopher in the sense that he never wrote a text dealing with a general treatment of the knowledge of Nature and its relation to humanity. However, he had an innovative cultural and methodological approach to the investigation of natural phenomena which was a nascent form of what today we loosely call the scientific method. One has to consider that Digges, as he wrote in the Preface of *Alae*, was educated to the Copernican system of the world first by his father Leonard and later by John Dee,[23] and his belief in this matter was so strong as to cause him to persist in the search for some unquestionable observational proof. For this, *Alae* serves as a preparatory document to his *A Perfit Description…* which appeared three years later. Papers in 2023 and 2024 have discussed the connection between these works.[24]

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[23]  See also Johnson, *Astronomical Thought in Renaissance England*, 157.
[24]  Usher and Massaro, "The sixteenth-century empirical disproof of Ptolemaic geocentrism"; Id. "The sixteenth-century empirical disproof of Ptolemaic geocentrism: Paper II".

*Alae* had a rather large diffusion in Europe and copies can be found in several Libraries, including those of relevant Universities of several countries (France, Belgium, Austria, Italy, Ireland, Spain, Czechia, Swiss, Poland and, of course, United Kingdom), in particular a copy is now still preserved in the University Library of Padua that is bound together with the *Parallaticae Commentationes* by Dee and that was transferred from the ancient Library of the Santa Giustina Abbey. Tycho held Digges's data set in high regard and wrote at length about it in *Progymnasmata*.[25]

Johnson pointed out Digges's relevance to the development of modern astronomy in England and its relationship to Giordano Bruno's cosmology which emerged eight years after Digges's paper of 1576 and which the Nolan developed in accordance with his philosophical beliefs.[26] This aspect warrants recondite consideration,[27] but is beyond the purview of this paper. It is possible that Digges's methodology was practiced in other institutions and contributed to the need for precise observations. Digges's exploration of Nature and the sky does not mean that he must be considered a pure empiricist who accumulates data and uses induction to extract their meaning and increase knowledge as does the later philosopher Francis Bacon (1561-1626).

Rogers[28] and the pioneering researcher Taylor[29] defined Digges and his father as Mathematical Practitioners, but this definition, at least for Thomas, may be too reductive. Such a label might apply to activity of the more mature Thomas Digges when he was busy mainly in military and engineering affairs, but not to his astronomical and mathematical work, as Johnston has pointed out.[30]

Digges was mainly intent on testing empirically whether the Copernican system was true and to modify it if required by observations. In *A Perfit Description…*, Digges tried to establish a better physical basis for the rotation of Earth by considering the relative motion observed from moving ships, an argument used also by Copernicus. Digges developed and introduced the invariance of the free fall of a plummet along the mast of the ship and like other scholars, he was concerned with ways to increase the accuracy of measurement. Digges may have acquired this interest from his work on new methods and instruments of

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[25]  Brahe, *Astronomiae Instaurate Progymnasmata…*

[26]  Johnson, "The influence of Thomas Digges on the progress of modern astronomy in Sixteenth-Century England", 392.

[27]  See: Granada, "Bruno, Digges, Palingenio: omogeneità ed eterogeneità nella concezione dell'universo infinito"; and Id., "Thomas Digges, Giordano Bruno y el desarollo del copernicanismo en Inglaterra".

[28]  Rogers, "Leonard and Thomas Digges: 16th Century Mathematical Practitioners", unnumbered p. 2.

[29]  Taylor, *Mathematical Practitioners of Tudor and Stuart England.*

[30]  Johnston, "Making Mathematical Practice: Gentlemen, practitioners and artisans in Elizabethan England", 103.

surveying, like those described by his father in their jointly authored *Pantometria* of 1571 for which the renovation of Dover harbour would have a need.[31]

Several authors have commented on the role of theological inspiration in Digges inter-pretation of natural phenomena (e.g. Koyré),[32] but this matter appears to be controversial and in need of further analysis. In the Elizabethan period, episodes of religious intolerance were frequent, and individuals might have a need to mask their thoughts with repeated declarations of faith particularly if they were involved in public affairs. Digges was on good terms with Sir Walter Raleigh (1552-1618), founder of the 'School of Night', known also as the School of Atheism, but beyond that, Thomas Digges adhered to a policy expressed in his address "To the Reader" of *Stratioticos*,[33] where he declared "by the example of my Father, Pythagorically I will content my selfe *Per manus tradere*, and to communicate them only with a few selected friends". He refers to Leonard Digges's emulation of Pythagoras (c. 570-c. 490 BCE) who conversed only with a select few.

Also, in *Stratioticos*, Digges declared that he began to write a treatise on Copernican astronomy entitled *Commentaries upon the Revolutions of Copernicus, by evidente Demon-strations grounded upon late Observations, to ratifye and confirm hys Theorikes and Hypoth-esis…*,[34] but no evidence for it has been found. Other books dealing with navigation and military subjects met the same fate, indicating that his main interests were already oriented towards engineering and practical works. Digges appears therefore to have characteristics more like those of a modern scientist than an observer or engineer from the Middle-Ages or the Renaissance, and the combined roles of Mathematics and precise observational methods distinguish him as a precursor to Galileo Galilei (1564-1642).[35]

## Appendix: English translations of selected pages of Alae

Translations of selected passages of *Alae* presented below are useful for emphasizing the need to establish precise observational methods. This was a priority for Digges, but his lit-erary style is not simple. Translations of the Latin are not literal and in some places we have taken liberties with the original text to facilitate understanding. Some long sentences are broken into parts, but use of italics and parentheses are as in the original text. Sometimes Digges's rhetorical comparisons and eulogies are excessive by modern standards with long and articulated passages and some repetitions, and he uses many superlatives which ap-pear unnecessary in modern writing. We therefore introduced a few limited shortenings of the text, indicated by [ … ], which do not affect meaning and that are not relevant in ex-

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[31]   Margetts *et al.*, "What "incomparable Jewells Havens, and sure harbours are".
[32]   Koyré, *From the Closed World to the Infinite Universe*, 37.
[33]   Digges and Digges, *Stratioticos*, Bvʳ.
[34]   *Ibid.*, a.ivʳ.
[35]   On this topic see Wallace (*Prelude to Galileo*).

plaining any topic of precision astronomical observations. Johnson and Goulding reported some translated passages from *Alae* in their works,[36] but the majority of these are from the Praefatio Authoris (Author's Preface) which is not considered here since generally we selected untranslated sections. Translated sections are denoted by a format with italic "*App*" that denotes this Appendix, such as *App* (ii). Segments in the sections are presented in paragraphs that are not present in the original text but are indicated in square brackets with a self-explanatory format, e.g., [*App* ii-1], to allow readers to find relevant sections more easily. Translated parts of *Alae* are:

> *App* (i): Title (sig. Ai$^r$);
> *App* (ii): Dedication Letter to William Cecil (1520-1598) (sig. Aiii$^r$-Aiiii$^v$).
> *App* (iii): Introduction (Proemium) to the mathematical treatments (sig. B1$^v$-B3$^r$).
> *App* (iv): Definitions concerning Parallax (sig. B3$^v$).
> *App* (v): Supplement on the Astronomical Radius: Short Practical Preface (sig. H4$^r$-H4$^v$).
> *App* (vi): Supplement on the Astronomical Radius: Chapter X (sig. K3$^r$-K4$^v$).
> *App* (vii): Conclusion of the book (sig. K4$^v$-L3$^v$).

The Latin copy is preserved at the Osterreichische Nationalbibliothek at the location 77.J.130 ALT PRUNK (http://data.onb.ac.at/rec/AC09813307). This copy has several interesting handwritten annotations including a handwritten correction of a typographical error of 1 degree in the Longitude of a Cassiopeia star that was noted by Tycho (see Fig. 2).

## *App* (i): Title

Mathematical Wings or Ladders, with which it is possible to ascend to the very remote Theaters of the visible Heavens and to explore the paths of all the Planets with new and unheard-of methods, in order to ascertain with extreme simplicity, the immense Distance and Magnitude of this portentous Star shining with unusual brightness in the region of the Boreal World, and at the same time to investigate this amazing manifestation of God revealed to the terrestrial inhabitants.

THOMAS DIGGES, man from Kent

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[36] Goulding, "Wings (or Stairs) to the Heavens, The Parallactic Treatises of John Dee and Thomas Digges"; Johnson, *Astronomical Thought*.

## *App* (ii): Dedication Letter to William Cecil (1520-1598)

To the much honored man WILLIAM CECIL, *most Illustrious Knight of the Order of Gold:*[37] *Baron of Burghley: Lord High Treasurer of England, and personal adviser to Her Royal Majesty.*

[*App* ii-1]

I have been meaning for some time, [...] to present you with proof of my gratitude to you, and at last an opportune occasion has arisen when (during your tenure) I have tried to measure position, motion, distance, and brightness [magnitude] of an extremely rare Phenomenon, a bright new star. At first glance, I had not seen it to have a fuzzy appearance in the form of a "mane", "hair", or "tail", and I was further amazed when I observed it for several nights and had not found any movement with respect to the fixed stars. I sought to discover a difference in the position,[38] or Parallax, and found it undetectable so that it was quite evident that [the New Star] lay beyond the Moon. Before stating such a finding and [...] after several more observations, I understood more clearly that it was far above the Moon. Then finally I began to recall in my mind the methods of all past and contemporary astronomers that I knew about for measuring distances and magnitudes of comets and celestial bodies, and I could not find anyone who had shown an adequate way of determining such very small parallaxes. Even the methods[39] of Regiomontanus, whose reputation towers above all others, are insufficient in practice as it will be later more fully demonstrated. Alone (as if thrown into the surging ocean of many doubts), and deprived of the aids of all Ancient and Contemporary astronomers, I decided to research the problem myself. In a short amount of time (as if favored by a mathematical breeze) I sailed into the desired port and discovered some very fast routes hitherto unexplored and safe from all peril of error.

[*App* ii-2]

After gathering these [results] in a little book, I have decided to present it to your Honor as proof of my work (unless such a high regard of myself[40] deceives me). The book is not

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37  Cecil became became chancellor of the Order of the Garter om 1551 and received the title of Knight in 1572: https://www.heraldica.org/topics/orders/garterlist.htm.

38  Digges uses the Latin word "Aspectus" whose literal meaning is "appearance" or "look". Likely he means "position" because its meaning is clear from the following mention of Parallax (see fn. 47).

39  Digges uses the word "Demonstrationes" (Demonstrations) likely to underline that a procedure, although based on a rigorous Mathematical reasoning, need not be the best suited one for practical applications.

40  Digges uses a word of Greek derivation, "Philautia", to denote self-consideration. It was used in a similar context by Erasmus (d. 1536) in the Dedication Letter of Moriae Encomium to Thomas More (1478-1535).

written in the vernacular[41] in order that it will not perish in a short time. Just as in our present age in which your deeds make you absolutely commendable to the hearts of all [ … ], so this book[42] will endure to Posterity as a tribute to your expertise in Mathematics (the most worthy among all sciences for any intellectual pursuit), and to your benevolence towards scholars of these disciplines. [ … ] I very humbly offer these first fruits from my previously uncultivated garden, which are the first Astronomical harvests that are rightly due to your Greatness, and which if you will accept them graciously, shall encourage me to greater and greater efforts [ … ]. Moreover, you will silence ignoble Imposters[43] and Epicureans[44] (who are the most inert and unproductive of all, yet they achieve fame falsely by plundering the works of others). [ … ]. Let those who deny the truth of this work do so freely: [The book] will not need any patronage, because it is so fortified by the strongest and firmest of geometrical demonstrations that it does not fear any Academician's cunning. These first fruits of my studies and this my first astronomical work were written in a very short time and so contain a series of propositions without any rhetorical embellishments, but if it were to be appreciated by the thorough evaluation of Your Illustrious Dignity, I shall be committed from now on (with the benefit of the favorable Mathematical Muses) to accomplish further and more important works. I shall not stop at this my first effort but I shall progress perhaps to the point where anyone may clearly understand that the mechanism of Celestial Globes and of the Visible World [Sun, Moon, and planets] [ … ] that was reformed by the divine Copernicus who was provided with more than human talent, might not be fully correct or whether there might be some points remaining to be carefully examined [ … ]. In the meantime, I beg the Creator of this admirable new star to grant you the longest and most prosperous life on Earth, and the happiest seat in Heaven for your pious soul.

*Very much grateful to your Highness*
*Thomas Digges*

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41   English.
42   Digges uses the Latin "Monumentum" that is difficult to understand if Digges means his book or Cecil's expertise; the simplest interpretation is that Digges intends the former.
43   Digges uses the word "Sycophantis" of Greek origin having the meaning of informer, liar, or swindler.
44   The word "Epicureis" is likely used by Digges in the broad sense of philosophers who spend their life in leisure and employ specious reasoning for their own advantage. This concept is also present in the widely known *The Colloquies* by Erasmus (1518): "Quia mihi placet otium. Arridet Epicurea vita" (I like idleness. Epicurean life smiles upon me.)

## *App* (iii): Introduction (Proemium) to the mathematical treatments

[*App* iii-1]

An amazing new PHENOMENON is visible in the "seat" of Cassiopeia, which is seen to rotate around the Pole together with the other fixed stars so uniformly that after each revolution it returns to the same position without any detectable difference [in position] as I have verified with the highest accuracy. My observations conform to the perception that either the huge sphere of fixed stars moves in a circle in the interval of 24 hours, or, following Copernicus, only the Earth rotates in the same time while the Sphere of fixed stars remains motionless. Everyone recognizes what is evident from experience, that both motions occur around the axis of the Earth that passes through the center of the Earth, and the same Celestial appearance follows in both cases so that we may assume this model as the basis of our geometrical proofs [ … ].

*This* PHENOMENON *that is [located] in a distant place does not exhibit any evident displacement contrary to the very fast motion either of the Prime Mover or of the Earth in a single Rotation,*[45] *and if in aforesaid times any change of position appeared to occur, it would not happen because of any type of motion, nor to Parallax,*[46] *which is a deviation of our line of sight from the centre of the Earth with respect to which it [the Phenomenon] rotates uniformly and without any detectable variation [of its position in the sky].*

[*App* iii-2]

If Regiomontanus (the famous mathematician) did not hesitate to measure the distances of comets whose [parallax] variations are a hundred times greater than those that occur in this [object, i.e. the new star] (if indeed it has any [parallax] at all) [ … ]. I have no doubt, however, that this Phenomenon is now farther from the Earth than it was initially, but its receding motion is so slow that any change [of the apparent position] could not be detected in a single rotation. If one were to observe other phenomena that have a detectable motion in a single rotation [like comets], [their motion] could easily be reduced by means of arithmetical calculations to any fraction of the [daily] rotation. It should be clear that I do not take these [phenomena] into account, because propositions [considerations] on *Parallax* are not necessary to unveil such phenomena that have been discussed extensively by other [astronomers]. Since this subject of astronomical parallax remains [ … ] poorly treated, for a better understanding I will say a few words about Regiomontanus. Even though he excelled above all others in this matter, yet I will show

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[45]   Here and in the following paragraph Digges uses the Latin word "revolutione" for the Earth's diurnal motion.

[46]   Likely, Digges uses a third conditional to stress that any apparent change of position of SN1572 is not physically possible and any report about it originates from errors in the observational procedures.

how the practical uses of his methods are scarcely useful and convenient [for the problem of the new star].

[According to Regiomontanus], a couple of observations of the Phenomenon are required to obtain the *Parallax*, and in both of these observations, the true Altitude above the Horizon and the distance from the Meridian, measured on the Horizon, are necessary; but these are not sufficient because the time between the observations must be known as well, and the method for measuring this time interval is not discussed [by Regiomontanus]. It is very difficult to measure the time in any way with an accuracy (of a minute). Either we use the Altitudes of some fixed [stars], and for this one must know their positions with very high accuracy because if one of their Longitudes or Latitudes is slightly wrong, it [this error] will produce a large deviation in the outcome. Furthermore, if one could know them [those coordinates] it is also necessary to know Altitudes or Azimuths, not at a single time, but twice, that is in both the measurements [for obtaining the parallax]. Moreover, those [astronomers who are] accustomed to observe stars, know how difficult this is [ … ] since in the course of a very fast observation, when one measures any angle, even two, three or four times, even if you consider the same angle, they [measured values] will be hardly in agreement; it [this angle] can only be known exactly by means of simultaneous observations, therefore it is impossible to measure it several times, because time passes rapidly during the observation. If you make an error of only two [time] minutes in the evaluating of the time, such a short a time [interval can] corresponds [up] to 30 [arc]minutes in the graduation along a major circle [Equator or Ecliptic] on the [Celestial] Sphere. [ … ] I do not mention here mechanical clocks, as they are so alien and unfit for use by mathematicians, especially for such fine parallax measurements that they have been rejected for some time with everyone's consent. When, therefore, I observed how inadequate it was to use current clocks to measure small *Parallaxes*, and that no-one had developed other methods, I thought it worthy of a mathematician to remedy the situation. How much I have advanced can be evaluated by others.

[*App* iii-3]

Even though I have not written this short work in vernacular English, and I have done so entirely without any help, yet lest anyone should be offended that I have described my findings on parallaxes devoid of numerical examples, I want publicly to report the following items. I discussed this work with my very learned friend, Mr. John Dee, who showed me a clear demonstration of the method which he had recently discovered for determining the Parallax of the new star Phenomenon that was easy and highly commendable. He told me that he had previously formulated new methods [ … ] for measuring the very small Parallax of this very rare Phenomenon; and to make them really useful, he prepared many new and original instruments. Since the first appearance [of the Phenomenon SN1572], he observed the Position, the Motion, and several Altitudes, with extraordinary energy,

diligence and admirable skills, and using a very accurate device, which will allow him to verify all the various *Parallaxes* reported up to now with the highest accuracy, as I will readily testify as eye-witness. However, a complete *account* of the subject cannot be provided in a short amount of time, and because the present booklet was ready to be printed, I decided to publish it right away so that the praise due to [Dee's] innovations would not be overshadowed by a "most" up-to-date edition of my work lest it weaken our inveterate Friendship.

Meanwhile, the reader may, as it were, climb these Stairs to the Sky and be an eye-witness to these mysteries. If you (whose mind is more sublime) choose to exert yourself a little to discover the truth of the subject, you will be more insightful and more qualified to evaluate the truly Herculean efforts in this Olympic competition. To avoid further ambiguities, and since you will soon take into consideration the matters [evaluation of parallax], and to grasp their meaning easily, I will start from the definitions lest the frequent use of Latin words would be unclear or produce doubts in the minds of readers.

### *App* (iv): Definitions concerning Parallax

1. PARALLAX, that others call the change of position[47], is the difference in the angles subtended by two points on the Earth's surface, which comprises the semi-diameter of the Earth with straight lines converging at the center of the comet or of the celestial body. But because the sphere of the fixed stars is so far from the Earth, no *parallax* is measurable for them since the globe of the Earth is a mere point when compared with the immensity of that sphere. In the case of stellar *parallax* therefore another definition can be given after the introduction of some other Definitions. [ … ]

2. As astronomers do in theories of planets and comets, I assume the TRUE LOCUS of the new star to be the [position] located on the sphere of fixed stars by the straight line connecting the center of Earth to the center of the star.

3. The APPARENT LOCUS is that [point] on the sphere of fixed stars established by the straight line connecting our position on the Earth's surface to the center of the star.

4. SIMPLE PARALLAX is the arc of a great circle on the sphere of the fixed stars, passing through the true and apparent positions of the celestial body.[48]

Other Parallaxes are: Total or Partial in Longitude, Latitude, Declination, or Right Ascension. [ … ]

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[47]   In this definition Digges writes "aspectus diversitate" translated with "change of position". He does not mention a celestial body with a detectable proper motion like a comet which was considered by Regiomontanus (see footnote 38).

[48]   Digges uses the Latin word "Stella" instead of "sydus" to denote the target of the measurements, which we prefer to translate as "celestial body" to avoid confusion with fixed stars.

### *App* (v): Supplement on the Astronomical Radius: Short Practical Preface

[*App* v-1]

Astronomical Practice consists of two chief processes: observational experiments and demonstrations by which the [human] intellect evaluates the truth of things; and Sovereign Reason that generates laws and contributes them to the senses. If these processes are followed adequately, we will never deviate from the TRUTH. However, when we rely solely on the senses with poor and obtuse judgment, and without being able to exactly execute all the rules of the Empress [of Reason], so that we can direct ourselves very close to TRUTH itself, the only aim of Mathematical Arts, two [things] must be mainly observed. First, that the Empress Reason with its absolutely true and infallible demonstrations does not prescribe too difficult work procedures. Secondly, when for improving the senses someone uses mechanical instruments of this kind [for astronomical observations], the smallest things may be detected and measured without error.

[*App* v-2]

Therefore, after I had considered Diopters, Triquetrums, Armillae [or Armillary Spheres], Radii, Astrolabes, Quadrants and many other instruments of ancient and recent [astronomers], by means of which they are accustomed to measure Altitudes, Distances, Longitudes and Latitudes of stars: [I found that] the Astronomical Radius is the most useful of all the others (both for its easy use in each case, and also for the capability in distinguishing the smallest differences of any kind). However, it should be used with caution because it may be subject to some errors (due to the position of the eye and the practice not being sufficiently studied), which must be corrected in the most accurate way before dedicating oneself to this very delicate practice. I noticed that this topic was completely neglected by those who wrote on the structure and use of the Radius and that the visual use of the Radius for parallax [measurements] has not been corrected by anyone until now. Having corrected all the errors in demonstrations and having avoided all the inaccuracies of the visual work, like very true demonstrations the use of the most exact practice will produce unquestionable truths.

### *App* (vi): Supplement on the Astronomical Radius: Chapter X

[*App* vi-1]

Anyone inexpert in astronomical hypotheses but not entirely lacking in common sense and judgment, would be able to understand easily through the following argument the mistakes of those who believe that this unusual star [SN1572] (located in the Elemental sphere below the Moon) has a parallax greater than that of the Moon.

Take a rod [rule] five or six feet long, made of wood or possibly of metal, in such a way that the sides  are two straight lines and are perfectly parallel to each other. Its width is not important, it could be one-half foot or wider. Then after sticking a six-foot high stake in

the ground, connect its visible extremity to the rod in such a way the other extremity can be turned in a circle to each side, and if you want to verify if the Phenomenon has parallax, proceed as follows: [In the following Digges explains the choice of two stars aligned with the new star between them.] [ … ].

At first, you may find that no [star] lies along the same vertical with the Phenomenon [the New Star], but after various attempts you can find [such stars], because verticals are continuously changing with time and other stars will be aligned with the [Phenomenon]. When you find [stars] so aligned, take note of them carefully. When they move away, you will lower the rod and point your eyes here and there in such a way that the line of the same passes through the center of the fixed [stars] lines as closely as possible. If the Phenomenon had some parallax then it will not be seen on the same line of as the Rule. But to know the truth of the matter as clearly as possible, six or seven hours after the first observation of the vertical you will be able to see (once adapting the lines of the rod to the same fixed [stars]) if the Phenomenon lies perfectly with them or if it deviates from them. If it does not deviate from it at all, but it seems to fit perfectly, it has absolutely no perceptible parallax. If instead it deviates from it, it is certain that it has a parallax.

[*App* vi-2]

The previous problems will show exactly how large it [the Parallax] is. For this reason, having observed for many nights this extraordinary Phenomenon, I noticed that it appeared in a straight line with the little star in the knee of Cassiopeia, and the other which is in the right hip of Cepheus under the belt and also with the one that is in the thigh of Cassiopeia and another that is found in the left arm of Cepheus. I noticed throughout a night of this month of February that the Phenomenon had not deviated from the same straight lines or circumferences of great circles, only in the width/amplitude of its semi-diameter, so you can deduce with extreme accuracy that its largest parallax, in this duration of time, is less than two [arc]minutes. Even only by eye unaided by any instrument, anyone will be able to see the madness of those who believe that it [the Phenomenon] is in the region of Elements, below the lunar sphere where it would have a parallax greater than a whole degree. If one compares its position only with that of the other little star placed in the basis of Cassiopeia's seat, in reality, you would not discover that the Phenomenon is displaced away from it three times the diameter of the Sun. If it had a Parallax greater than a single degree, it would be necessary that the Phenomenon would be above [this star] along the same vertical, closer to it by two thirds of the previous distance and not differing from that by a single diameter of the Sun, or about 30 [arc]minutes, as it is clear from the proofs in the tenth and fifteenth Problems. There is nobody unable to notice such a big difference in such a small distance by the sight only without an instrument. But if a man wishes to examine this matter, not only would he know that such a big difference in the position does not exist, but he would find it so small and undetectable that he would not know whether

to believe that it is without Parallax like a Fixed Star above the spheres of all planets. It is almost the case that only someone blind or benighted by a very crass ignorance would claim that the Phenomenon is below the Moon.

[*App* vi-3]

I had decided not to discuss the [exact] determination of the parallax of this wonderful star, or the evaluation of the limits of its parallax, because it properly concerns the history [sequence of events] of the star. However, a short time ago I heard that some people inexpert in Mathematical science had publicly claimed to have observed with demonstrative methods that the parallax of this unusual star was greater than one degree. They then concluded that its place was below the sphere of the Moon and that it was in the usual region for comets. In order that their terribly gross and almost obvious mistake [on the location] from where the star was shining, might be understood, I thought that adding this simple method [the use of a rod] would be useful so that even men who were uncultured in mathematics but were endowed with intellect and common sense could lay blame on professors of mathematics who make gross errors and could show their incompetence. [ … ].

Furthermore, you will be able to demonstrate in the most exact way by means of this method the true place of the Phenomenon in the Heaven. You will be able to point at it with your finger and show those who are inexpert that it rests always exactly at the intersection of the vertical with the straight line or the great circle through the fixed [stars] selected by the method already discussed. In this way its true place will be made known and be self-evident to all. Inexpert shepherds and sailors, informed in this way, can know the value of the parallax and how it changes [ … ]. If we accept that these starting points are right, we will publish with God's consent these and other unpublished matters. These shall be examined later more extensively with the easiest method and with the help of a new instrument, along with other Parallaxes that no one has treated up to this time or that were known and believed by very few people.[49] Certainly, these Parallaxes result from various locations of the observer relative to the center of the Earth.[50] If God is fa-

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[49]   Digges does not clarify the type of new instrument. It seems quite unlikely that he intended simply an Astronomical Radius of a larger size. He mentions explicitly that none had been used before to measure parallax and that only very few people know these facts. One cannot therefore exclude that this sentence may concern the Perspective Glass, an optical device designed by his father for terrestrial use, but that it was useful also for astronomical observations. See: Usher and Massaro, "The sixteenth-century empirical disproof of Ptolemaic geocentrism", 661-664.

[50]   Again, Digges does not write his thought explicitly, but it is likely that he considered diurnal parallaxes as well as those due to the orbital motion of the Earth around the Sun, as expected in the Copernican system. This interpretation agrees with Goulding. See Goulding, "Wings (or Stairs) to the Heavens", 50n38.

vourable to such great enterprises and the Parcae[51] have regard for future generations, these matters shall be clearly understood.

[*App* vi-4]

However, someone might criticize me for the many methods presented in this book and for supplying few illustrative examples. I admit that in those respects I am also not particularly satisfied, and in fact I would have liked to have added very short and clear computations to the individual Problems. And I would have liked to have explained tools suitable for this work using vivid images and clear explanations if the short time available and my other affairs had not prevented me. But in this period of my life, I was forcibly removed, and almost torn, from these observations of celestial bodies by some recent human affairs in order to provide for the goods of Fortune.[52] These restrictions moved me to quit writing the book and to remove my hands from the desk [to stop the work]. Furthermore, since the specific goal of my work is to enable people everywhere to make very precise observations [of the Phenomenon] (before it and this most opportune occasion passes). [ … ] Since it is uncertain how long this star will continue to shine, I thought that it would be better [ … ] to lay a few traps and nets as soon as possible [instead of] throwing the largest nets too late [by printing a small book instead of a long treatise before the Phenomenon disappeared]. Later, however, having settled and overcome the obstacles posed by situations of life and fate, again with God's favour, we shall resort to our most serene sources of Mathematics. We shall examine how much our Muses are worth in this Country and with the help of the Almighty we shall faithfully share with all scholars the secrets of Nature which the work shall reveal.

## *App* (vii): **Conclusion of the book**

[*App* vii-1]

Although the *Problems* and Canons, which have been set forth above, are all shown to be correct by robust proofs, yet I admit that not all are equally useful in *Practice*. Some are more useful than others, and perhaps those unaccustomed to observing will be surprised that even though everything is true, not all are suited to reach the *Truth*. This does not occur because of flaws in the demonstrations of the *Canons*, but, as already noted, it is due to the limitation in the use of the Senses. Therefore, those wanting to participate in the *Olympic Astronomical* competition must convince themselves that the *Senses* can never precisely aim to satisfy the demands of Reason. Like Archers, one must approach the target as close as possible, and those who achieve it are considered more skilled.

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[51]  "Parcae" is the Latin name for the three Greek Fates represented as old women spinning the threads of human destiny.
[52]  "Fortunae bonis" or the "goods of Fortune" are economic benefits for him and his family.

[*App* vii-2]

In this Mechanical[53] controversy I have observed three main sources of errors. *First* and foremost, since an [observer] must measure so many different quantities, a small error in each of them will accumulate in the course of the operation. *Next*, in observations that must be made quickly, if one errs by even a small amount, the resulting errors will be so large that the time used for repeating measurements (necessary for high precision measurements) would be completely wasted. *Last*, when we use [astronomical] *Instruments* of this type,[54] which, although they are made and divided in a very fine and exact way, nevertheless, for small intervals of [arc]minutes or of other fractions, the weakness of the sight does not allow us to measure small differences. Thus, although we are anchored to very robust demonstrations and equipped with correctly-made and finely-divided instruments, in proceeding with this Olympic competition we will receive shame not honor. Instead, […], in order that anyone could directly reach the fortress of TRUTH and obtain the desired prize, let me report a few things on these Methods […].

[*App* vii-3]

Instruments for measuring angles in scruples [arcminutes][55] should have a very large size, and you would be able to obtain the Parallax successfully. However, both the methods [discussed in the 10th and 11th Problems] require measurements of time and if you deviate a little [from the exact time], in the meanwhile fast variations in Altitudes will occur, which will hide a *small Parallax* very easily, or produce a fictitious one, and therefore I do not consider them. […] In those Problems [in which] the positions of the Fixed [Stars], i.e. Longitudes and Latitudes, are clearly not considered at all, one has time enough to examine any [angular] distance[56] twice, three, four times, down to a [minimum] detectable deviation of a semi-scruple [half an arcminute]. Furthermore, if one admits that in mea-

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53   Digges writes "In isto autem Mechanico certamine…"; the word Mechanico referring to certamine (competition) has an uncertain interpretation because its meaning can be related either to the practice of observation or to a scientific context.

54   Digges does not specify what type of instruments he considered, but on the basis of his text we can interpret them as the Devices for the measurement of celestial coordinates and angular distances like the Astronomical Radius or the Circle.

55   "Scruple" can be interpreted as the smallest quantity that can be measured. According to the Encyclopedia Britannica, "scruple" (from Latin scrupulus, "small stone" or "pebble") is a unit of Roman commercial weight as well as a unit of coinage weight". In the 1st page of *Alae*, Latitudes and Longitudes of stars in Cassiopeia are given in degrees and arcminutes, whereas angular distances of SN1572 from some of these stars are in Degrees and Scruples. Considering that no written scruple value is higher than 60 (the highest one is 58) it is likely that 1 scruple could correspond to 1 arcminute. The accuracy of coordinates of Cassiopeia stars is 10 or 5 arcminutes.

56   These Distances are the angular separations between SN1572 and nearby stars.

suring Altitudes (since times are established) we could make an error of a whole degree: nevertheless, in the determination of the Parallax, we should not deviate from the true [value] even by a half-scruple [half arcminute].

[*App* vii-4]

The methods presented are very certain and absolutely free from any defect, and moreover, are well suited for detecting a very small parallax. The evaluation of a Parallax with the method of *Regiomontanus* requires ten or twelve simple data.[57] Changes in *Altitude and Azimuth* are fast, [and when] one misses slightly the correct times as required, who does not know how large in size instruments must be to measure the Azimuths, and to correct the positions of the Fixed [stars with the precision] of [one] scruple? Thus, the Regiomontanus's architecture rests on a very unstable foundation that does not admit of correction, so that if a small [error] occurs in a single measure, then at the end it will produce an [error] of a large amount; and if in the calculation of time one deviates from the truth by only one scruple [time minute], it would correspond to fifteen [arc]minutes[58] on the maximum circle of the Sphere (on which Parallaxes are measured). Who then does not see how difficult it is for those who have adopted these methods, to avoid *Ruin*, particularly, when *very small Parallax* must be measured? For Comets, whose Parallaxes occasionally can reach eight degrees,[59] it may be used quite conveniently. But in the present [case] with so many small [measurements], in which the greatest Parallax does not reach a few [arc]minutes, it is not suited at all. I have dwelled on these matters not to denigrate Regiomontanus who was a really very expert Mathematician, but for fear that others who in our time would not completely miss the palm [trophy, goal] of TRUTH in this Olympic challenge by insisting on useless paths which despite being correct in theory are not [good] in practice. I have no doubt that if Regiomontanus were alive he would have to discard his old method, and he would have liked to find new ones that would be capable of seeking the truth of this Mystery hidden in the pitch-darkness.

[*App* vii-5]

There is another type of error, much less relevant than the others [but] which should not be neglected in the search for very small Parallaxes. Even if measurements had the highest precision, afterwards many Multiplications, Divisions, and extractions of *Roots* of *Sines* must be computed before one can reach the goal, small errors will occur in each of these operations [ … ]. This happens because the precise [true] values of *Sines* cannot be known

57    Simple data are those consisting of only one measurement.
58    Likely here Digges uses the word scruple for 1 minute of time that corresponds to 15 arcminutes in Right Ascension (see footnote 55).
59    In the original book we used there is a handwritten note in Latin by an anonymous reader which makes clear the meaning of the Digges sentence.

because many are irrational [numbers]; furthermore, true values of *Roots* cannot always be known completely as numbers [with a finite number of digits]. In my sixth and seventh Problems, proofs provide the [angular] Distances of the Phenomenon [SN1572] and the [partial] Parallaxes separately.[60] Also, my Friend's[61] Method which he calls Nucleus, [ … ], can be adapted to all those Problems of mine, which depend on my Sixth and Seventh Problems. Therefore, [ … ] since both ways of working (i.e., those of John Dee and of my problems, consist in several multiplications, divisions, and extractions of *Roots* of the different *Sines*, [and] excluding the occurrence of large parallaxes, for the very small ones considered here, I would take care that an intelligent Observer of this Miracle [SN1572], would adopt other Methods, which use a simpler, shorter and less error-prone calculation of the *Sines*. This booklet is not lacking in such a rich matter, particularly in the last five Problems, [which are] clearly verified, and not so cryptically complex, that any Mathematician could easily select [among them] according to different needs [ … ]. In any case, if someone likes to use those complicated and intricate Methods with evaluations of many *Square Roots*, I would suggest he adopt the way of *Algebraic* calculations; i.e., multiplying and dividing the same *Square Sines* (which can be found more precisely) and assigning the proper *Characters* to each result [number][62] so that only one extraction of a *Square Root* should be necessary. This concerns the precautions and checks to be applied in practice.

[*App* vii-6]

I cannot then end here without [ … ] pointing out once more to all scholars of the *Celestial Science* how the opportunity available to *Terrestrial* beings is great and desirable. The *Monstrous System* of the Celestial orbs[63] constructed in antiquity was perfectly

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[60]  Likely, Digges refers here to the components of parallactic displacement, like the Longitude and Latitude Parallaxes mentioned in the Definition section.

[61]  The Friend of Digges is clearly John Dee, indicated in the Preface as his mentor and second father who in March 1573 published booklet on the problem of the measurement of parallaxes (Dee. *Parallaticae Commentationis*). The Foreword of Dee's booklet was written by "Thomas Diggseus, Benevolo Lectori".

[62]  Digges writes: "singulis inventis suos Characteres attribuendo", the meaning of which is not entirely clear. The word "Character" is derived from the ancient abacus terminology and likely was used by the Digges father and son to indicate the exponents of prime factors of a number (Digges and Digges. *Stratioticos*, 32. See also: Cajori, *A history of mathematical notations*, 169-171). Later in 1585, Simon Stevin (1548-1620) used the same word to indicate powers of 10 in his practical book, *La Disme* or *Thiende* on arithmetical calculus: Cajori, 154; Sanford, "La Disme of Simon Stevin".

[63]  Digges uses the words: "Coelestium globorum Systema" and "Coelestis Systematis". These expressions for indicating the totality of orbs of planets and their spatial order and structure was used by Rheticus, as reported in the extensive historical study of Lerner, who however did not mention Digges.

corrected and improved by *Copernicus*, a divine rather than a human talent, yet there are still some things to be worked out. I realized that this could not have been done except by means of very accurate observations either of this *Very Rare Star*, or of the remaining *Wandering* bodies [comets or planets] and of their variations in appearance [position and brightness], made from different *Regions* of this dark and mysterious *Terrestrial Star* where we spend a troubled life […] wandering like pilgrims across a small region. I really do not see any better reason to spend life (than to contemplate the works of the most good and most great God). In fact, eyes were given to men for this very reason, to appreciate […] how many and invisible things exist by way of the visible things of GOD. You [readers], then, who have a more sublime mind and were not born subjugated by hard chances nor chained by the bonds of avarice, lust, and other vices, have become prisoners in the realm of *Sarcotheus*,[64] may take this province for yourselves. This unexpected opportunity to shake off indolence should not slip out of your hands. [One could hope] that a more fruitful doctrine of Celestial Science would finally emerge from the many considerations about the Celestial spheres ([developed] by very expert Mathematicians), which, in different regions and places on the Earth, are presented and discussed by means of numbers and measures with flawless competence, and then published and collected in public essays.

[*App* vii-7]

If *Copernicus* (who can never be praised enough) were alive at present, this year he would have been a *Centenarian*, and we could hope that on this occasion the true knowledge of the Celestial System [[27]] would be given to Mortals (as far as human weakness can achieve). But it is vain to hope for the return to life of a so great man. Lest this very rare and first desired Occasion should vanish fruitlessly, […] my work should not be considered the close of this Olympic competition, […]. Not to seem myself to be highly indolent and too negligent of my duty to begin this competition, and also to raise the interest of others whom URANIA enriched more with her benefits, I have prepared these STAIRS [SCALAE] by which mathematicians and even Tyrunculi [students] may ascend the Ethereal Towers and measure all Distances in detail, and investigate truthfully the places of the Celestial Globes. They can also examine the syntax [structure] of the World, and the *Magnitude, Distance* and position of this portentous Star presented to *Terrestrial [People]* by the Almighty [Lord]. Finally [they can] explore the remote and terrible region […] of the star (different from the one that announced to the [Three Wise

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[64]  Sarcotheus is a devil whose aim is to rule over the sublunar world in order to have it dominated by passions, illness, and death. Marcellus Palingenius Stellatus (likely Pietro Angelo Manzoli, known as "Palingenius") writes of Sarcotheus in Book VIII (Scorpius, 229, line 28*ff*) of *Zodiacus Vitae (Palingenius, Zodiacus Vitae, Lyon: Jean de Tournes, 1503)*, a poem much admired by Thomas Digges.

Kings] MAGI the advent of the CHRIST GOD [a comet]). Without any doubt they [can] testify the astonishing Miracle of GOD to the others, who cannot raise their faces from the Earth, so that all people may finally know the great things of GOD, to whom alone all PRAISE, HONOR and GLORY must be directed in all Ages.

### THE END OF MATHEMATICAL STAIRS

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— ESSAY REVIEWS —

# Galileo, Rosmini, Darwin.
# Triumviri del cattolicesimo riformatore, (1870-1918)

Massimo Bucciantini, Michele Camerota
*Galilæana*, Editors-in-chief

*On March 7, 2024, at the Accademia Nazionale dei Lincei in Rome, Massimo Bucciantini and Michele Camerota presented Paolo Galluzzi's book,* Galileo, Rosmini, Darwin. Triumviri del cattolicesimo riformatore, (1870-1918). *Given the importance of the book for Galilean studies, we have decided to publish their speeches.*

*Il 7 marzo 2024, a Roma, nella sede dell'Accademia Nazionale dei Lincei, Massimo Bucciantini e Michele Camerota hanno presentato il volume di Paolo Galluzzi,* Galileo, Rosmini, Darwin. Triumviri del cattolicesimo riformatore, (1870-1918). *In considerazione dell'importanza del libro per gli studi galileiani, pubblichiamo i loro interventi.*

C'è una peculiarità che contraddistingue il lavoro storico di Paolo Galluzzi. Ogni volta che esce una sua nuova ricerca sai che si tratta di un libro nuovo e non di una raccolta di studi precedenti. Questo vale per *Tra atomi e indivisibili. La materia ambigua di Galileo* (2011), *"Libertà di filosofare in naturalibus". I mondi paralleli di Cesi e Galileo* (2014), *The Italian Renaissance of Machines* (2019) e anche per *Galileo Rosmini Darwin. Triumviri del cattolicesimo riformatore* (2022).

Come entrarci dentro e provare – in poche pagine – a dare il senso di questa sua ultima fatica? Inizierò dal titolo. Un titolo che a prima vista non ti aspetti. Due grandi

scienziati e, in mezzo, a fare da *pendant*, un sacerdote e teologo di Santa Romana Chiesa. Che cosa hanno in comune? Perché formano un triumvirato? E perché proprio Rosmini? È lo stesso autore a chiederselo nelle prime pagine: "Che diavolo di relazione può intercorrere, viene spontaneo domandarsi, tra lo scienziato toscano ed il suo *Dialogo sopra i due massimi sistemi del mondo* ed il sacerdote roveretano e la sua monumentale quanto impervia *Teosofia*" (22). Lo apprendiamo leggendo questo rigoroso e dettagliatissimo lavoro di storia delle idee, che rappresenta anche la ricostruzione – da un angolo visuale originale – di cinquant'anni di storia d'Italia. Dagli squilli di tromba dei bersaglieri che vittoriosi entrano a Roma il 20 settembre 1870 agli esiti disastrosi che seguirono all'indomani della Grande Guerra con l'avvento del fascismo e poi con l'accordo tra Stato e Chiesa cattolica siglato l'11 febbraio del 1929. Una battaglia politica e culturale che Galluzzi ci racconta con un ricorso a un numero di fonti impressionante, facendo subito capire al lettore che lo scontro non avviene tra due schieramenti compatti, come spesso – schematicamente – si racconta.

Uno dei meriti del libro è appunto quello di aver recuperato, filtrato e portato alla luce discussioni e conflitti all'interno del mondo cattolico italiano tanto da renderlo tutt'altro che monocorde. Sono discussioni che hanno al loro centro quella che io chiamo la "questione scienza", ovvero il rapporto che era necessario stabilire con l'evoluzionismo darwiniano e con le concezioni filosofiche e cosmologiche galileiane. E dopo poche pagine si comprende subito quanto sia stereotipata l'immagine di un'Italia in cui a fronteggiarsi sono due partiti in lotta tra loro: da un lato quello laico, anticlericale, massonico (e poi socialista), e dall'altro quello dell'intransigente ortodossia cattolica, capeggiato dalla Curia romana e dai gesuiti de "La Civiltà Cattolica". Protagonista del libro è infatti una pattuglia di intellettuali cattolici liberali e uomini del clero che sentono la necessità e l'urgenza di una profonda riforma della Chiesa. Una riforma che abbandoni le tentazioni del potere temporale e che torni a guardare ai valori evangelici delle origini e, al tempo stesso, prenda atto dell'affermazione irreversibile della libertà scientifica, di pensiero e di espressione. Siamo in presenza di un terzo polo – scrive Galluzzi – "che subirà una sconfitta non meno severa di quella patita dagli appassionati partigiani della laicità dello stato" (461). Ed è una sconfitta istruttiva, che è bene conoscere, anche perché da essa in parte dipende la fotografia di questo Paese, che sta diventando sempre più fragile e debole, sia culturalmente che politicamente: fragilità e debolezze spesso mascherate da roboanti enunciazioni programmatiche che però restano tali, incapaci di trasformarsi in un reale rinnovamento politico e culturale degno di questo nome.

Con la lettura del primo capitolo – oltre cento pagine – Galluzzi ci guida dentro il mondo in gran parte ancora oggi poco conosciuto della cosiddetta "setta rosminiana", come in modo sprezzante veniva apostrofata dai difensori intransigenti della Chiesa cattolica. Sulle pagine de "la Civiltà Cattolica" il padre gesuita Giovanni Maria Cornoldi parlava appunto di "peste rosminiana", bollando così le opere del sacerdote di Rovereto infette

di ontologismo e panteismo e che, se non bloccate in tempo, avrebbero allontanato i credenti dal genuino insegnamento della Chiesa, quello tomista. I molti "rosminiani" che prendono vita nel libro sono stati quasi completamente dimenticati. Ne cito solo alcuni: Giacomo Zanella, Fedele Lampertico, Geremia Bonomelli, Luigi Luzzatti, Giuseppe Morando. Oggi, tutt'al più diventati nomi di strade di città capoluoghi di provincia o poco più. Ad eccezion fatta per Antonio Stoppani e Antonio Fogazzaro. Eppure, il mosaico è così fitto e coinvolgente che alla fine della lettura del libro ciascuno di loro acquista un rilievo e una caratura nazionale. Tutti cattolici liberali e rosminiani. Tutti animati dalla volontà di battersi per il rinnovamento della Chiesa. E, fatto non secondario, tutti provenienti da precise aree geografiche: innanzitutto quella friulana e trentina, e veneta e lombarda, con poche eccezioni. Il centro e il sud sono quasi completamente assenti da una mappa che potremmo chiamare del "rinnovamento ecclesiale".

In questa battaglia i nomi di Galileo e Darwin ricorrono sempre più di frequente associati a quello di Rosmini. Soprattutto il primo. La questione rosminiana diventerà ben presto – siamo negli anni Settanta e Ottanta dell'Ottocento – la questione galileiana.

Quando il 7 marzo 1888 papa Leone XIII condannò solennemente la speculazione filosofica e teologica di Antonio Rosmini, i seguaci del sacerdote di Rovereto risposero che si stava compiendo un errore tanto grave nel campo metafisico quanto quello compiuto due secoli prima nei confronti di Galileo. Di più: il parallelismo tra Galileo e Rosmini condusse anche al parallelismo tra Urbano VIII e Leone XIII. Galluzzi insiste su questo punto. Ci sono delle pagine in cui sembra che due secoli così distanti tra loro – il Seicento e l'Ottocento – finiscano per toccarsi e quasi sovrapporsi. Come l'adesione alle idee copernicane di Galileo portava con sé l'ombra della cosmologia infinitista di Giordano Bruno, altrettanto accade con la concezione rosminiana della natura dell'essere ideale, secondo la quale le creature risultano apparentate all'Essere creatore, contenendo i germi del panteismo ontologico a tal punto da rischiare di annullare la netta distinzione tomista tra Ente creatore e cose create e aprire così la strada al razionalismo.

Già a partire dal 1881 il nome di Galileo ricorre sempre più spesso negli scritti dei discepoli di Rosmini (che era scomparso ben 25 anni prima). E accanto al nome di Galileo compare quello di Charles Darwin. È sufficiente leggere le parole del rosminiano vescovo di Cremona Geremia Bonomelli per comprendere il livello dello scontro: "Galileo ha capovolto il cielo: la geologia capovolge la terra; l'archeologia o, piuttosto, la paleontologia, sfonda la parete dei seimila anni: basta, basta. Certi teologi ci vogliono rinserrare nella loro miserabile credenza dei sei giorni e dei 6000 anni! Che povera gente! Sono simili a un bambino che credeva di toccare la Luna salendo un monte" (240).

Naturalmente siamo di fronte a una teoria dell'evoluzione depurata da ogni impianto materialistico, in cui si postula una intelligenza superiore che ne programma lo svolgimento. In questo modo va letta anche l'adesione al darwinismo di un altro protagonista del libro, ovvero del "prete di campagna" Raffaele Caverni, a cui è dedicato il secondo e

sorprendente capitolo del libro. Come osserva Galluzzi, il rosminiano Caverni, atten-
to studioso di Galileo e poi suo denigratore, è stato uno dei primi esponenti del clero
italiano a occuparsi di Darwin. Siamo a metà degli anni Settanta. Le opere del natura-
lista inglese erano state appena tradotte. Caverni – al pari di Fogazzaro – è un convinto
darwiniano, nettamente contrario a qualunque concezione materialista. Ma ciò non gli
fu sufficiente a evitare la condanna delle gerarchie ecclesiastiche romane: nel 1878 la sua
opera *Nuovi studi di filosofia* venne proibita dalla Congregazione dell'Indice. E il nome di
Caverni non può non evocare quello di Antonio Favaro, il grande studioso "artigiano" a
cui si deve la monumentale Edizione Nazionale delle Opere di Galileo, con cui si chiude
il volume.

Il corpo a corpo tra Caverni e Favaro che Galluzzi ricostruisce con passione contie-
ne molte novità, sia dal punto di vista delle fonti sia da quello interpretativo.  Galluzzi
ci presenta Favaro quasi come un "signor nessuno", un isolato e un solitario, che per de-
cenni vive ai margini della battaglia che nel nome di Galileo si sta combattendo in Italia.
Favaro è un sincero amico di politici e intellettuali di formazione rosminiana, che concepì
la realizzazione dell'Edizione Nazionale come una sorta di "guerra di liberazione" da qua-
lunque uso strumentale e ideologico di Galileo, sia da parte clericale che da parte laica.
La conclusione del libro è interamente dedicata a lui, alla sua lezione storico-filologica,
unico e potente antidoto per non "sbandierare immagini pesantemente contraffatte dello
scienziato toscano" (457).

Se ci sono libri che aprono e libri che chiudono *Galileo Rosmini Darwin* apre a nuove ri-
cerche. E proprio per questo è da collocare sullo scaffale dei libri necessari. Naturalmente
lo dico a chi nutre ancora passione e interesse per una storia non semplificata né addome-
sticata. A chi non ha smesso di voler comprendere i tanti intrecci da cui dipende la storia
di questo Paese.

*Massimo Bucciantini*

⌣

Il libro di cui si parla è, al fondo, un libro sulla 'modernità', o meglio sul disagio della
modernità.

È forse vero, come scriveva Walter Benjamin nelle sue affascinanti e (per tanti versi)
paradossali riflessioni sul concetto di storia, che "ogni epoca si presenta irrimediabilmente
moderna": "Non c'è mai stata – notava lo studioso berlinese – un'epoca che non si sia sen-
tita, nel senso eccentrico del tempo, "moderna" e non abbia creduto di trovarsi immedia-
tamente davanti a un abisso", perché "la consapevolezza disperatamente lucida di stare nel
mezzo di una crisi decisiva è qualcosa di cronico nell'umanità" (W. Benjamin, *Sul concetto
di storia*, a cura di G. Bonola e M. Ranchetti. Torino: Einaudi, 1997, 131).

Lo stesso Benjamin riconosceva però che "il 'moderno' è diverso nel senso in cui sono diverse le varie figure di uno stesso caleidoscopio". Ogni epoca, dunque, percepisce la propria "modernità" in quanto avverte inevitabilmente l'impellenza del presente e l'angoscia del futuro, ma declina l'apprensione in modo composito, in una varietà fortemente differenziata di atteggiamenti, idee, opinioni.

Ciò è tanto più vero in un contesto in cui la "modernità" assume le minacciose fattezze di un preciso orizzonte storico, segnato da processi di radicale discontinuità con l'esperienza del passato e da un impetuoso dinamismo che travolge certezze consolidate e innesca disorientamento e inquietudine.

La storia, o meglio le storie narrate nel bel libro di Paolo Galluzzi ci dicono delle reazioni al "moderno" (inteso nella duplice accezione appena delineata) di un ambiente – quello della cultura cattolica italiana della seconda metà dell'Ottocento – compatto nell'attaccamento ai valori fondamentali, ma, al tempo stesso, segnato da una significativa disparità di punti di vista.

In quella temperie, coloro che Galluzzi definisce i "triumviri" del cattolicesimo riformatore (Galileo, Rosmini, Darwin) furono chiamati in causa – talvolta in singolare apparentamento – come espressioni dell'esigenza di rimodulare il rapporto con una realtà sociale e culturale profondamente mutata nel corso degli ultimi due secoli. Come osserva Galluzzi, infatti, tra le file dei cattolici riformatori "maturò la percezione del parallelismo tra l'esito drammatico del tentativo di Galileo di convincere le autorità ecclesiastiche che la verità dell'universo copernicano non poteva essere messa in questione sulla base delle affermazioni in senso contrario dei testi sacri e la sorte altrettanto sfortunata toccata alle geniali speculazioni filosofiche, teologiche ed etiche di Rosmini; il quale, con la propria concezione dello sviluppo graduale dell'anima dalle funzioni puramente sensitive a quelle intellettuali, aveva indicato la strada da seguire per elaborare una teoria dell'evoluzione creazionista e finalista da contrapporre alla declinazione materialistica e deterministica propostane da Darwin e dai suoi seguaci" (10).

Così, le vicende dei rosminiani italiani – impegnati a difendere l'idea di un originario lume della coscienza (*l'essere ideale*), in grado di garantire evidenza e universalità al conoscere ma evocatore, altresì, dello spettro dell'ontologismo malebranchiano – si intrecciano con le controversie sulla teoria evoluzionista e con le furiose polemiche sulla condanna di Galileo.

A ben guardare, proprio lo scienziato toscano assume un ruolo privilegiato all'interno del dibattito in questione. Il suo travaglio giudiziario non costituì, infatti, solo motivo di duro scontro con il fronte anticlericale, ma, nell'ambito della contrapposizione tra anime diverse del mondo cattolico, venne investito di una peculiare esemplarità. In tal senso, nel richiamare il controverso precedente galileiano, i *novatores* cattolici esortarono pressoché concordemente le autorità romane a non ripetere gli errori del passato, elevando condanne che avrebbero accentuato lo scollamento tra l'istituzione ecclesiastica e la "modernità".

Essi insistettero, inoltre, sul valore delle considerazioni di Galileo in merito ai limiti veritativi *in naturalibus* delle Scritture, evidenziando la correttezza esegetica e la avvedutezza epistemologica delle posizioni galileiane.

Non mancarono, peraltro, tentativi di istituire nessi di continuità teorica tra la riflessione dell'autore del *Dialogo sopra i due massimi sistemi* e le concezioni di Rosmini. Eloquenti, in tal senso, sono le pagine che Galluzzi dedica all'accostamento – prospettato da Antonio Fogazzaro e Giuseppe Morando – tra la tesi galileiana dell'eguaglianza *intensive* di conoscenza umana e divina in ambito matematico e la dottrina rosminiana dell'*essere ideale*, un'associazione teorica giustificata a partire dalla sottolineatura del costitutivo afflato divino che, per entrambi gli autori (Galileo e Rosmini), qualificherebbe – garantendone la veridicità – il conoscere della mente umana.

Galluzzi esamina nel dettaglio – spesso basandosi su fonti inedite – gli articolati sviluppi di una discussione accesa e sorprendentemente franca e diretta, in cui il "triumviro" Galileo rivestì, a tutti gli effetti, un ruolo cruciale.

Proprio alla luce della centralità della figura galileiana assume un significato rilevantissimo l'apporto storico di Antonio Favaro, infaticabile indagatore di ogni (anche minuto) aspetto della vita e dell'opera di Galileo, nonché artefice della Edizione Nazionale dei suoi scritti. Galluzzi dedica a Favaro più di un terzo del volume, offrendoci quella che (a mia conoscenza) costituisce la più esaustiva, documentata e sagace ricostruzione della fisionomia intellettuale dello studioso padovano.

Alla pari degli altri, anche questo capitolo presenta una miriade di suggestioni innovative. Segnalerò qui, in modo cursorio, alcuni temi su cui l'analisi svolta nel libro fornisce elementi preziosi per una più adeguata comprensione del lavoro compiuto da Favaro.

Galluzzi ricorda come il rigoroso criterio oggettivo e documentario con cui fu pensata e costruita l'Edizione Nazionale delle *Opere* di Galileo abbia indotto la critica a ritenere che Favaro mantenesse un atteggiamento neutrale rispetto alla battaglia ideologica che infuriava attorno al significato storico delle vicende processuali galileiane. In realtà, una volta portata a compimento la sua grande impresa (l'Edizione Nazionale, appunto), e venuta meno la tacita moratoria istituita con le autorità vaticane al fine di poter consultare gli archivi inquisitoriali, Favaro intervenne nel dibattito, non lesinando sferzanti critiche alle ricostruzioni più tendenziose e apologetiche (quali quelle dei gesuiti Carrara e Müller).

In generale, nelle sue prese di posizione polemiche, Favaro contrastò con particolare durezza gli studi che svalutavano il contributo scientifico galileiano. Se pure, quindi, tollerò una lettura moderatamente "ideologica" del caso Galilei, rifiutò con decisione ogni forma di "revisionismo" storiografico tendente a disconoscere l'originalità e la crucialità dell'apporto dato dallo scienziato toscano al progresso della scienza. È in questa chiave (non esclusiva ma certamente decisiva) che va letta la rottura con la singolare figura di Raffaello Caverni, i cui sempre più accesi (e per molti versi incomprensibili) furori anti-galileiani determinarono la brusca interruzione dell'intenso dialogo avviato con lo storico padovano.

L'analisi del profilo intellettuale di Favaro condotta da Galluzzi ci consegna poi un elemento di grande novità con lo svelare le sue cordialissime relazioni con figure del riformismo cattolico. Il libro illumina qui un tratto misconosciuto della biografia favariana, esaminando il sintonico rapporto del professore padovano con uomini quali Giacomo Zanella e Fedele Lampertico, intellettuali di schietta ispirazione rosminiana.

E forse, al di là dell'indefettibile attaccamento alla deontologia professionale dello storico, proprio la silenziosa condivisione delle istanze espresse da tali personaggi contribuì a indurre Favaro a intervenire contro l'anti-galileismo strumentale proposto da tanti esponenti del clero più retrivo e intransigente.

Sono questi solo alcuni dei molti spunti che rendono il libro di Galluzzi davvero prezioso. La sua disamina della variegata congerie di voci che animava il dibattito all'interno del cattolicesimo di fine Ottocento restituisce appieno la complessità di uno scenario in cui il rigore storico veniva sovente sacrificato a vantaggio di disinvolte ricostruzioni "ideologiche", sapientemente finalizzate ad egemonizzare il presente attraverso la propalazione di una artefatta immagine del passato.

Di contro a tale tendenza – un vizio ricorrente nella tormentata storia della nostra nazione – la serena, operosa acribia favariana assume pertanto, a tutti gli effetti, i connotati di un impegno civile a favore di un assetto del vivere sociale più integro, aperto e trasparente.

*Michele Camerota*

— OBITUARIES —

# Jim Bennett (1947-2023)

Pietro Corsi

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with the assistance of Mara Miniati, Sylvia Sumira and Stephen Johnston

James Arthur Bennett, known to scholars all over the world as "Jim", was a familiar and much-loved figure within the Italian community of students of scientific instruments, museum curators and historians of science.

He was born in Belfast on April 2, 1947. After earning his M.A. at the University of Cambridge in 1969, in 1974 he was awarded a Ph.D. He spent one year (1973-1974) as Lecturer in History and Philosophy of Science at the University of Aberdeen. Appointed archivist at the Royal Astronomical Society (1974-76), in 1977 he joined the National Maritime Museum as Curator of Astronomy (1977-79). From 1979 to 1994 he was Curator of the Whipple Museum of the History of Science at the University of Cambridge, his *alma mater*. The pace of his scholarly and curatorial engagement at the Whipple was truly outstanding and brought Jim to the attention of the international community of scholars of scientific instruments and of the history of science in general. As Joshua Nall, the current curator of the Whipple, has meticulously documented https://www.whipplemuseum.cam.ac.uk/news/jim-bennett-1947-2023, in the fifteen years Jim spent at Whipple, he curated or co-curated sixteen major exhibitions. During his curatorship, the Whipple Museum published twenty-four guides to exhibitions, catalogues and monographs, several of which were authored or co-authored by Jim.

In 1994 Jim was appointed Director of the Oxford Museum of the History of Science (now History of Science Museum, HSM), succeeding Francis Maddison. For those of us

who are old enough to remember, the Oxford Museum was well known for the competence and excellence of its curators, less so as a venue accessible to the public. As a student at Oxford in the early 1970s, I remember the crammed, dusty rooms and the difficulty to access the Museum: spaced-out opening hours were often purely nominal. Few students and indeed Faculty both in the sciences and in the humanities knew what exactly was inside the wonderful little building adjoining the Sheldonian Theatre in Broad Street. With his quiet, gentle touch and relentless work Jim gave the collections and the Museum a new lease of life. In 1997 he obtained a major grant from the Heritage Lottery Fund and gained much needed space thanks to a major renovation project, digging under Broad Street. It is less known that the cost was underestimated, though not by Jim, on whose shoulders fell nevertheless the task of raising more money to complete the furbishing of the new spaces. His only regret was that it proved impossible to finance the complex architectural project and the building of an elevator external to the main body of the Museum, to allow access to disabled visitors. He kept trying until the last day of his tenure. Intellectually, he continued the work started at Cambridge, that of opening the history of scientific instruments to a renewed and intense dialogue with historians of science and historians tout-court. No one working on Early Modern culture and societies can dispense with reading Jim's meticulous and passionate reconstructions of instrumental practices and their role in scientific, intellectual and social settings.

Often with the assistance of Stephen Johnston, at Oxford Jim curated eighteen exhibitions before retiring in 2012. In 1996 he had started a Master's course in the History of Scientific Instruments, that lasted until 2006. His amazing curatorial work, enough to fill one life, was duplicated by a stream of publications, from short notices and scholarly articles to monographs, exhibition catalogues, even a short play on Guglielmo Marconi, first shown during the exhibition *Wireless World: Marconi and the making of radio* (April-October 2006, https://www.mhs.ox.ac.uk/marconi/presspack/). The Italian inventor was presented in succession as a Bolognese inventor, the wealthy man linked by marriage to Irish whisky distillers, and a cool operator of the City of London, who spent more money on patent lawyers than in research. At the end of the play, the public was asked to vote which of the three personalities most resembled the real Marconi. It should be noted that in 2004 Jim was instrumental in the acquisition of the Marconi Archives and Collection, now deposited at the Bodleian Library and the Museum (https://www.mhs.ox.ac.uk/marconi/collection/). Johnston, now Curator Emeritus at the Oxford History of Science Museum, Jim's former student and life-long friend and collaborator, has provided an important and moving testimony of his career as multi-faceted curator, scholar, and "museum practitioner", as he liked to call himself (https://journal.sciencemuseum.ac.uk/article/jim-bennett-1947-2023-life-as-a-museum-practitioner).

During his tenure, the yearly number of visitors rose from 18,000 to almost 200.000. In the Fall of 2009 and early winter of 2010, there were long queues in Broad Street to access

one of the most inventive and successful exhibitions Jim hosted, *Steampunk*, that totalled 70.000 visitors (https://www.mhs.ox.ac.uk/exhibits/steampunk/). For someone as unworldly and completely absorbed in his work as Jim was, recognition finally came in the most gratifying way in the new millennium: from the awarding of The Paul Bunge Prize of the German Chemical Society (2001), to the Sarton Medal (2020).

I had the privilege of chairing the board of trustees (the Visitors, in Oxford parlance) of the Oxford Museum from 2006 to 2015; until 2012, when Jim retired, I interacted with him on a regular basis. Apart from the statutory termly meeting, at which Jim reported on the activities of the Museum, there were always small and big problems to attend to, from approval of loans to fending off attempts during 2010 and 2011 to merge the Museum of the History of Science with another major Oxford museum (a very unfriendly takeover bid) that took up a lot of time and emotional energy. Over the years, the only difficulty I personally experienced with Jim was having lunch with him at Linacre: he skipped it most of the time. He was very reluctant to leave his crammed, chaotic room – amazingly, he was always able to find a single sheet of paper in one of the several inches thick piles spread on tables and the floor.

As several recollections of Jim have stressed, he was a truly unassuming person. He had no time for academic parading and networking, that in his eyes took up precious time. When I realised that he had not been granted the title of Professor, in a university where people start working for it almost as soon as they are hired, I made enquiries and found out that he had never applied: in fact, just a letter and a standard cv were required. Jim was very reluctant to start the procedure. He had no time for this, and I am sure never gave a thought to it. I finally managed to convince him with what was possibly the only good argument with him: he should take the title as part of his duty, not of his career, but as a recognition of the role of the history of scientific instruments and of the Museum in the Oxford research and teaching landscape. Indeed, our Master students in the History of Science, Medicine and Technology program were offered classes at the Museum. The compulsory class on methods and themes in the history of science devoted one in eight lectures to the history of scientific instruments, held at the Museum, and followed by a hands-on session. The title of Professor was immediately conferred upon Jim in 2009, as soon as the application was in.

As I mentioned above, Jim had close links to the Museo Galileo: Paolo Brenni, Paolo Galluzzi, Mara Miniati, Giorgio Strano were his personal friends with whom he co-authored articles and volumes. Fittingly, the last major work Jim published was the catalogue of surveying instruments kept in the Florence institution, *Museo Galileo. Catalogue of Surveying and Related Instruments* (Florence, 2022), the accomplishment of many years of painstaking work.

# Remembering Enrico Giusti

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Enrico Giusti died on March 26th, 2024, at nearly 84 years of age. I met him in November 1978 – a lifetime ago. And with him, a large part of *my* life is gone. There will undoubtedly be other occasions to remember him as a mathematician and a historian of science, fields in which Enrico left his own mark, a very important one. What I hope to do here is to weave together the threads of memory from more than forty years of exchanges and friendship.

## How I met Enrico

In November 1978 – I had a research grant but was also "serving the country" at the Military District of Pisa – I happened to go to the Mathematics Institute at Via Derna. Freshly graduated and still quite inexperienced, I was told that Giusti (What? You don't know him? He wrote groundbreaking works on minimal surfaces with De Giorgi and Bombieri! He has just moved to Pisa from Trento and is teaching Analysis for the students in Computer Science) was giving a seminar on the History of Mathematics. Since my graduation, I had been fascinated by the subject; so, even though the seminar was almost over, I decided to enter the room. I remember three things from what I heard: that a group of mathematicians wanted to re-launch historical research; that Enrico was working on an interpretation of Bonaventura Cavalieri's geometry; and that there were two fields where he thought one could work productively: nineteenth-century mathematics (demanding

a knowledge of French and German) and seventeenth-century mathematics (requiring at least a basic grasp of Latin and French). And he invited those who were interested to come forward.

I seized the moment. I really liked his manner and was enthusiastic about the idea of working in such a fascinating field of research. So, I showed up in his office and told him that the seventeenth century seemed perfect for me. As you have probably understood, I was an inexperienced and a rather impulsive young man: yes, of course, I knew some Latin and could speak French, but I had little knowledge of history, even less of history of science, and least of all of seventeenth-century mathematics. Despite this, the encounter between one of the most renowned mathematicians of that time and a naive, clueless young man worked quite well: Enrico welcomed me. Perhaps he saw in my limitations the kind of challenges his project entailed. He, an internationally renowned mathematician, was embarking on a new endeavour and was well aware of what lay ahead. His ambition was to renew the stale and provincial approach to the history of mathematics, particularly in Italy. Achieving this meant breaking away from deeply rooted interpretative traditions and engaging with worlds – especially that of historians of science – that were far from the one where he had achieved recognition and success.

His first historical work, *Bonaventura Cavalieri and the Theory of Indivisibles* (1980), fully reflects his perspective. Traditional interpretations of the geometry of indivisibles, which often regarded Cavalieri as a "precursor" of integral calculus, or even set theory, were obliterated by a new conception: conceiving Cavalieri's indivisibles as a geometric magnitude subject to the rigid constraints of Euclidean proportion theory. In this way, Giusti was able to explain both its success as a tool and its theoretical failure. Beyond a new textual analysis, Enrico worked hard to meticulously reconstruct Cavalieri's life and biographical events. I remember one day – after the work had already been published – he told me with pride, "I managed to locate the Jesuate convent where Cavalieri lived here in Pisa!".

Historical research and textual interpretation: two aspects that could seem obvious. And yet, at the end of the Seventies they were not obvious at all. Most works on the history of mathematics aimed to identify results of contemporary mathematics that could have been foreshadowed or anticipated by the author under study, from Ancient Greece to the Eighteenth century. Archival research was mostly neglected and the work of textual reconstruction was overlooked or carried out using criteria that would make any philologist cringe.

During the two years we were both in Pisa – Enrico was to move to Florence in autumn 1980 – this was one of the main subjects of our conversations. He had suggested that I work on Luca Valerio, a little-known mathematician of the second half of the Sixteenth century. I was enthusiastic about this new world of research as well as about the perspectives that opened up. And one of the things I loved the most about Enrico was the freedom he gave me and his esteem. During those years and beyond, he never made me feel like his pupil or subordinate, but always as an equal. This is probably the most important quality of a true Master.

### The Bollettino di storia delle scienze matematiche

Enrico was certainly not an easygoing person. I began to understand this aspect of him more clearly after 1982, when I started collaborating as the editorial secretary for the *Bollettino di Storia delle Scienze Matematiche* that Giusti had founded in 1981 along with Luigi Pepe, Tullio Viola, and Clifford Truesdell, also with the support of the Unione Matematica Italiana (UMI), and which he directed until 2022.[1]

The *Bollettino* quickly became a reference point for Italian historians of mathematics, though not without its share of friction and controversy. Enrico was particularly forthright, especially in the early years, as he worked to establish and solidify a new approach to the history of mathematics. His project had to contend with the existing Italian landscape, where research groups and individual scholars had already become established: Tullio Viola's group in Turin, the Centro Studi della Matematica Medievale directed by Laura Toti Rigatelli and Raffaella Franci in Siena, Luigi Pepe's group in Ferrara, Umberto Bottazzini in Bologna, Silvio Maracchia, and the school of Lucio Lombardo Radice and Giorgio Israel in Rome, Antonio Garibaldi in Genoa, and Massimo Galuzzi and Angelo Guerraggio in Milan – and I am pretty sure I am forgetting someone.

Of course there was discontent and disagreement, especially when Enrico promoted two important conferences: in 1982 in Cagliari[2] and in 1983 in Cortona.[3] In particular, the Cagliari meeting was attended by most of the Italian researchers interested in the history of mathematics: this represented the premise of a new community of scholars aimed at a rigorous historical, philological and mathematical analysis of sources as well as at abandoning precursor-focused or merely celebrative approaches.

### *Ars analytica*

In September 1983, in Perugia, Enrico Giusti gave the opening lecture at the 12th Congress of the UMI. Enrico spoke to an overcrowded room about the birth of infinitesimal calculus, presenting a highly innovative thesis: Leibniz's differential calculus was primarily developed to provide an efficient method for solving the problem of determining the tangents to an algebraic curve.[4] I recall having a discussion with Tullio Viola, who argued that

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[1]   Please find the index of the issues published until 2000 on the website of *Giardino di Archimede. un museo per la matematica*: https://php.math.unifi.it/archimede/archimede/bollettino/bollettino.php and that of the issues 2001-2022: https://php.math.unifi.it/archimede/archimede/bollettino/bollettino21.php. The issues between 2001-2024 are available here: http://www.libraweb.net/riviste2.php?chiave=bollettino%20di%20storia.

[2]   The Proceedings are published in Montaldo & Grugnetti (eds.), *La storia delle matematiche in Italia.*

[3]   The Proceedings are published in Various Authors, *Storia delle matematiche in Italia.*

[4]   Giusti, "A tre secoli dal calcolo…".

Enrico had missed an opportunity: in front of the "Estates general" of Italian mathematicians, he should have given a much grander talk on the importance of history. I countered that, instead, he had opened up new perspectives on how to actually do history.

In Perugia, I caught up with Aldo Brigaglia and Pietro Nastasi from Palermo, whom I had first met in Cagliari and later seen again in Cortona. We came up with the idea of organizing study meetings on Marino Ghetaldi, a mathematician of the early seventeenth century, one of the first experts who recognised the importance of François Viète's innovations in algebra. It was in the side discussions of the Congress sessions dedicated to history that we decided to involve Enrico in organizing this project. Giusti welcomed the idea with enthusiasm: the plan was to form a working group, with each session of the seminar devoted to the analysis of one or two texts by Ghetaldi. Participants would be expected to study the texts introduced by a lecturer. There would be no time limits for discussion or presentations.

The first session of the seminar *The Figure and Work of Marino Ghetaldi* was held in Pisa at the beginning of 1984, if I remember correctly. This was followed by several more sessions, and after Ghetaldi, we analyzed the work of Viète and then Descartes. These meetings, which continued until 1986 under Enrico's guidance, led to the formation of a group of historians who shared research methodologies and objectives. One can get a clear idea of this by browsing the indexes of the *Bollettino* from those years and the following ones.

These seminars were quite informal: people would interrupt each other, criticising openly. And often, the discussion would heat up. Also because, as I have already said, Enrico was anything but easygoing: if he had the feeling that someone was missing the point or going off on a tangent due to a flawed understanding, he wouldn't hesitate to interrupt and point out that what was being said didn't make any sense. Naturally, some people would get upset.

It happened to me too: at the end of the "Ghetaldi" seminar, a discussion arose about what should be done thereafter. I argued one position, Enrico another, and at a certain point, he said something like, "Daniele, calm down." "Don't tell me to calm down!" I snapped, losing my temper and stormed out of the room, slamming the door behind me. In anger, I left the Department building. An hour later, after cooling off, I came back, brooding over the end of my career as a historian. Just as I was entering the lobby of the department, Enrico and the others were coming out of the classroom for a break. He came up to me, shaking my hand with a big smile. I doubt many others would have done the same.

Giusti made a significant contribution to these meetings, and his article on Descartes' *Géométrie* and the relationship between numbers and magnitudes remains, in my opinion, a cornerstone. It was the result of many discussions we had during those years on the relationships between algebra, geometry, and the geometrization of reality.[5] At the

5    Giusti, "La *Géométrie* di Descartes tra numeri e grandezze".

end of September 1987, at the *Ars analytica* workshop held at the Centre International de Rencontres Mathématiques in Luminy (Marseille), we discussed these topics with our French colleagues.[6] Maybe I'm just glorifying things – *le souvenir*, it's well known, *c'est embellisseur* – but I clearly remember feeling proud of how our "school" presented a clear thesis and program: the research perspective that Giusti had begun to outline at the 1983 Perugia congress had taken shape and were opening new horizons.

Nevertheless, just as it seemed that an Italian school of the history of mathematics with international relations and connections was coming into being, the aforementioned disagreements began to deepen into dissent and growing impatience towards Giusti's leadership. It was perhaps at this point that our community's decline began to take shape.

## At the dawn of modern mathematics

Not that Enrico did not perceive that things were not going so well. In a conversation of a few years later – it must have been Spring or Summer 1993 – Giusti confided to me the need to relaunch this kind of experience. "What could we do?" he asked me. "We might tackle Maurolico", I replied doubtfully. In fact, the idea of approaching the work of this 16th-century mathematician – about 5000 pages of old prints and manuscripts, many of them still unpublished – had indeed come up several times in the previous years. In particular, the idea had emerged occasionally after the publication of Rosario Moscheo's 1988 study on Maurolico, which included a detailed catalog of his writings and could serve as a starting point.[7] The project was therefore not as far-fetched as it might seem, but it still presented a significant challenge. To my doubts, Enrico replied, "What does it matter? Let's give it a try anyway!"

This is how the seminar *At the Dawn of Modern Mathematics: Francesco Maurolico and the Return of the Classics* (Pisa, 1993-1996) was conceived, which led to the more developed *Maurolico Project* (1998-2009). The Seminar and the Project brought together about fifty researchers from various backgrounds: young graduands, renowned philologists like Ottavio Besomi, historians of science such as Carlo Maccagni, and and many Italian historians of mathematics, as well as several international scholars, such as Ken Saito, Ken'ichi Takahashi, Jean-Pierre Sutto, and others. Over the course of a decade, we managed to explore that *mare magnum* of texts, complete a full digital transcription, and successfully propose the establishment of the Edizione Nazionale of Francesco Maurolico's *Opera Matematica*.

This endeavour has been ongoing for twenty-five years. And, if it has managed to continue, it is largely due to Enrico. Not only because of the published contributions, albeit

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6   The proceedings of that meeting were not published, but you can find the program here: https://www.academia.edu/112087580/Franco_Italian_colloquy_ars_analytica?uc-sb-sw=4963832.
7   Moscheo, *Francesco Maurolico tra Rinascimento e scienza galileiana.*

significant.[8] But especially because of his ceaseless, always active, and insightful participation – I cannot recall a single seminar or internal meeting on Maurolico at which he was absent. And, more prosaically, for his support: Giusti made the Project one of the main pillars of the various PRIN "History of Mathematics" grants funded between 1997 and 2004, for which he was the principal investigator.

The last time I saw Enrico (only online, as his illness, which eventually took him from us, had forced him into extreme caution) was last February, for a meeting of the Scientific Committee of the National Edition. It is almost impossible for me to imagine that the next time we meet he will not be with us.

## De motu antiquiora

I will miss Enrico so much. Just as I have missed – and still miss, even today after more than twenty years – Pierre Souffrin.[9] Pierre had made sporadic appearances at the "Ghetaldi" and "Maurolico" seminars and had become friends with both Enrico and me. Like Enrico, Pierre was a physicist by training, and his interests were focused on "pre-classical" mechanics, in particular on Galilean mechanics. Enrico had long explored similar topics. As early as the 1980s, had also focused on Galilean kinematics; he had curated an edition of *Two New Sciences*; and in 1993 he had published an important monograph on the challenges Galileo faced in trying to describe a new physics using the framework of Euclidean proportion theory.[10] This led to the development of a deep scientific friendship, although Pierre and Enrico did not always agree. In fact, I recall rather lively discussions between them, particularly on the concept of velocity and Galileo's use of it, as well as on the Galilean theory of tides.

Pierre worked at the Observatoire de la Côte d'Azur in Nice, and together we organized a series of *ateliers* to study certain early writings of Galileo, known in the literature as *de motu antiquiora*. The style was the same as described above: a lecturer with no time limits and open discussion. Giusti was one of the key figures in the four or five meetings held between 1993 and 1997, in Nice and Pisa. Enrico was particularly enthusiastic about

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[8]  Giusti, "Maurolico et Archimède…"; Introduction to the volume *Archimede* in the site of Maurolico Project (http://people.dm.unipi.it/maurolic/edizioni/archimed/intro.htm). As much important are the lessons held in Firenze in 2000: *Centrobaryca. Equilibrio dei gravi e centri di gravità dall'Antichità al Cinquecento* which could be consulted until quite recently at http://web.math.unifi.it/users/giusti/corso%20storia%20matematica/centrobarica%201.pdf but which is now unavailable.

[9]  Pierre died in 2002, he was 67 years old. His writings were collected in Souffrin, *Ecrits choisis d'histoire des sciences.*

[10]  Giusti, "Aspetti matematici della cinematica galileiana"; "Ricerche galileiane: il trattato *De motu aequabili*…"; Galilei, *Discorsi e dimostrazioni matematiche…* (critical edition by Enrico Giusti); Giusti, *Euclides Reformatus…*

the meetings in Nice: Pierre organized them at the Westminster Hotel on the Promenade des Anglais, where seminar discussions enjoyably continued with digressions on the most array of topics, in the exceptional scene of the Westminster's *terrasse*.

One of the issues with these texts – which we have in Galileo's original handwriting – was to establish their chronology. To put it simply, we had three texts ($T_{10}$, $T_{23}$, and D), all incomplete. It was unclear when they were composed (when Galileo was in Pisa? Or in Padua?), and, above all, their relative chronology was also uncertain. In the literature, various proposals had been made, and in particular, four out of the six theoretically possible chronological orders had been suggested using the mst extravagant ideas and methodologies.

I remember Enrico's sarcasm regarding this and other oddities of Galilean studies – he drafted a pamphlet, *Il metodo Caverni* (The Caverni Method), which advised a young scholar at his first steps in the history of science to adopt the most absurd theses, as they would surely appear quite original: this would have ensured him a brilliant career. Unfortunately, he never wanted to publish it, and who knows where it has ended up. However, putting sarcasm aside, Enrico decided to face the matter head on. He took over the manuscripts and set out to create a new edition aimed at accounting for all of Galileo's various interventions (corrections, marginal additions, erasures, intertextual references). He presented the results of his study on these interventions in the fall of 1996 at a workshop in Ascona, *Testi e contesti galileiani*.[11] There, he established the relative chronology beyond any doubt as D, $T_{10}$, $T_{23}$. A debate that had been ongoing since the early years of the century could then finally attain a definitive conclusion.

## Textual criticism

Giusti published the results of his work in *Nuncius* in 1998;[12] however, his edition of *De motu antiquiora* was never published. It was a pity because that experience marked an important step in the evolution of his interests toward the relationship between history of mathematics and philology.

From his earliest works, Enrico had been addressing this issue. I remember that at the end of the summer of 1980, he had already organized a meeting at the Mathematics Institute in Florence, focusing on the editions of correspondences. He spared no effort in order that Christoph Clavius' correspondence might be published.[13] In 1985, at the CIRM in

[11] *Galilean Texts and Contexts* (October 28 - November 2, 1996), organized by the Chair of Italian Literature at the Federal Polytechnic of Zurich, the Museum of the History of Science in Florence, and the Max Planck Institute for the History of Science in Berlin.

[12] Giusti, "Elements for the relative chronology".

[13] Despite Giusti's support, the project remained partially unfulfilled. Clavius' correspondence was published in 1992 only as a preprint by the Department of Mathematics in Pisa, although it is now available online: https://echo.mpiwg-berlin.mpg.de/content/mpiwglib/clavius.

Trento, he organized, together with Luigi Pepe, a conference on the relations between critical editions of mathematical and scientific texts.[14]

As I mentioned, in 1990, Einaudi published his edition of Galileo's *Discorsi* (Two New Sciences). I remember the discussions I had with him about this work. It naturally needed to measure up to the national edition by Antonio Favaro and the more recent one by Adriano Carugo and Ludovico Geymonat. When he first told me he was working on this task, I was dumbfounded:

"But you'll have to write countless footnotes!" – I remarked with surprise, thinking of the heavily annotated Carugo and Geymonat edition.

"I have no intention of doing that", he replied. "I am planning to write a detailed introduction on Galileo's kinematics and limit myself to purely textual notes".

Enrico often argued that overloading an edition with editor's comments and reflections only makes it prematurely outdated. He would cite examples like the correspondence of Marin Mersenne or the edition of Descartes' works. Any oversight – or worse, any mistake – made by the editor in the footnotes would be practically indelible, given that the edition would become a reference point for scholars in the years to come.

He believed that anyone undertaking the task of producing a critical edition inherently assumes a significant responsibility. What gets published will be *the* text, literally, for decades to come. As he often pointed out, even if you publish an article explaining why the footnotes on such-and-such pages are wrong or misleading, what impact will your article have compared to a work that took years to produce and is widely known? When people argued that avoiding detailed commentary meant losing the accumulated capital of knowledge the editor had built up, he would respond that one could always publish their opinions separately. He often mentioned Antonio Favaro as an example: without annotating his edition of Galileo's works, Favaro published dozens and dozens of notes and articles in the series *Amici e corrispondenti di Galileo* (Friends and Correspondents of Galileo) and *Adversaria Galilaeiana*.

The 1996 seminar in Ascona was organized by Ottavio Besomi, one of the leading contemporary experts in Italian studies, who was working with Mario Helbing on a new critical edition of the *Dialogue Concerning the Two Chief World Systems*.[15] I was with Giusti and Besomi, waiting to go to dinner, and we were discussing Enrico's presentation and his findings on the chronology, when Enrico showed him his own edition of *de motu antiquiora* texts. In order to better highlight the various interventions of Galileo on his own text, Giusti had showered it with diacritics: in addition to square and angle brackets, there were double square brackets, double angle brackets, curly brackets, and passages in italics that had specific meanings… For his main goal – to establish a chronology – it might have

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14  Giusti and Pepe, eds., *Edizioni critiche e storia della matematica.*
15  Galileo (Besomi and Helbing eds.), *Dialogo sopra i due massimi sistemi del mondo.*

been fine, but the text was tough to follow. Ottavio, like the true old-school gentleman he is, pointed this out with great discretion, also offering his assistance if Enrico ever intended to publish it.

This is how the edition remained unpublished. But every cloud has a silver lining. At the end of 1996, the seminar *At the Dawn of Modern Mathematics* was almost at its end, and the Maurolico project was about to come to light. Enrico, Carlo Maccagni – another friend who had passed away and whom I miss dearly – and I thought that it would be a good idea to involve Besomi in the creation of a digital edition of Maurolico's works. And Ottavio gave his "fateful reply".

And so it was that from 1998 to 2005 our discussions on how to present Maurolico's texts – and more in general how to realize the edition of a scientific text – were enriched with new visions and perspectives: in addition to Ottavio a young classical philologist also "converted" to the textual critique of scientific writings, Paolo d'Alessandro. I think that these experiences had an important impact on Enrico as well as on his work and the way it developed in his last years, leading him to undertake the edition of Leonardo Fibonacci's works.

## *Leonardi Bigolli Pisani* Opera quae extant omnia

2002 marked the eight-hundredth anniversary of the publication of the *Liber abbaci*. But it was also the year in which, after the Twin Towers and the invasion of Afghanistan, the wicked war in Iraq was looming on the horizon. Enrico had the brilliant idea to organize a major international conference in Pisa and Florence, which would also serve as a clear signal of peace: a conference celebrating Leonardo Fibonacci that would also remind us how much Western society and culture owe to the Arab civilization. It was attended by numerous scholars, particularly Arabists such as Roshdi Rashed, Jacques Sesiano, Djamil Aïssani, and Ahmed Djebbar.[16] In addition to the conference, we also set up the exhibition *Un ponte sul Mediterraneo* (*A Bridge across the Mediterranean*), accompanied by a volume of essays.[17] Giusti wrote a quite hefty contribution, *Matematica e commercio nel Liber abaci* (*Mathematics and Trade in the Liber Abaci*), in which, thanks to his remarkable skills as popularizer and the rigor he was known for, he discussed the content and significance of this text for the development of modern mathematics and society.

It marked the beginning of a passion. Enrico began working seriously on Leonardo's text, although it was only a few years later (in 2015, when he was already retired) that he

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[16] The proceedings of the convention *Leonardo Fibonacci. Matematica e società nel Mediterraneo del secolo XIII* (Leonardo Fibonacci, Mathematics and society in the Mediterranean in the 13th century) were published in the second issue of 2023 and in the first issue of 2024 of the *Bollettino di storia delle scienze matematiche*; unfortunately they do not include all the interventions.

[17] *Un ponte sul Mediterraneo: Leonardo Pisano, la scienza araba e la rinascita della matematica in Occidente*, ed. by Enrico Giusti in collaboration with Raffaella Petti.

presented a project to Veronica Gavagna, Paolo Freguglia, and to me: a revision of the edition of the *Liber* prepared by Baldassarre Boncompagni in 1859 – an edition as rare as Leonardo's manuscripts and, moreover, full of transcription errors, especially in its mathematical aspects. It was a "modest proposal", given that it entailed revising hundreds and hundreds of pages.

But of course, it was not like him to stop there. His long-standing experience in studying and publishing mathematical texts, along with his friendships with prominent philologists, soon led him to study the manuscripts – about twenty of them! – so that the original project evolved into that of a true and proper critical edition.

We began to regularly meet in Pisa to stay updated on his progress and try to help him with any problem he might encounter: Carlo Maccagni, Paolo d'Alessandro, and myself. It was during these meetings that he shared with us his discovery of a version of the text preceding the revision Leonardo made for Michael Scot; there we long discussed also whether this version could actually date back to 1228, as was widely believed, uncovering evidence that cast doubt on this date; there we also established that the name 'Fibonacci' was an invention of 18th-century erudite scholars and that, from a historical perspective and despite the current universal usage, the Pisan mathematician should more be correctly referred to as Leonardo Bigollo; and there we examined numerous issues of interpretation and textual criticism. During these meetings, Enrico found in Paolo the ideal mate, someone who could reassure him about the philological decisions required for such a complex edition.

By 2018, the critical edition had already taken shape, although there was still much work to be done to check the collations and the critical apparatus. The main problem, however, remained where to find the funds to publish it. Thanks to Paolo Galluzzi and the Museo Galileo, as well as Paolo Mancarella, Rector of the University of Pisa, we managed to reach an agreement with the publisher Olschki. And finally, in 2020, the eight hundred pages of *Leonardi Bigolli Pisani vulgo Fibonacci Liber abbaci: edidit Enrico Giusti adiuvante Paolo d'Alessandro* came to light.

The edition had not yet been published when Enrico started working again – this time involving Paolo d'Alessandro from the very beginning – on the project of completing the edition of Leonardo's works. The critical editions of the *Practica geometriae*, *Liber quadratorum*, and *Flos* were still missing. This work was nearly finished when Enrico passed away last March. Thanks to d'Alessandro, it will be fully completed: in the next few months, the new edition will come out, once again with the support of the Museo Galileo and the University of Pisa. I do not think I am exaggerating when I say that only Enrico could have carried out this work: only his mathematical insight and philological passion could have made it succeed.

These *Opera omnia Leonardi Bigolli Pisani* are the most beautiful monument Enrico could have ever left us.

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As I read back over these lines, I realize how little they manage to convey forty years of friendship and collaboration. I wish I could better convey his ability to grasp the central point of a problem or a discussion, and his remarkable gift for explaining complex mathematical problems in simple terms. These were the qualities that made Enrico an outstanding teacher and popularizer, which found their embodiment in the *Giardino di Archimede*, the first museum in the world dedicated solely to mathematics. Qualities that shine in his novel, *La matematica in cucina* (Mathematics in the Kitchen), in his insightful reflections in *Ipotesi sulla natura degli oggetti matematici* (Hypothesis on the Nature of Mathematical Objects), and in his analysis textbooks, on which thousands of students have studied.

And I have said nothing about the trips and journeys we took together, the pieces of advice he gave me on my academic career, the lunches at his home in Florence and his wife Francesca's *polpettone*, his passion for fine wines, and his love for rare books.

But, above all, I wish I could manage to better describe Enrico's human side: the liveliness of his intellect, his sense of humor, his generosity, his openness to discussion and debate. There is also an important aspect of his character that I have not mentioned yet – his extreme discretion. His reluctance to talk about himself or his personal concerns made it difficult to establish a more intimate relationship beyond the purely intellectual. Yet, behind this façade of emotional reserve, I have always felt his affection and profound kindness.

And I can only feel deeply proud and grateful to have shared such a significant part of my life with him.

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