

The pyramid of knowledge: tracing the roots of the intellectual background of the florentine Accademia del Cimento

Acknowledgments

Thank you Matteo and thank you everyone for being here. It's a real pleasure for me to be able to give a talk in the institute and to receive your feedback and your suggestions on my research.

I have divided my presentation into 5 parts: the first one provides a brief introduction, the second puts into context the main source, the third provides a geometric-visual analysis of the source, while the fourth focuses on the intellectual legacies in the space of the Accademia del Cimento. A short conclusion will bring the presentation to an end.

Introduction CAMBIO

The Florentine Accademia del Cimento was the first European society to put experimentation at the core of scientific activity and to be supported by a public power. Nevertheless, most monographs on the Accademia have rather left in the shade a very important aspect in its study, namely the intellectual and natural-philosophical roots underlying its experimental activity.

CAMBIO To investigate this matter, I pose the following question: is it possible to reconstruct the intellectual background of a XVII-century scientific academy through the study of lésts? This is one of the main expected outcomes of the first part of my research project. In fact, one of the few sources available for the study of the founding moments of the Accademia del Cimento is precisely a varied set of those analytical tools.

The most well-known is certainly the list of books that Carlo Rinaldini brought to the attention of Prince Leopold de' Medici in November 1656: this list, as argued by Giulia Giannini in a recent contribution, was a starting point for the construction of the Academy's experimental agenda. In fact, many of the theories discussed and experiments carried out in the course of the circle's early work were taken from the titles mentioned by Rinaldini.

But there are several other forms in which a list can present itself in the manuscripts, apart from the more 'traditional' ones such as Rinaldini's.

A plethora of other sources – including library inventories, *desiderata*, wish-lists, *memoranda*, to-do lists, as well as lists included in research notes, which capture a specific moment in the scholar's annotation work – also survive, giving us insight into the Academy's intellectual activities. Using these tools, the philosopher could then identify other texts or authors that he wanted to consult in the analysis of certain specific topics, or alternatively draw up a list of experimental verifications to be carried out and preliminary steps useful for this purpose. Of course, there could also be 'hybrid' lists, falling into more than one of these categories. Lastly, there are other particular kinds of lists that fall outside the previous types, due to their much more pronounced visual component, as in the case of depictions of books in sketches, drawings or oil portraits, which often had a symbolic-allegorical function. It is precisely on these kinds of lists that I would like to focus this talk.

The first page of the diary **CAMBIO**

Looking now at the first page of the diary of the Accademia del Cimento of the year 1657, before the splendid pen illustrations of the instruments used during the sessions, the secretary of the circle, Alessandro Segni, chose to depict what he considered to be the most significant intellectual elements in the birth of the society of scholars to which he belonged. In this sheet, Segni depicted a wonderful 'microcosm in miniature' through a list of symbolic images relating to the first steps that the Accademia del Cimento was taking, not only from an

intellectual but also from an experimental point of view. And so, we can observe some drawings of scientific instruments used in various fundamental fields of study, such as five objects for measuring lengths and some weight measurement units. Next to them there are three liquid-in-glass thermometers, one fifty-degree, one sixty-degree and one centigraide, the invention of which was attributed to Grand Duke Ferdinand II de' Medici, patron of the Academy together with his brother Leopold. There are also a pendulum, compasses and goniometers.

CAMBIO However, it is on the right side of the page that the most interesting images are to be found. A curious 'long fork' whose stated purpose was to measure the weight of water, a drawing of a bench – in all likelihood the one on which Segni himself sat – together with a pen and a sheet of paper on which some lines were sketched to indicate the drafting of the report of an academic meeting. Also: a wooden board on which rest a dial, a compass, an hourglass and a small armillary sphere. **CAMBIO** Finally, the most important piece of evidence appeared, a list embedded in another list, that could be called the 'pyramid of knowledge', **ANIMAZIONE** a drawing of twelve volumes arranged pyramidally and containing – each on its lower edge – the name of an author. As you can see from the image, the penultimate one is an exception: the secretary of the Cimento had written only 'NOVA FILOSOFIA'.

CAMBIO Before analysing the peculiar list in detail, a critical reflection on the epistemological significance of this 'introductory' sheet seems appropriate. In fact, Segni intended to trace the experimental perimeter of the Academy's activity, condensing it into a single page, into a visual instrument, firstly the perception that its members had of what the fundamental dimensions of sensible reality were and, secondly, the type of studies that they would like to carry on. And so, from left to right, here is the measurement of length, followed by that of temperature verified by thermometers, pivotal instruments of Florentine meteorology; then the measurement of movement (the pendulum) and that of weight. The compasses and goniometers, on the other hand, indicated the value of a mathematical-geometric approach to the study of natural philosophy, while the hourglass, the quadrant and the compass represented the temporal and spatial dimensions. The armillary sphere then,

in which it is impossible to distinguish the system represented, certainly symbolised the prominent role played by cosmology and astronomy. Finally, there is the peculiar pyramid of books, which indicate an upward trajectory of natural philosophy, both through the names of the wise men of the past, and of scholars chronologically closer to the Cimento, considered by academics to be the most suitable to express their vision of the subject.

Verticality CAMBIO

However, this kind of symbolic-visual list with a marked epistemological value was not a novelty introduced by Alessandro Segni. Indeed, in Mannerist portraiture we can find some other examples: some characters could be depicted with artefacts and books stacked one on top of the other in order of importance. We can see here the portrait that Giovanni Stradano made of fellow painter Alessandro Allori. CAMBIO In fact, the Flemish artist depicted Allori with a small vertical stack of books on his right, surmounted by an armillary sphere. The volumes bore the name of a Greek author on the back edge: thus, from bottom to top, one can read 'Homerus', 'Euripides' and finally 'Ptolemaeus', thus showing an ascending line from epic to cosmology.

ANIMAZIONE

Secondly, an analogy can also be found in some printed books: a very fitting example is one of the plates accompanying the Venetian edition of a well-known collection of Renaissance medical texts, the *Fasciculus medicinae*, published for the first time in 1491 on behalf of the German physician Johannes de Ketham. CAMBIO

The frontispiece of the work depicted a *physicus* named Petrus de Montagnana (not to be confused with the homonymous humanist), as he annotates a text on a lectern. Three patients are at the bottom, each carrying a stick and a bucket, perhaps the one in which the *matula* – the glass container for urine – was carried. CAMBIO The scene is characterised above all by a strong verticality, achieved through the sticks and the books, which are distributed on various

levels according to a carefully studied arrangement. Firstly, at the bottom, next to the sick, you can notice three medical texts arranged on a bench, each of which bears either the title or the author's name on the cover. The heavy desk on which the physician works has a door open at its front, inside which are four untitled volumes stacked irregularly, bringing the observer's eye to the next visual level. **ANIMAZIONE** Here, in addition to the book Petrus de Montagnana is annotating, there is another one open to his left, located in an elevated position next to a small hourglass: it bears the inscription 'Caius Plinius de Naturali', referring to Pliny the Elder's *Naturalis Historia*. **ANIMAZIONI 2-3** A window finally leads to the apex of the plate, in which eight works by the most famous authors of Greco-Arabic medicine were placed frontally on a shelf, as an ideal conclusion to the representation.

Looking deeper into the titles of the volumes at the first level, we have, from left to right, the *Conciliator differentiarum et praecipue medicorum* by the Paduan physician and astrologer Pietro d'Abano, who lived between the second half of the 13th century and the first half of the 14th. Above, it rests a book that bears only the name of the author, the obscure Jewish sage Isaac Benimiram, as if to enclose his *opera omnia*. The third does not bear a title on the cover either, but only 'Abesoar', which would refer to the Latinised name of the Arab philosopher Abū Marwān ibn Zuhr, who was Averroes' teacher. If on one hand, the volumes located inside the flap, without any indication of author, could represent a link to the Latin knowledge embodied by Pliny the Elder, on the other, the picture of the last 'intellectual level' of Petrus de Montagnana's library appears clearer. In fact, moving from right to left, we notice the names of the Arab world's most famous physicians and thinkers, Averroes, Yūḥannā ibn Māsawaih, known as John of Damascus or Mesué the Elder, the latter term appearing in the book that ideally encapsulated his wisdom. Then there were 'Rasis', the Persian scholar Abū Bakr al-Rāzī and Alī ibn 'Abbās al-Majūsī, known as Haly Abbas. The remaining four tomes were the production of Ibn Sina, placed in a central position and bound with studs at the corners to emphasise his importance, followed by those of Galen, Hippocrates and, finally, the *opera omnia* of Aristotle, the first author listed, remarking his usual superiority on the other scholars.

CAMBIO A little over one hundred and seventy years later, Alessandro Segni's placement of Aristotelianism in the 'pyramid of knowledge' took on a diametrically opposite form. Here the Stagirite and his famous commentator Albertus Magnus constituted the lowest level of the list, almost 'crushed' by the weight of the other wise men. This also suggests how the various stories of the peculiar list must be read from left to right, Aristotle being chronologically prior (as well as master) to the *Doctor Universalis*. And even, unlike ibn Zuhr and Averroes, Theophrastus, the first of Aristotle's disciples, was not one, but two levels above his master. This probably signifies how, in the thinking of Segni and his colleagues, the students of the Stagirite who had managed to detach themselves from some of the fundamental concepts and doctrines of the now-discredited Aristotelian system, were to be revalued, as they had 'elevated' themselves philosophically.

When the work of the Academy began, a symbolic (and informal) representation such as the 'pyramid of knowledge' appeared as the perfect opportunity to mark a collegial distancing from Aristotelianism. And even if there were also some philosophers within the Cimento who expressed peripatetic positions, such as Ferdinando Marsili, the Academy wanted to underline its adoption of a purely inductive methodology.

From Pliny to Galileo

Between Aristotle and Theophrastus lay two tomes representing the *opera omnia* of two authors from the 1st century A.D., Pliny the Elder, also 'demoted' from the position occupied in the *Fasciculus*, and Plutarch of Chaeronea. Several quotations from them can be found in the Academy's lists, which allows us to investigate more precisely the influence their writings had on the Cimento. Firstly, both Pliny and Plutarch are mentioned by Rinaldini in his list; secondly, many of their works must have been known and, in some cases, owned by academics, as shown by both the presence of Plutarch's *Opuscula* in Viviani's library. **CAMBIO** Let us now look at a third list compiled by Viviani – completely unpublished –. This is a short index that could be classified as

'hybrid' in that it mixed authors' names, titles of works and notes taken while reading them.

The undated document began precisely with the words 'Plutarcus de primo frigido', thus citing that small treatise, later included in the *Moralia*, on the origin and properties of the primary quality of cold. It is interesting to note how, at the end of the index, Viviani inserted two annotations to Plutarch's treatise, most likely part of a verification work carried out on the texts indicated by Rinaldini. In fact, the Florentine mathematician noted that:

"It is false what Plutarch says that from the same mouth the breath now comes out hot, now cold, because now rarefied, now thickened",

commenting with these words on what the Greek philosopher had argued about a much debated topic within the Cimento, namely the very essence of cold. Plutarch, in fact, took a position in favour of its positive rather than its privative nature, a position on which the academics would instead take sides, 'sublimated' in 1666 by the *Discorso* that Prior Orazio Ricasoli Rucellai delivered during a session of the Accademia della Crusca. Viviani then made a second annotation, unfortunately incomplete, on the same question:

"See if there is any demonstration by which it can be proved that if frigid atoms were given ...".

The abrupt interruption of the sentence does not give the possibility of understanding the demonstration Viviani was aiming for, although he did make two very interesting references. The first is his reference to the existence of atoms, and the second concerns the question of the possibility of cold as an active quality, showing how Plutarch's *De primo frigido* had caught his attention. And this high consideration of the subject was shared with other members of the Accademia del Cimento, first and foremost Carlo Roberto Dati, who even proposed to translate the work into the vernacular.

CAMBIO Focusing now on the third floor of the pyramid, the author on the right, thus situated in a more authoritative position than Theophrastus, who occupied the left half, also belonged to the Latin intellectual universe, particularly to the westernmost territories of the Empire. The reference is to Lucius Anneus Seneca, a native of Cordoba. In addition to the more distinctly

moral aspects of Seneca's Stoic thought, whose reading by Viviani is proven by a list of maxims transcr(a)ibed by him, the work that the academicians of the Cimento took most into account in their experimentalist perspective of philosophical-natural studies, must certainly have been the *Naturales Quaestiones*. Indeed, numerous passages from this work by Seneca were taken up in the intellectual space of the Grand Duchy, especially in the field of meteorology, such as Book Three, dedicated to water. And in this regard, the Grand Duke Ferdinand II himself is said to have grappled with the question of the origin of the springs, as evidenced by some documents.

Both the fourth and fifth of the seven levels of the 'pyramid of knowledge' were reserved for Plato and his school. The master, unlike Aristotle, occupied the leading position, at the top right, while on the level below, from left to right, the inscriptions 'Macrobius' and 'Mirandulanus' appeared on the lower edge of the books depicted. They referred on the one hand to late-antique Neo-Platonism, and on the other to the revival of Platonic thought that took place during the Renaissance. Moving then from the extreme West to the extreme South of the territories of the Roman Empire, the role of the link between Roman wisdom and Platonic doctrines was delegated to the African Macrobius, who had insisted on trying to demonstrate a filiation of Ciceronian philosophy from the Platonic one. However, only three works by Macrobius have come down to us, which allows us to identify with sufficient certainty the contents of the texts that the academics of the Cimento studied. Moreover, his inclusion in the list of Platonic thinkers would suggest that academics were familiar with his two early works, the *Saturnalia*, modelled on the Platonic *Symposium*, and the *Commentarii in Somnium Scipionis*, modelled on the *Timaeus*.

The presence of a secondary author such as Macrobius in the place of neo-Platonic thinkers who are certainly better known, above all Plotinus, whose works, unlike Macrobius', appear several times in the inventories of the academicians' libraries, poses the basis for some questions about the selection criteria of the peculiar list. **CAMBIO** And in this sense, even more surprising is the name found to the right of Macrobius, Giovanni Pico della Mirandola, included in the pyramid as a representative of Renaissance Neo-Platonism,

and in particular of the 15th-century Florentine Academy, which represented in the collective imagination of the Cimento a palpable historical precedent to their experience.

One might have expected to find Marsilio Ficino instead of Pico alongside Macrobius, since Ficino was the undisputed animator of the Florentine Academy, as well as the protagonist of the rebirth of Neo-Platonic thought in 15th century Florence. Perhaps even more astonishing is the total absence of any reference to the figure of Ficino in the eulogy pronounced in 1643 by Carlo Dati in memory of his late maternal uncle Niccolò Arrighetti, another leading figure of Florentine Neo-Platonism between the 16th and 17th centuries. To explain this mystery, one could look in the direction of an important section of Ficino's *Corpus Philosophico-Naturalis*, namely astrology, a discipline against which Giovanni Pico della Mirandola had lashed out in his *Disputationes adversus astrologiam divinatricem*. In fact, Marsilio Ficino, who in the 17th century was often referred to by the epithet “the Florentine astrologer”, might have appeared in the eyes of the Cimento as a figure closely linked to an outdated superstitious type of knowledge. And in this regard, Elide Casali pointed out that in the intellectual world of Ferdinand and Leopold's court, astrology was banned, judged as “a by-product of traditional cosmology, unacceptable for intellects open to a true knowledge of reality”. And, returning once again to Macrobius, one can see a further consonance between the latter and Giovanni Pico della Mirandola, in that, as Jacques Flamant argues, Macrobius had managed to resist the allure of astrology, from whose appeal late Latin Neo-Platonism was by no means immune.

These considerations highlight the important role of absences within the lists of books and authors, absences which could conceal precise and motivated choices. This is the case with the Cimento's attempt to renounce any astrological-divinatory heritage to instead focus strictly on Galilean experimentalism.

CAMBIO Before looking at the top of the pyramid, constituted by Galileo, it is useful to dwell on the last of the authors included by the academicians in the list of Platonists, Ghélen of Pergamon. While Galen in his writings repeatedly showed a preference for Plato's philosophy, the question of the relationship

between the two scholars is of course more complex. But here it is appropriate to focus on the academicians' perception of the orientation of Galen's thought, who, within the pyramidal list, represented first and foremost the close interconnection between natural philosophy and medicine, and thus the princely role played by the latter among the different disciplines. Indeed, among those who took part in the meetings were some important physicians and scholars of anatomy and physiology, such as Borelli, Uliva, Stensen and Redi, although many non-physicians who had gravitated around the Studium of Pisa must also have been familiar with medicine, having read the discipline's main texts. And so, in the view of the academicians, as evidenced also by his inclusion in Rinaldini's list, Galen must have appeared as the classical authority best suited to represent their approach to the study of medicine and its practical-surgical applications. This was also because, again in their perception, Galen appeared closer to Plato's doctrines than Hippocrates, the other famous physician of antiquity, who was almost never mentioned in the documents. As further confirmed by the role reserved for them in the 'pyramid of knowledge', platonic theories were held in high regard in mid-17th-century Florence.

The penultimate level of the pyramid is the most singular: in fact, it is the only one in which the name of an author is not found, but only the inscription "NOVA FILOSOFIA" appears on the edge of the corresponding book, the most voluminous of the group. And if the citation of a current of thought made it possible to shorten the list, thus avoiding the need to mention all the authors taken into consideration, it is however crucial here to investigate which works and which scholars belonged, to this category in the view of the academicians. Above all, it is fundamental to ask what Segni and the other members of the Cimento perceived as novelties in the natural-philosophical production of the 17th century.

CAMBIO Looking back at Viviani's short list of authors, Plutarch was followed by Plato, Aristotle, and several atomist philosophers, such as Lucretius, Gassendi and Descartes. **ANIMAZIONE** However, it is surprising to note the presence of a second 'Timaeus Locrense', mentioned as a separate author, in addition to the Platonic dialogue's namesake. **ANIMAZIONE** Of course,

Viviani was not referring again to the Pythagorean philosopher, but to the pseudonym behind the author of the *Epistola qua motuum illorum vera causa per circumpulsionem ad mentem Platonis explicantur*, delivered to Viviani himself through Michelangelo Ricci. **CAMBIO** Its real author was indeed the Calabrian physician Tommaso Cornelio, a sensist philosopher and founder of the Accademia degli Investiganti in Naples, as well as one of the main disseminators of Cartesian thought in the Italian Peninsula. The subject of the short work was a corpuscular reading of the relationship between matter and motion. Cornelio drew on the theory of circumpulsion expounded by Timaeus to link up with the doctrines of Descartes, particularly on the question of the non-existence of the vacuum and the presence of a subtle ether between the interstices of the various particles of matter.

Cornelio and the other members of the Accademia degli Investiganti were no-doubt *novatores*. And, as argued by Alberto Vanzo, the most important elements that distinguished this category of thought were its adherence to corpuscular philosophy on the one hand, and a mechanistic and proto-experimental epistemology on the other. Influenced above all by Descartes and Bacon, they were characterised by a marked praise of

“senses, experience and observations, which provide ‘the only path’ to advance our knowledge of the natural world and their view that a new, comprehensive natural history ought to provide a ‘solid foundation for natural philosophy’”.

The link with authors who represented a break with the scholastic tradition therefore appears most clearly in the neo-atomistic school, with its marked French traits, but it was also manifest in works such as Niccolò Cabeo's *Commentaria* on Aristotle's meteorology. And this probably also included well-known texts on mechanics such as Niccolò Zucchi's *Nova de machinis philosophia* (1649), also included by Rinaldini in his index and whose name already reveals a clear differentiation from previous traditions.

In attempting to extend the geographical radius of the new philosophy to England, Carlo Rinaldini's list once again offers us valuable food for thought. In fact, in many cases he did not cite the books with their true title but with his own reworking, mostly a summary of the complete wording. **CAMBIO** But on one occasion he completely changed the name of a work, referring to it as

'Thomae Obes Nova Philosophia'; he was referring to the mechanist *Tractatus de corpore*, printed in 1655. And, already in the dedicatory to his patron William Cavendish, second Earl of Devonshire, Hobbes confronted the figure of novelty, manifesting his desire to place the work in a different intellectual space, saying, I quote:

“it is also almost entirely new, yet it will not offend anyone with its novelty”.

CAMBIO This 'Nova Filosofia' preceded – in the depiction on the first page of the Academy's diary – the last author listed by Segni, the one occupying the tip of the pyramid, Galileo. Obviously, the role of the 'noble father' of the Cimento was attributed by the academicians to the Pisano, placed at the top of the pyramid with the aim of reinforcing the filiation of the Florentine circle's experience with Galileo's. Vincenzo Viviani, who had called himself the 'last of Galileo's disciples', together with Carlo Rinaldini had edited the first edition of Galileo's works, which was printed in Bologna between 1655 and 1656, just a year before the activities of the Cimento started.

CAMBIO But what exactly were the contours of this 'Galilean era' which, in the interpretation of academics, was situated at the apex of the upward trajectory of natural philosophy? As stated by J. Renn, the 'Galilean moment' went hand in hand with the diffusion of new technical-scientific knowledge, in particular from the encounter between traditional blocks of knowledge, such as engineering, and the university theoretical tradition. Evident in such a perspective are the debts of the Cimento to Galileo, starting from its motto – "Provando e riprovando" ("Trying and trying again") – which clearly referred to the experimental method in its purest Galilean sense. And explicit too are the methodological references to the *Saggiatore*, especially in that "experimenting and narrating" that would later become the official purpose of the *Saggi di naturali esperienze*, the only book produced by the Academy.

Conclusion CAMBIO

To summarize the visual analysis of the 'pyramid of knowledge', it is fundamental to emphasise the Accademia's effective awareness in representing – under the political-intellectual lead of the Prince Leopold de'

Medici – a novelty, or rather of being in some way the product of a double change, as heirs to that caesura indicated by the words 'Nova Filosofia'. This in turn preceded the crucial moment of Galilean experimentalism, the pinnacle of the pyramid of which the Cimento was to represent its ideal upward extension.

To conclude, I would like to quote James Delbourgo, who wrote that:

“Listing people was an art of self-construction through collective association: the production of a self defined by a collectivity”.

35 minuti