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How the world lost its centre. The relation of truths and facts in Middle Ages and early modernity

Rienk Vermij

Abstract: In the Middle Ages, it was commonly accepted that Jerusalem was the centre of the (inhabited) world. This was proven not just from Biblical sentences, but also from an alleged empirical fact: people claimed that in Jerusalem at noon during the summer solstice a vertical pole throws no shadow, the sun being in its zenith. This is not true and even it if were, it would not prove anything. This should have been easy to grasp for an educated medieval person; still, the claim was repeated over and over again. Only at the end of the fifteenth century, it suddenly became subject to investigation and criticism, whereupon it quickly became completely obsolete. The reasons for this shift are not completely clear, but the growing availability of information likely played a role. The episode demonstrates both the importance and the unimportance of empirical facts in the Middle Ages. Jerusalem's central position was not just the symbolic representation of a spiritual truth, it was considered empirically true as well; but this fact was not critically evaluated. The "truth" of Jerusalem's centrality dictated what "facts" were credible. The questioning of these presumed facts at the end of the fifteenth century should therefore be regarded as an important turning point in European intellectual history. After all, the realization that truths must be based on independent facts is a basic precondition of modern science.

Keywords: Jerusalem, centre of the world, facts, truth, symbols.

1. Introduction

In the Middle Ages, it was a common belief that Jerusalem was situated at the centre of the inhabited world. This idea is best known from its graphical representation in the medieval mappaemundi. By the end of the fifteenth century, however, the idea disappeared and hardly a remembrance was left. Historians have paid little attention to this sudden turnaround. Abandoning the idea of Jerusalem's central location might seem unproblematic, for it was flatly contradicted by the facts. The interesting thing however is that those very facts had been known for centuries. The question of why facts that had always been ignored suddenly became decisive *is* problematic.

Studies of medieval world maps have well documented the changing view but give only scant indications about the causes. According to Edson, "In the mid-fifteenth century, the mappaemundi was still holding its own, but in the last twenty years of the century it began to give way."[1] According to her analysis, the mappaemundi were transformed rather than abandoned. Mapmakers increasingly introduced information from non-traditional sources and rethought traditional content. Some of them experimented with new forms for the mappaemundi (most notably the Beham globus). However, most of the newly introduced information had been available for centuries. The TO maps had existed side by side with the portolan maps, with their exact delineation of coastlines.[2] Manuscripts of Ptolemy's Geography proliferated in the west since about 1300.[3]

The tension this created can be seen in a fifteenth-century world map by Fra Mauro. On the one hand, Jerusalem's location on the map is determined by the available geographical information. Its central position is thereby abandoned. On the other hand, Jerusalem's centrality is maintained in a long caption that Fra Mauro adds: "Jerusalem is in the middle of the inhabited world according to the latitude of the inhabited world, although according to the longitude it is too far west. But because the western part, Europe, is more heavily populated, it is still in the middle according to longitude, not considering the physical space of the earth but the number of its inhabitants."[4] The centrality of Jerusalem was defended despite the known facts. Indeed, the transformation of world maps seems the result a new look at old material, rather than the discovery of any new information.

The central position of Jerusalem was not only graphically depicted, it was also stated in texts and defended by both biblical and rational arguments - at least, arguments that claimed to be rational. And here again, as will be explained in some detail, these allegedly rational arguments were directly contradicted by the science and knowledge of their own time. People knew the facts, the problem was to apply them to a given question. Their failure to do so was not due to the intricacies of the specific problem at hand but had a more general background. Jerusalem lost its status as centre of the world, it would seem, not because of any new evidence, but because the existing evidence was assessed by new standards. What is at stake here, I would argue, is the very principle that our knowledge must be based on independent facts.

The question of how facts should be valued has been largely ignored in the history of science. No one doubts that the discovery, recognition, or evaluation of specific facts was often problematic, but the significance of facts as such and their role as evidence has most often been tacitly assumed to be something that must have been obvious throughout history. However, the rise of "alternative

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facts" in our present world has taught us that reliance on independent facts is far from self-evident. In many cases, facts (in practice if not in theory) have only limited relevance for people's understanding of the world. The introduction of explicit standards for assessing facts must be considered a crucial development in the history of knowledge. If we want to write the history of science for a present-day audience, we have to explain not just how specific facts were discovered, but also how scientists came to turn "facts" into important constituents of knowledge in the first place.

The abandonment of the idea of Jerusalem's centrality appears to coincide with, and be part of, this turn in western scholarship towards the recognition of the value of independent facts. The initially trivial question of Jerusalem's exact position thereby becomes part of a much wider story. In this article, I will discuss the episode to throw light on this general shift in the use of factual, empirical evidence. This will include a rather detailed investigation of the arguments by which Jerusalem's central position was defended in the Middle Ages.

2. From truth to fact

One reason that historians of science have paid little attention to the turn towards factual evidence is that it took place largely outside the sciences and well before the so-called scientific revolution of the seventeenth century. The recognition that knowledge needed to be based on empirical, objective facts was a prerequisite of the scientific revolution, not a consequence or even an element. Without it, no investigation of nature would deserve the name "scientific". The old positivist ideal that it was modern science that demolished the medieval attitude and brought about a more modern outlook is clearly untenable.

Other fields have paid more attention to the production of "fake knowledge". Medievalists have long been aware that people in the Middle Ages often created their own "facts", by inventing histories and forging documents.[5] The change of this attitude has since long been attributed to the humanists of the Renaissance, who no longer accepted such inventions and unmasked many ancient and modern documents as forgeries. The debates on the "comma Johanneum", the Gift of Constantine and the forgeries of Annius of Viterbo are probably the best-known episodes.[6] From those debates one might get the impression that the Renaissance was teeming with forgeries. No doubt it was, but it seems unlikely that they were more abundant than in earlier periods. Forgeries became a matter of debate because documents were then assessed by new and rigorous standards, irrespective of whether they agreed with accepted truth.

The rejection of Jerusalem's centrality happened at about the same time as this humanist onslaught on forged documents. This would not seem a mere coincidence, but the exact connection is far from clear. Most studies on medieval or Renaissance forgeries or their rejection have focused on historiography, law, or religion. Forgeries in the investigation of nature have hardly been studied and historians of science who do discuss them typically fail to relate them to the study of Renaissance forgeries in general.[7] As to the emergence of the scientific fact, the topic has been mostly studied in the context of the traditional "scientific revolution".[8] This appears not very helpful for the problem at hand.

An interesting attempt to answer the question how and why facts that had been so malleable in the Middle Ages became hard and solid in the modern period was made some years ago by Peter Harrison. He claimed that it was a new approach to texts that brought a new understanding of the world.[9] According to his view, the protestant Reformation did away with the allegorical reading of biblical texts and emphasized the literal interpretation. This would have led to a more factual, empirical understanding of the real world as well. This suggestion is interesting but has serious problems. Making the Reformation directly responsible for the whole shift seems a bit far far-fetched, if only for chronological reasons - the developments can be traced back to the fifteenth century at least. Moreover, Harrison's claim begs the question. Why would people suddenly accept only a literal interpretation of a text? Still, by seeking the roots of the modern understanding of the natural world in the humanities, including textual hermeneutics, rather than in the sciences, he has made an important inroad.

Rather than to the Church Reformers, it seems we should look at the aforementioned humanist scholars of the Renaissance. In early modern natural history indeed, historians have identified humanist scholarship as a main influence on the turn towards factual descriptions in the sixteenth century.[10] Humanists represented a new ideal of knowledge. They brought many ancient writings back to light that they took completely seriously. By trying to incorporate them in the existing worldview, they deliberately transcended existing boundaries. Fields that in the Middle Ages had been studied separately were now brought together, and discrepancies and contradictions that so far had not bothered anybody came to be recognized as problems that had to be resolved. To what extent this directly affected other fields and problems, such as the location of Jerusalem, needs to be investigated.

3. Medieval travellers visiting the centre of the world

References to the central location of Jerusalem can be found especially in the many travel narratives left by pilgrims to the Holy City. Many of them mention the centre of the world, and some give arguments why this fact should be true - or not. I will start with two examples, from about the same time and place, but quite different in their attitude.

At the end of the fifteenth century, the Flemish nobleman Joos van Ghistele, from a prominent family in the city of Ghent, undertook a pilgrimage to the Holy Land. Devotion to the holy places does not appear to have been his sole motivation, for he continued his voyage to among other places Persia and Tunis. After having been four years away from home, he finally returned to his native city in 1485. Shortly afterwards, a detailed narrative of his travels was compiled by a certain Ambrosius Zeebout, about whom there is no further documentation. Maybe he was a Carmelite. The book became quite popular. Zeebout's work has been preserved in three manuscripts

and a few early printed editions. A modern edition appeared in 1998.[11]

Zeebout was not a mere ghostwriter. As was common at the time, he freely used other sources to fill in gaps in the narrative or to give further explanations. He was by no means a critical historian and the sources he used included legends and stories from classical mythology. Still, in some cases he was rather critical. This is definitely the case when he describes Van Ghistele's visit to the Church of the Holy Sepulchre in Jerusalem. Many pilgrimage accounts relate that in the cleft in the rocks at Golgotha, shown to the visitors of the church, had been found the skull of Adam. Zeebout duly relates the story but gives as a comment: “but in the Historia Scholastica, on the Gospel, one can clearly see that this cannot be true.” (98) In the same church Van Ghistele was shown “a white-grey stone, square, somewhat protruding above the pavement, with a circular hole, which is said to be the midpoint of the earth (“den rechten middewaert vander weerelt”), and that at this place, the sun does not cast any shadow at midsummer at noon, confirming this by the words of David in the 77th [sic] Psalm: Operatus est salutem in medio terre.”[12]

This was indeed a well-known claim at the time. Another Flemish nobleman, Anselmus Adorno, had made a pilgrimage to the Holy Land a few years before Van Ghistele, in 1470-1471. He too, before returning to his hometown Bruges, visited many other places in the Near East besides the usual highlights. His travel narrative was edited by his son Johannes, who had studied at Padua and who had accompanied his father on his pilgrimage. The Latin text is preserved in a single manuscript from the fifteenth century. On Jerusalem it says: “This after all is the city of cities, the holier of the holy places, mistress of all peoples, the place of our salvation in the centre of the world, placed in the middle of the earth, elected and sanctified by God.” In his description of the Church of the Holy Sepulchre he mentions the same stone as Zeebout “which indicates that here is the centre of the world. For this is proven by a natural argument, by the sun that shining in that place casts no shadow.”[13]

However, the two authors react quite differently. Whereas Adorno accepts the claim as a confirmation of the exalted position of Jerusalem, Zeebout engages in a long and devastating critique:

> At a closer look, it is not possible that the city of Jerusalem or any place therein would be the midpoint of the habitable earth. This can be shown in many ways. For the true midpoint of the earth should be equidistant from the east, the west, the south, and the north, to wit, ninety degrees from each. That is not the case, for Jerusalem is much farther north than south and also farther west than east. Also, Jerusalem should be under the celestial equator and night and day should be of equal length in winter and summer, which is also not the case, as one can see by daily experience. So it cannot be the midpoint of the world, unless one takes the midpoint of the world at any place, in the way that could be done with an apple or a ball. For because it is spherical, wherever one takes a point, one may keep that for the centre, and in the same way, one might call any place on earth the centre. As for the claim that the sun at noon does not cast a shadow at Jerusalem, that is not true either, as said before. This can be shown by many arguments too long to write here, as known to those who study astronomy or cosmography. As to the words of David mentioned before, "Deus operatus est salutem in medio terre", that should be understood of the inhabited earth, it being equally close to every human.[14]

Fig. 1. *OT map* (orbis terrarum) *with Jerusalem in the centre.*

4. The mystery of the vanishing shadow

Medieval authors who wanted to demonstrate that Jerusalem was the centre of the world in the first place referred to some biblical verses, foremost Psalm 74:12, but also Ezekiel 5:5. (“Thus saith the Lord God; This is Jerusalem: I have set it in the midst of the nations and countries that are round about her.”) But, as shown in the narratives of Zeebout and Adorno, some authors were not satisfied with that and advanced a more scientific, empirical proof. This was the alleged fact that at noon during summer solstice, the sun at Jerusalem stands exactly in the zenith, so that any vertical pole or stick indeed will cast no shadow. (In the following, I will refer to this alleged phenomenon as “the vanishing shadow”.)

This argument is deeply flawed, not just according to modern geography, but according to the standard knowledge available in the Middle Ages. In the first place, the alleged fact is simply not true. There are many places on earth where the sun stands in the zenith one or two times a year (actually, this is true for any place between the tropics), but Jerusalem is not one of them. Jerusalem is north of the tropic of Cancer and consequently the sun will never reach the zenith. To people in Scotland or to incidental visitors this fact may not have been immediately obvious, but any local must have been aware of the discrepancy.

More damning still, even if the fact were true, it would prove nothing about Jerusalem's central location, as Zeebout perceived quite well. This should not have been hard to understand for any educated medieval person, certainly not for someone like Johannes Adorno with his Paduan background. After all, spherics was one of the elementary parts of the medieval propaedeutic curriculum. Nor was this knowledge only accessible to people with a basic university training. By the end of the fifteenth cen-

tury, many texts had become available for laymen explaining the basics of geography, astronomy, and astrology.

The episode reveals us a good deal about the use of facts and natural arguments in this period. The central location of Jerusalem, and the "natural" argument used to prove it, are clear examples of invented facts, facts that were not established independently but were deemed real because they demonstrated or supported a preconceived truth. It is not that in the Middle Ages people did not refer to empirical facts; of course they did. Truths were defended with an appeal to facts. However, the way such facts were identified, and the role they played in the establishment of truth, deviated from modern standards (though not always from modern practice).

The question that spontaneously arises is of course why an educated person such as Johannes Adorno would believe this apparent nonsense. From his words, it seems evident that the centrality of Jerusalem was an important truth for him. Obviously, he had this "truth" determine his facts, not the other way round, as modern standards of assessing evidence would require. The second, more interesting question is why Zeebout did reject both the centrality of Jerusalem and the fact of the vanishing shadow, a stance which clearly was not self-evident in his time, and which puts him on the threshold of the modern understanding of factual evidence.

5. The position of Jerusalem

As the case of Adorno indicates, if people accepted the evidence that Jerusalem was at the centre of the world, they did so because the position of Jerusalem was important to them. So, before looking at the evidence by which Jerusalem's centrality was upheld, let us have a look at the claim itself.[15] The idea that Jerusalem was the center (or navel, "omphalos") of the world is of respectable antiquity. It can be traced to ancient Jewish traditions. These traditions attribute the central place more in particular to the temple, where the "foundation stone" was believed to mark the midpoint of the earth. Such "omphalos stones" are known from many cultures. It seems likely that the early Christians borrowed the idea from the Jews. The Church father Jerome, who called Jerusalem "umbilicum terrae", is often mentioned as the person who christianized the idea, but the transmission is not fully clear.[16] In any case, rather than in the temple, the Christians put the centre of the world in Mount Golgotha.

Anyway, to the Christians of the first centuries, the idea appears not to have been very important. Historians agree that it is only with the Crusades that Jerusalem came to play an important role in the Christian imagination, initially above all as a powerful image of the heavenly city.[17] But once Jerusalem came to be seen as the world's spiritual centre, this easily led to the idea that it was its physical centre as well. It would be interesting to know whether such a shift is indeed reflected in the biblical commentaries of the period, in their explanations of Psalm 74:12 and Ezekiel 5:5, but this has not been studied. Still, it is hardly a coincidence that the tendency of medieval mappaemundi to depict Jerusalem at the center begins in this very period.[18]

In the wake of the Crusades, the pilgrimages to the Holy Land became a large-scale industry and thereby very much standardized. Local guides showed the pilgrims the various sites in the city, repeating the same stories over and over again. The centre of the earth became firmly fixed in the Church of the Holy Sepulchre, which was consecrated in 1149 and where the centre was marked by the stone described by Zeebout. (The present omphalos stone is a different one.)

It has been shown by Brefeld that most written reports left by pilgrims of their voyage are based on a standard narrative, a kind of travel guide that must have existed in written form but that has been lost. It appears to have been very succinct, an aide-mémoire rather than a real narrative. The "centre of the world" is mentioned in sixteen out of eighteen narratives on which Brefeld's analysis is based. Most texts simply report that "here is the center of the world, as is said by some," without any reference to a biblical or natural argument.[19] (The addition "as is said" merely seems to indicate the lack of an authoritative written source, not any doubt about the claim's truth.)

Even though the position of Jerusalem was important to many people, we should keep in mind that it was not a matter of Church doctrine, nor the subject of devotion. The central location certainly underlined the importance of the biblical places, but in itself probably was not a matter that most pilgrims spent much thought on. They went to the Holy Land to worship at the places where Christ had performed His work of redemption, not to be instructed about geography. Indeed, many travel narratives and descriptions of Jerusalem never mention the centre of the earth, and those that do, do so generally rather as an illustration or a confirmation of the biblical verse, not because it would have any special significance in and of itself. The issue was of interest either to people who wanted to underline the special place of Jerusalem (as seems to be the case for Adorno), or for educated persons who apart from personal devotion also had some interest in the world in general. Belief in the centrality of Jerusalem was not an element of popular or religious culture, but of the worldview of the intellectual elite.

And then, at the end of the Middle Ages, this worldview apparently collapsed. The idea of Jerusalem as the centre of the world disappeared to the point that it was not even worth refuting any more. When by the middle of the sixteenth century astronomers in defense of the motion of the earth started to collect examples of theologians mistakenly deducing cosmographical information from the Bible, they would bring up the flat earth or the antipodes, but none of them would recall the use of Psalm 74:12 or Ezekiel 5:5 to prove the centrality of Jerusalem. Apparently, by that time the argument had long been forgotten.

(Remarkably, however, in the seventeenth century the claim that Jerusalem was the centre of the world would turn up again in the writings of some Franciscan theologians. Vincenzo Berdini in 1642 even attempted to demonstrate this in a rational, scientific way, although without referring to the vanishing shadow.[20] This episode should be studied in the context of the confessionalization of science during the counter-Reformation, which is beyond the scope of the present article.[21])

So, how did that happen? Did people develop a new idea of the world because of new empirical facts, or did the empirical facts gain a new significance because of a changing view of the world?

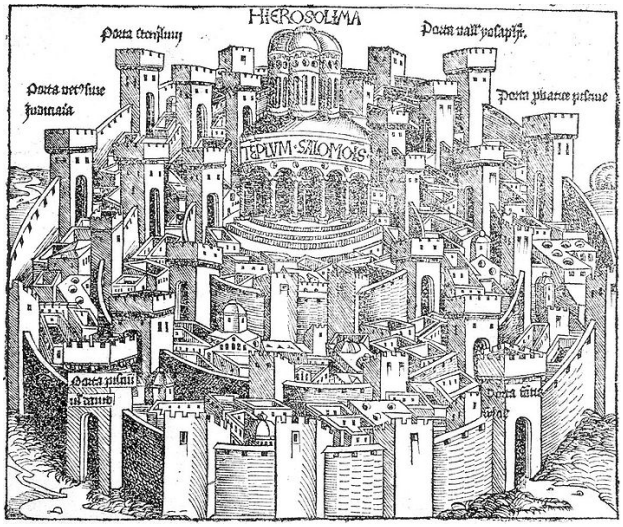

Fig. 2. *A picture of Jerusalem from Hartmann Schedel's* Liber Chronicarum (1493).

6. The vanishing shadow throughout the Middle Ages

Certainly not everybody referred to a "natural" argument when asserting the central position of Jerusalem.[22] As we will see, the argument of the vanishing shadow becomes prominent especially in the fifteenth century. One might speculate that exactly at a time when the centrality of Jerusalem became harder to maintain, it became important to adduce supporting evidence, whereas earlier, people had simply accepted it without questioning. Still, in western Christianity, the argument of the vanishing shadow can be traced as far back as the seventh century. Adamnon, abbot of the Scottish monastery of Iona, around 685 wrote a narrative of the voyage of a certain Arculf to the Holy Land. He tells about a very high column in the centre of Jerusalem that "fails to cast a shadow at midday during the Summer solstice, when the sun reaches the centre of the heavens. (...) And so this column, which the sunlight surrounds on all sides blazing directly down on it during the midday hours (...) proves Jerusalem to be situated at the centre of the world." This is followed by a reference to Psalm 74. The story of the column may go back to ancient Jewish legends.[23]

For a long time, Adamnon's narrative remains a rather isolated case. Even though by the twelfth century, during the Crusades, Jerusalem's central place becomes more commonly accepted in the West, very few writers initially see the need to defend it by referring to a rational argument. (Numbers say little, however, given the fact that many authors, as explained above, appear to follow a single source.) The exception is the twelfth-century Icelandic cleric Nikulás of Thverá, who mentions it in his pilgrimage account in a very succinct form: "The centre of the earth is there, where the sun shines directly down from the sky on the feast of John."[24] Saint John's Day, 24 June, is traditionally the day that midsummer is celebrated. In Iceland, it is known as Jónsmessa and is an important feastday.

Interestingly, when the vanishing shadow turns up in the twelfth century, it is initially NOT used with respect to Jerusalem, although still with respect to the Holy Land. It would appear that the argument had existed as an independent, not strictly local tradition before the "tour guides" in the city seized upon it and monopolized it for the omphalos in the Church of the Holy Sepulchre. In the well-known *Otia imperialia* of Gervase of Tilbury, there is the following passage on the center of the world: "Some feel that the centre of the circumference is in the place where the Lord spoke with the Samaritan woman at the well [cf. Gospel of John, chapter 4]. For during summer solstice at noon the sun passing overhead shines down on the water in the well without casting any shadow, as the philosophers tell happened [fieri] at Syene..."[25] Given that the *Otia* are a work of compilation, the argument must have existed earlier. Interestingly enough, at another place in the same work Gervase does appear to argue for the central position of Jerusalem, but without reference to the vanishing shadow.[26]

The claim that the centre of the world is at the well where Christ spoke with the Samaritan woman is also made in the widely read *Historia scholastica* of the twelfth-century theologian Petrus Comestor (the same book that Zeebout used to refute the claim concerning Adam's skull): "Some say that that place is the navel of our habitable world, because every year on a certain day in the summer at noon the sun shines down on the water of the well without casting any shadow, as the philosophers say that happens at Syene."[27] The ancient Greek mathematician Eratosthenes had estimated the circumference of the earth by measuring the shadow at Alexandria at noon during the summer solstice, at the moment that at Syene (Assuan) the sun stood in the zenith, as shown by its shining down into a deep well. It is interesting that although Petrus and Gervase are aware that the phenomenon can be observed at other places on earth, this does not appear to raise any doubt with them as to the value of the argument.

Somewhat more dubious is an anonymous twelfth century author who claims that a certain mountain called "*Amor Reorum*" [Love of the guilty] is the centre of the earth. This author states that he has established this by a measurement of which he gives a detailed explanation. He had a circular log, twelve cubits long and one in diameter, suspended vertically in the air by means of a rope, and he had moved this installation around until he had found the place where at noon on the seventh of the Kalender of July the shadow of the log was right beneath and of the same circular shape; "and from this very measurement, I learned that the centre of the earth was at Mount Amor Reorum." For greater veracity, the author adds: "This I measured in the year 39. I had not drunk any wine, my eyes were not satiated with sleep (...)."[28] The whole story is definitely too good to be true. It nearly looks like a romance, but it is found in the context of a collection of scientific and scholarly texts. In any case, it does show the importance that apparently was attributed to the argument.

The vanishing shadow becomes firmly connected to the city of Jerusalem only in the well-known Book of

John Mandeville, which must originate from the second half of the fourteenth century. Higgins has noted that this book lays particular emphasis (at least in its most widely divulged versions) on the central place of Jerusalem. Apparently, the author wanted to prove this point by every possible argument. As the book explains, the centrality of Jerusalem "is shown by a spear fixed in the earth at the hour of noon, which casts no shadow in any direction."[29] Apparently, the author did not deem it worthwhile to mention a specific date. In the medieval Dutch version of the book, this omission is made good in a somewhat unexpected way: a spear put erect is supposed to cast no shadow at noon not during solstice, but during the equinox (which would imply that Jerusalem is on the equator).[30]

The Book of John Mandeville was very popular and no doubt helped to make the argument of the vanishing shadow widely known. Interestingly, another (less popular) version of the book of Mandeville, composed between 1396 and 1415 and dubbed by Higgins the Vulgate Latin, does deny that Jerusalem is the centre of the world. The arguments are basically common sense: Jerusalem would have to be on the equator, there would always be equinox, whereas in reality in Judea the polar star can be seen high above the horizon. Moreover, Judea would have to be at the antipodes of the earthly paradise in the east, whereas to this author it seems more probable that it is actually at the midpoint between paradise and its antipode. However, the author does not refer to the vanishing shadow, neither to refute the argument nor in another way. Most of his arguments were pretty sound and commonsensical, but they do not appear to have had much impact for the time being.

By the fifteenth century, the vanishing shadow is not only described in travel narratives, but also in didactic works. An example is an anonymous Dutch text from (probably) 1464, "A short description of this sphere". It appears to have been written for the instruction of clerics and offers the kind of basic knowledge about the world that an educated person should have. It includes such topics as cosmology, chronology, geography, angels, and the human body. Jerusalem is called the centre of the world, again with reference to Psalm 74, but also with appeal to the natural argument: "One also reads that if one places a lance upright at the place where the cross of Our Lord stood on mount Calvary, exactly at noon on the day of St Vitus martyr [15 June] (...) and on the day of St Lucia [13 December] (...), it will not throw a shadow to any side. For at that moment, the sun is right above the lance, and at those times the days are shortest and longest."[31] It is somewhat remarkable that this version of the argument turns up in a text with scholarly pretentions. The alleged fact, that in Jerusalem the sun is in the zenith at *both* the two solstices is not just untrue, but geometrically impossible, as anyone with even a basic understanding of spherics would have known.

7. The vanishing shadow in the last decades of the fifteenth century

As explained before, the idea of Jerusalem as centre of the world appears to have fallen apart in the last decades of the fifteenth century. Interestingly, it is at this very time that the argument of the vanishing shadow is most debated. In the fifteenth century, people would have more access to books and knowledge about the world increased. Some pilgrims to Jerusalem, like Van Ghistele and Adorno, were not just interested in worshipping at the Holy Places but appear to have been driven by genuine curiosity about the world. Their pilgrimages went far beyond the traditional Holy Places. To such people, the question of whether or not Jerusalem was at the centre of the world was of inherent interest. The argument of the vanishing shadow appears to become more prominent, but at the same time it became a topic of investigation.

At nearly the same time that Van Ghistele travelled in the Near East, there were other visitors who commented on the centre of the world. The Baseler dominican Felix Fabri and the German nobleman Bernard von Breydenbach, a lawyer and canon from Mainz, travelled to the Holy Land in 1483-1484 in the same group of pilgrims.[32] They were joined there by the Franciscan Paul Walther von Guglingen, who had arrived a year earlier. All three of them wrote a travel narrative; Guglingen even combined this with a full treatise on the Holy Land. Breidenbach's narrative was soon thereafter published, whereas Fabri's report appears to have been destined for circulation among his convent brothers only. A shortened German version was printed in 1556, but the main work was not published until the nineteenth century. The same is true for Guglingen's itinerary, whereas the accompanying treatise remains largely unpublished to this day.[33]

Interestingly, their descriptions of the centre of the world are completely different. Breidenbach includes only a short description of the omphalos stone adding: "where it is said that the centre of the habitable earth is."[34] The formulation "where it is said" is rather standard and probably copied from the "travel guide" reconstructed by Brefeld.

Guglingen too makes only the barest mention of "the place of the middle of the world" in his itinerary, in a list of things that can be seen in the Church of the Holy Sepulchre.[35] However, in the treatise on the Holy Land that he wrote at the same time, the centrality of the Holy Land and of Jerusalem are a main point. Most of his ideas are of a theological nature, following the metaphysical and cosmological ideas of Bonaventura, but there is also a reference to the vanishing shadow: "And I have heard from persons worthy of belief, and found in writing, that the midpoint or centre on the earth's surface of the whole world is in the middle of the choir of the Church of the Holy Sepulchre. (...) And this place is nowadays marked in the Church of the Holy Sepulchre. And I have myself often been in that place. That Jerusalem is in the centre of the earth is also proven by sun and moon, for in the month of June the sun stands directly above us in Jerusalem, so that a man casts no shadow. The moon has the same position in December, and this is shown by experience."[36] The point made about the moon seems unique. I do not know it from any other source. Again, the fact is not correct and would not prove anything anyway.

In Fabri's narrative, the natural argument is especially prominent. His narrative makes clear that the story was by now rather standard and elicited serious interest from at least some pilgrims. In describing the omphalos stone in

the Church of the Holy Sepulchre, Fabri explains that according to ancient histories, before the church was built philosophers had erected a large column in that place that did not throw a shadow at noon during the spring equinox [sic], as at that moment the sun was standing right above. Interestingly, some people in Felix' company wanted to see this with their own eyes. One of them, a knight, got permission to climb to the dome of the church. There, a place had been made where someone could stand exactly above the omphalos, for the express purpose, as Fabri explains, that people could have the experience of the vanishing shadow. The fact that such a place had been made is reminiscent of the modern tourism industry, but from an astronomical point of view it makes little sense. Even many miles away, there would be no noticeable difference in one's shadow, so it is hard to see why one should stand so exactly at the place of the omphalos. The exact date was clearly of much less concern, for at the time of Fabri's visit it was already July and more than a month past solstice. This apparently bothered nobody.

As Fabri relates, “The knight climbed there at noon to see whether his body would cast a shadow. And he told us for certain that he had not seen any shadow of his body.” Of course, the sun's distance from the zenith at Jerusalem around solstice is not very large, less than ten degrees, and a human body is not a very accurate measuring device, so for a pious pilgrim it was probably easy to see what he believed he should see.

Fabri did not doubt the observation of his companion, but was skeptical whether this actually proved anything about the central position of Jerusalem: "That it would be a sure and true sign that a place is at the centre of the earth if the sun at noon shines so directly above the head of the bodies that the body does not throw a shadow, I do not see. For I have read in various books about several places where bodies at a given time do not throw a shadow.” He gave examples from the works of Dionysius ab Halicarnassos, Petrus ab Abbano (*Conciliator*) and the maps of Ptolemy. “And it is known that those regions are not in the midst of the earth. Many believe that a certain island is in the centre of the world, where however the sun throws a shadow every noon.” He also noted the argument that since the earth was a sphere, any place could be seen as the centre: among the antipodes too, someone would stand under the highest point of the heaven and on the midpoint of the earth. However, Fabri pointed out that Augustine had refuted the existence of antipodes, and reason also seemed to reject it.

However, unlike Zeebout, Fabri does not call the central position of Jerusalem into doubt. His conviction is exclusively based on his reading of the various biblical verses: “This way or that, Sacred Scripture that states that Jerusalem is in the middle of the earth and that our Redeemer worked salvation in the centre of the earth, must be believed.” Zeebout's solution, that these texts could be interpreted in a different way, did apparently not occur to him.[37]

As stated, after Zeebout and Fabri, both the idea of Jerusalem's centrality and the argument of the vanishing shadow appear to vanish. Their criticism therefore happened at a rare moment in time: the idea of Jerusalem's centrality was already losing credibility but was still prevalent enough to be seriously considered.

8. Conclusion I: Facts in the Middle Ages (with a note on methodology)

The discussion about the location of Jerusalem demonstrates that medieval authors definitely cared about facts. It is sometimes suggested that facts were only of secondary importance to them. So, Pamela Gravestock concludes about the question of whether medieval scholars actually believed in the fabulous creatures they described: “Perhaps the most useful way to approach the problem of imaginary animals is to hypothesize that medievals knew quite well that these animals did not exist and to view the questions as to whether or not they actually existed as irrelevant. That is, what was important was that imaginary creatures served a didactic purpose. (...) Perhaps, then, the imaginary animals in the bestiaries were used to fill certain ‘spiritual gaps’ for which the real animals were not as readily adaptable.”[38] It has also been claimed that medieval persons were not really interested in the question whether the relics of the saints they venerated were genuine or not. “The most effective means available from the ninth through eleventh centuries to determine the authenticity of relics was in reality a very pragmatic one: if the relics performed as relics - that is to say, if they worked miracles, inspired the faithful, and increased the prestige of the community in which they were placed - they had to be genuine.”[39] In a similar vein, Alexander has claimed that the maps which placed Jerusalem in the centre belonged to a tradition “of Christian symbolic and mythical geography for which the real world was of little moment. ...for most Christian writers Jerusalem was a spiritual entity which the Christian could experience anywhere.”[40]

At a certain level, these statements are no doubt true. It can hardly be doubted that many things were considered in a purely allegorical or symbolic sense, without necessarily implying that such descriptions referred to anything in the physical world. But it would be wrong to claim that medieval scholars considered the truth in a purely pragmatic or instrumentalist way. As the case of Jerusalem shows us, they wanted to back up their truth claims with solid and observable evidence. We are not talking of an allegorical understanding of the world that is separate from a more practical and realistic approach to reality. The empirical world was founded on moral and religious principles. Factual truths were important because they had a deeper meaning.

However, that certainly did not mean that scholars were interested in a critical evaluation of the alleged facts, detached from their meaning. As is clear from the above examples, the carelessness and inaccuracy of their descriptions is often quite shocking. Equinox and solstice, or summer- and winter solstice, are occasionally confused or put on equal footings. Before the end of the fifteenth century nobody seems to have taken issue with that.

How important these facts were to them is often hard to tell. Ordinary pilgrims in the Middle Ages no doubt had little interest in geographical problems. As stated, the people who were interested in these aspects were those who had some education and were curious about the world and its overall structure. This did not necessarily mean that they were much interested in the way this knowledge was achieved or could be demonstrated, or whether it agreed with other information.

If this case offers any guidance, it seems safe to say that medieval authors were ready to accept as "fact" anything that supported their preconceived worldview. Their use of facts is thereby highly ambiguous. On the one hand, they recognize that facts offer solid and empirical evidence for the claims they make, and that is exactly the reason why they refer to these facts. On the other hand, the things that the facts have to prove are a priori given. Whereas a critical scientific approach would require that the truth was dependent upon the facts, medieval authors, even learned and curious ones, had their facts determined by what they considered the truth.

Methodologically, the above should encourage us to take past authors at their word and not reject or reinterpret their statements simply because they seem absurd or contradictory. Developments in the modern world after all have reminded us that humans have an amazing capability to believe even the most bizarre and outlandish claims. It takes many years of special training to master the art of constructive criticism.

9. Conclusion II: The vanishing centre

It seems safe to say that Jerusalem did not lose its central position because of any new information or insights. The counterarguments had been known for centuries, only, people did not necessarily put any weight to them. Gervase of Tilbury and Petrus Comestor knew that there are other places on earth where the sun at a certain moment is standing at its zenith, but they do not appear to draw any conclusion from that. The argument of the vanishing shadow was as untenable in the seventh or eleventh century as it would be in the sixteenth. Its refutation was largely a matter of common sense. Fabri clearly realised the untenability, even though he still held firmly to the idea of Jerusalem's centrality.

The motives that caused people to assess the arguments for and against Jerusalem's centrality in this way or that have left hardly any trace in the sources. The location of Jerusalem is not the subject of learned debate. Its centrality is questioned by a few authors, but in most cases, the issue is simply dropped, not refuted or answered. Still, if we follow the argument over the years, it appears that there is a significant shift by the end of the fifteenth century. At this time, there was clearly an urge to reconsider the various arguments, even if that not always resulted in a rejection of the traditional view. The natural arguments get more emphasis vis-à-vis the biblical ones. In summarizing the traditional view, Zeebout mentions first the natural argument and then says that the fact is "approved" by the text from Psalms. Johannes Adorno writes that the centrality of Jerusalem is "proven by a natural argument", without mentioning any biblical sentences. And Fabri puts forward the objections against the centrality of Jerusalem at great length before deciding that they are outweighed by the testimony of the Bible. It would seem that to these people the central location of Jerusalem was no longer simply a matter of pious acceptance, but something that demanded proof. Apparently, the importance of independent evidence was recognized even before it overturned the traditional ideas.

Change in religious outlook did not seem to play a role. Jerusalem remained of central importance to the authors we discussed, even to those who no longer saw it as geographically central. Of course, since most of our testimony comes from pilgrims, one could hardly expect otherwise. To what extent the views on Jerusalem coincided with a specific interpretation of the respective biblical sentences should be the subject of a separate investigation. It is worth noting however that in the whole debate, the centrality of Jerusalem is supported by a literal interpretation of the respective biblical texts. Harrison's thesis of a transition from an allegorical to a literal understanding does not appear very helpful to explain the rejection of such a notion.

The suggestion that the change in outlook was mostly due to humanist scholarship does not find much support in our results either. Zeebout was certainly not a critical historian. The recognition that Jerusalem cannot be the centre appears very well to maintain along with ideas on the earthly paradise or other legendary stuff. The rejection of the vanishing shadow was not the result of philological acumen.

The information people had access to was not new, but the available facts were combined in new ways. There appears to have been an active desire to incorporate all knowledge, either old or new, into one's picture of the world. Instead of remaining satisfied with the familiar lore, some people became curious about what was beyond their horizon. In the study of particular questions, they included knowledge that had traditionally not been referred to in this context. The availability of information thereby certainly played a role. In criticizing the centrality of Jerusalem, Fabri referred to his readings, among them the Ptolemaic maps, which before the age of printing would be out of most educated people's reach.[41] Still, it is worth noting that this information did not change his basic view that Jerusalem was the centre of the earth, nor did he doubt the fact of the vanishing shadow (although he did refute its significance). The problem is in how people used the available knowledge, not the availability itself.

The safest conclusion is probably to recognize that even though most of the information itself was not new, its accumulation was. For the learned elite at least, the invention of printing made maps and alternative views of the world more easily accessible. Information now could more easily be retrieved and compared. Moreover, the introduction of printing was only one aspect of a much wider "communications revolution", including postal services and better means of transport.[42] The voyages of discovery too widened people's horizons. Such developments did not automatically change people's minds on important questions, but they did introduce the need to come to terms with a variety of viewpoints.

People can reach agreement on "facts" only if they share a common truth. If documents, or any form of evidence, only need to confirm what everybody already knows, there is no need critically to analyze them. In the Middle Ages, relics, charters, and chronicles typically existed in a small, well-delineated world where there was consensus upon the basic truths. By the end of the fifteenth century, people became aware of a wider world and were much more likely to encounter unfamiliar ideas.

In some cases, this elicited curiosity and the desire to know more about the world. Soon, the falling apart of Christendom into warring factions, each with its own truth, would put many established certainties into dispute. Though this development may not have originated the new outlook, it seems plausible that it reinforced it and helped it survive. Only when truth is called into doubt and needs to be defended in front of a panel of independent, external judges, that is, without a priori certainties, does it become worthwhile to critically assess the relevant facts and make the truth dependent upon them.

Notes

[1] Evelyn Edson, *The world map, 1300-1492. The persistence of tradition and transformation* (Baltimore 2007) 204.

[2] Edson, *World map*, 205-235.

[3] J. Lennart Berggren and Alexander Jones, *Ptolemy's Geography. An annotated translation of the theoretical chapters* (Princeton and Oxford 2000) 43. Józef Babicz, 'De heropstanding van Ptolemaeus,' in: Marcel Watelet ed., *Gerardus Mercator Rupelmundanus* (Mercatorfonds Paribas 1994) 51-69, esp. 56-60. (This book also exists in a French version.)

[4] Edson, W*orld map,* 145; see also 231.

[5] The literature on medieval forgeries is vast and expanding. I will just refer to Detlev Jasper ed., *Fälschungen im Mittelalter* (5 vol, Hannover 1988-1990) (Schriften der Monumenta Germaniae Historica, 33), the result of an international conference at Munich in 1986; Alfred Hiatt, *The making of medieval forgeries. Fake documents in fifteenth-century England* (Toronto 2004).

[6] Here too, the literature is vast. See a.o. Walter Stevens, 'Discovering the past: the Renaissance arch-forger and his legacy', in: Earle Havens ed., *Fakes, lies, and forgeries* (Sheridan Libraries, John Hopkins University 2016) 67-84 (on Annius of Viterbo). Martin Rothstein, 'The reception of Annius of Viterbo's forgeries. The Antiquities in Renaissance France', in: *Renaissance Quarterly* 71 (2018) 580-609. Wolfram Setz, *Lorenzo Valla's Schrift gegen die konstantinische Schenkung: De falso credita et ementita Constantini donatione. Zur interpretation und Wirkungsgeschichte* (Tübingen 1975). Grantley McDonald, 'The Johannine comma from Erasmus to Westminster', in: Dirk van Miert, Henk Nellen, Piet Steenbakkers, and Jetze Touber ed., *Scriptural authority and biblical criticism in the Dutch Golden Age. God's word questioned* (Oxford 2017) 61-72.

[7] Fake natural knowledge has mostly been studied in the case of imaginary animals. See for instance Willem Gerritsen, *Het spoor van de eenhoorn. De geschiedenis van een dier dat niet bestaat* (Leiden 2011). On fake actual specimens see Myriam Marrache-Gourand, 'Merveilles de nature et contrefaçons dans les cabinets de curiosités', in: Pascale Mounier and Colette Nativel ed., *Copier et contrefaire à la Renaissance. Faux et usage de faux* (Paris 2014). The study of alchemy offers another venue; see Tara Nummedal, 'The problem of fraud in early modern alchemy', in: Marc Crane, Richard Raiswell and Margaret Reeves ed., *Shell games. Studies in scams, frauds, and deceits (1300-1650)* 37-58.

[8] Barbara J. Shapiro, *A culture of fact. England 1550-1720* (Ithaca (NY) 2000). David Wootton, *The invention of science. A new history of the scientific revolution* (London 2015) 251-309.

[9] Peter Harrison, *The Bible, protestantism, and the rise of natural science* (Cambridge 1998).

[10] Wolfgang Harms, 'Bedeutung als Teil der Sache in zoologischen Standardwerken der frühen Neuzeit (Konrad Gessner, Ulisse Aldrovandi)', in: Hartmut Boockman, Bernd Moeller, Karl Stackmann ed., *Lebenslehren und Weltentwurfen im Übergang vom Mittelalter zur Neuzeit. Politik-Bildung-Naturkunde-Theologie* (Göttingen 1989) 352-369; Brian Ogilvie, *The science of describing. Natural history in Renaissance Europe* (Chicago 2006) esp. 87-138. Incidentally, the influence of humanist scholarship on some proponents of seventeenth-century science has been discussed, e.g. Paul R. Muller, 'Textual criticism in early modern natural philosophy: the case of Marin Mersenne', in: Kevin Killean and Peter J. Forshaw ed., *The Word and the world. Biblical exegesis and early modern science* (New York 2007) 78-90.

[11] Ambrosius Zeebout, *Tvoyage van Mher Joos van Ghistele* (R.J.G.A.A. Gaspar ed.) (Hilversum: Verloren 1998).

[12] Zeebout, *Tvoyage*, 98. My translation. The reference is to Psalm 74: 12, in the King James version: [God] "working salvation in the midst of the earth." In the vulgate version, this is Psalm 73. (All three manuscripts give the Psalm as 77.)

[13] Jacques Heers & Georgette de Groër ed., *Itinéraire d'Anselme Adorno en Terre Sainte (1470-1471)*. Paris (éditions CNRS) 1978. (Sources d'histoire médiévale publiées par l'Institut de Recherche et d'Histoire des Textes) 254, 268. My translation.

[14] Zeebout, *Tvoyage*, 98-99. My translation. The passage has earlier been discussed by Hans van Dijk, 'Reizigers naar het Heilige Land en het middelpunt van de wereld', in: W.P. Gerritsen, Annelies van Gijsen en Orlanda S.H. Lie ed., *Een school spierinkjes. Kleine opstellen over Middelnederlandse artes-literatuur* (Hilversum: Verloren 1991) 49-52.

[15] For earlier discussions on the idea of Jerusalem as centre of the earth, see Dorothea R. French, 'Journeys to the center of the earth: medieval and Renaissance pilgrimages to Mount Calvary', in: Barbara N. Sargent-Baur ed., *Journeys toward God. Pilgrimage and Crusade* (Kalamazoo, MI 1992) 45-81; Iain Macleod Higgins, 'Defining the earth's center in a medieval "multi-text". Jerusalem in the Book of John Mandeville', in: Sylvia Tomasch and Sealy Gilles ed., *Text and territory. Geographical imagination in the European Middle Ages* (Philadelphia1998) 29-53. John Kirtland Wright, *The geographical lore of the time of the Crusades. A study in the history of medieval science and tradition in Western Europe* (New York: American Geographical Society 1925) 259-261. More generally on the perception of Jerusalem: Folker Reichert, 'Nabel der Welt, Zentrum Europas und doch nur Peripherie? Jerusalem in Weltbild und Wahrnehmung des späten Mittelalters', in: *Zeitschrift für Historische Forschung* 38 (2011) 559-584.

[16] Jewish beliefs that Jerusalem is the centre of the earth are discussed by Michael Tilly, *Jerusalem - Nabel der Welt. Überlieferung und Funktionen von Heiligtumstraditionen im antiken Judentum* (Stuttgart 2002). See also Philip S. Alexander, 'Jerusalem as the omphalos of the world: on the history of a geographical concept', in: *Judaism* 46 (1997) 147-158. For Jerome, see Susan Weingarten, *The saint's saints. Hagiography and geography in Jerome* (Leiden and Boston: Brill 2005), 198; Mette B. Bruun, *Parables. Bernard of Clairvaux 's mapping of spiritual topography* (Leiden and Boston 2007) 27.

[17] Cf. the spiritual topography of Bernard of Clairvaux. Bruun, *Parables*, 28-30, 66-70, 103-105.

[18] David Woodward, 'Medieval mappaemundi', in: J.B. Harley and David Woodward ed., *The history of cartography*, I *Cartography in prehistoric, ancient, and medieval Europe and the Mediterranean* (Chicago and London 1987) 286-371; see p. 340-342. Ingrid Baumgärtner, 'Mapping narratives: Jerusalem in medieval mapped spaces', in: eadem, *Mapping narrations - narrating maps. Concepts of the world in the Middle Ages and the early modern period* (Berlin and Boston 2022) 189-219, see p. 195. French, 'Journeys', 60-65, argues that the rise of sacred cartography directly influenced the idea of Jerusalem as a physical, not just symbolic centre.

[19] Josephien Brefeld, *A guidebook for the Jerusalem pilgrimage in the late Middle Ages. A case for computer-aided textual criticism* (Hilversum 1994) 52, 53, 140, 194-195.

[20] Marianne P. Ritsema van Eck, *The Holy Land in observant Franciscan texts (c. 1480-1650). Theology, travel, and territoriality* (Leiden and Boston 2019) 66-71.

[21] On confessionalization, see among others Andreas Blank, 'Confessionalization and natural philosophy', in: David M. Miller and Dana Jalobeanu ed., *Cambridge History of Philosophy of the Scientific Revolution* (Cambridge 2022) 111-27.

[22] Several of the following references were suggested by Reichert, 'Nabel der Welt', 560. See also French, 'Journeys', 55.

[23] Denis Meehan ed., *Adamnan's De locis sanctis* (Dublin: Dublin Institute for Advanced Studies 1958) 56 (Latin), 57 (translation). For the possible Jewish origin cf. French, 'Journeys', 52, referring to Eliade.

[24] Quoted in John Wilkinson a.o. ed., *Jerusalem pilgrimage 1099-1185* (London: The Hakluyt Society 1988) 217. For the original text, see Rudolf Simek, *Altnordische Kosmographie, Studien und Quellen zu Weltbild and Weltbeschreibung in Norwegen und Island vom 12. bis zum 14. Jahrhundert* (Berlin and New York 1990) 483; on Nikulás, see 265. A number of other sources translated by Wilkinson also refer to Jerusalem as centre of the earth, (87, 90, 92, 103, 128, 198, 212, 233, 260), but without mentioning the vanishing shadow.

[25] Wright, *Geographical lore,* 260, with the Latin text quoted in note 24 on page 461.

[26] Wright, *Geographical lore*, 259-260, and note 19 on p. 461.

[27] Petrus Comestor, Historia scholastica, in: J.P. Migne ed., *Patrologia cursus completus, series Latina*, CXCVIII, *Adami Scoti opera omnia* [etc.] (Paris 1855) column 1567. My translation.

[28] Wright, *Geographical lore*, 260, with the Latin text quoted in note 23 on p. 461. A few sentences are hard to understand, but the overall message is clear. Solstice of course falls nearly two weeks before 7 Kal. Julii (June 27) in the Julian calendar. The manuscript is described in G.F. Warner and J.P. Gilson, *Catalogue of Western manuscripts in the old*

Royal and King's collections, I (London: British Museum 1921) 192-193, MS 7 D xxv. The story of the experiment appears to be part of a collection of notes and tracts on chronology, meteorology, etc.

[29] Iain Macleod Higgins, 'Defining the earth's center in a medieval 'multi-text". Jerusalem in the Book of John Mandeville', in: Sylvia Tomasch and Sealy Gilles, *Text and territory. Geographical imagination in the European Middle Ages* (Philadelphia1998) 29-53. See esp. 44-45; quote on p. 44.

[30] N.A. Cramer ed., *De reis van Jan van Mandeville, naar de middelnederlandsche handschriften en incunabelen* (Leiden: Brill 1908) 157. See also Van Dijk, 'Reizigers'.

[31] *Eyn corte decleringhe deser spere, uitgegeven door een werkgroep van Utrechtse neerlandici* (Utrecht: Instituut de Vooys 1983) I, 68. (My translation.) The date (in the Julian calendar) given for the winter solstice is more or less correct for the fifteenth century, but the date for the summer solstice is several days off. Quite likely, the author simply took the nearest major feastday.

[32] On the relation between Fabri and Breydenbach, see Elizabeth Ross, *Picturing experience in the early printed book. Breydenbach's Peregrinatio from Venice to Jerusalem* (University Park (Pen) 2014) 10-11.

[33] On Guglingen, see Ritsema van Eck, *Holy Land*, 19-22, and 36-51 for a summary of his treatise.

[34] Bernhard von Breydenbach, *Sanctarum peregrinationum in montem Syon ad venerandum Christi sepulcrum in Jerusalem* (Mainz 1486). No page numbers. The passage on the centre of the world is the third paragraph of the chapter "De egressu ex templo dominici..." My translation.

[35] Paulus Walther von Guglingen, *Itinerarium in Terram Sanctam et ad Sanctam Catharinam*, M. Sollweck ed. (Tübingen 1892) 291: "Item locus medii mundi".

[36] The Latin text is given by Ritsema van Eck, *Holy Land*, 50 note 45. My translation.

[37] Felix Fabri, *Evagatorium in Terrae Sanctae, Arabiae et Egypti peregrinationem*, C.D. Hassler ed., I (Stuttgart 1843) 306-308: De loco, ubi dicitur esse centrale medium totius mundi. The passage is discussed by Higgins, 'Defining the earth's center', 38-39, and French, 'Journeys', 72-75.

[38] Pamela Gravestock, 'Did imaginary animals exist?', in: Debra Hassig ed., *The mark of the best. The medieval bestiary in art, life, and literature* (New York and London 1999) 119-139, on p. 130.

[39] P. Geary, *Furta sacra. Thefts of relics in the central Middle Ages* (Princeton 1978) 66.

[40] Alexander, 'Jerusalem', 154.

[41] For a discussion on the impact of Ptolemy's Geography, see Jean-Marc Besse, *Les grandeurs de la terre. Aspects du savoir géographique à la Renaissance* (Paris 2003), 112-132. For Ptolemy's introduction in the west, cf. Berggren and Jones, and Babicz, as in note 3. Besse does not discuss ideas on the inhabited world's centre.

[42] For the term "communications revolution", see Wolfgang Behringer, 'Communications revolutions: a historiographical concept', in: *German history* 24 (2006) 333-374.

The Persistence of Tychonism

Peter Barker

Abstract: Tychonism, if it is considered at all in histories of the Copernican Revolution, is briefly acknowledged as an alternative cosmic scheme, but seldom mentioned as an active tradition extending into the seventeenth century. I will make a case that it lasted into the eighteenth century. In this paper I will consider astronomers, almanac makers and natural philosophers who adopted and spread Tychonism. I will summarize and supplement the accounts of Carolino (2023) and Kallinen (1995) who document sequences of Tychonists in Lisbon, Portugal and Turku, Finland, respectively. I will then argue that Maria Cunitz (1610-1664) declares herself a Tychonist in her celebrated book *Urania Propitia* (1650). The same considerations emphasize the importance of Christian Longomontanus' (1562-1647) *Astronomia Danica* (1622) as a resource for Tychonism. I will conclude by examining a few almanac makers who adopted Tychonism, some of whom used Longomontanus. I offer corrections to earlier accounts of Tychonism, especially Schofield (1984). In conclusion I will suggest that the historical longevity of Tychonism has been considerably underestimated and also that Tychonists were not generally restrained from public endorsement of heliocentrism by religious pressure. On the contrary, I suggest that the continued acceptance of Tychonism was conditioned by its congruence with scientists' religious beliefs.

Keywords: Tycho Brahe (1546-1601); Tychonic system; Christian Longomontanus (1562-1647); Maria Cunitz (1610-1664); Christine J. Schofield; early modern almanacs; Jesuit scientists; Lutheran scientists; science and religion.

1. Introduction

My aim in this paper is to present a preliminary survey of Tychonism as a research tradition,[1] from the publication of *De mundi aetherii recentioribus phaenomena* in 1588 to the end of the next century.[2] By 'Tychonism' I mean the astronomical system introduced by Tycho in that book, developed in *Astronomiae instauratae progymnasmata* published 1603, and appearing in fully mathematical form in Christian Longomontanus' *Astronomia Danica* in 1622.[3] Tycho postulated a cosmos with a stationary central Earth, which the Moon and Sun revolved around while all the other planets revolved around the Sun. The orb of fixed stars was still the boundary of the cosmos and still concentric to the earth. Adoption of this scheme required the abandonment of solid celestial orbs as the causes of planetary motion. Longomontanus endowed the Earth with a daily rotation, and this innovation was adopted by many later adherents of Tychonism. Later writers also sometimes made only the inner planets and Mars revolve around the Sun, with Jupiter and Saturn again taking the Earth as the center of their motions. Consequently, I take the main markers of adherence to Tychonism to be acceptance of the overall cosmic scheme in either the original or modified form, a central Earth which may rotate or not, and the abandonment of celestial orbs.

Tychonism, if it is considered at all in histories of the Copernican Revolution, is usually acknowledged as an alternative cosmic scheme, but seldom mentioned as an active tradition extending into the seventeenth century. I will make a case that it lasted into the eighteenth century. In this paper I will consider astronomers, almanac makers and natural philosophers who adopted and spread Tychonism. I will summarize and supplement the accounts of Carolino (2023) and Kallinen (1995) who document sequences of Tychonists in Lisbon, Portugal and Turku, Finland, respectively.[4] I will then argue that Maria Cunitz (1610-1664) declares herself a Tychonist in her celebrated book *Urania Propitia* (1650). These considerations emphasize the importance of Christian Longomontanus' (1562-1647) *Astronomia Danica* (1622) as a resource for Tychonism. I will conclude by examining a few almanac makers who adopted Tychonism, some of whom used Longomontanus. I offer corrections to earlier accounts of Tychonism, especially Schofield (1984). More importantly, I suggest that the historical longevity of Tychonism has been considerably underestimated and also that Tychonists were not generally restrained from public endorsement of heliocentrism by religious pressure. On the contrary, I suggest that the continued acceptance of Tychonism was conditioned by its congruence with scientists' religious beliefs.[5]

2. Jesuit Tychonists

The strongest reaction to Tycho's work seems to have been from Jesuit scientists. As early as the 1610/11 academic year Otto Catenius (1582-1635) lectured on the Tychonic system at Mainz. The following academic year another Jesuit, Christophoro Borri (1583-1632), lectured on the Tychonic system at the College of Brera in Milan.[6] His unpublished treatise on astrology records the content of these lectures. Borri presented the cosmic schemes of Ptolemy, Copernicus and Tycho and chose Tycho for religious and physical reasons. In 1612 Borri was removed from his teaching position for views that were "non-orthodox." The Order sent him to Macao in 1615, and to Vietnam in 1617-22.[7] He took his Tychonic convictions with him and wrote books on astronomy while abroad. On

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the way back to Europe, he met the Italian traveler Pietro della Valle in Goa, on the east coast of India. At della Valle's request he wrote a summary of the Tychonic system (*Compendium ...de nova mundi constitutione iuxta systema Tichonis Brahae aliorumque recentiorum mathematicorum*) which Della Valle himself translated into Persian and then Italian.[8] On returning to Europe Borri taught in Portugal. Towards the end of his life, he composed another Tychonic text *Doctrine of the Three Heavens*, that formed part of his *Astronomical Collection* published in Lisbon in 1631.

Borri carried Tychonic doctrines over a large part of the world, before returning to teach in Portugal, but other Jesuits closer to home were active Tychonists, especially those involved with Galileo's telescopic discoveries, and Galileo himself, in 1610-11. One famous outcome of Galileo's visits to Rome was the statement added by Christopher Clavius to the last edition of his celebrated *Sphaera*, listing Galileo's discoveries, and concluding, "Since things are this way, Astronomers should consider how the celestial orbs ought to be arranged so they are able to explain these phenomena."[9] This has been read as an endorsement of Tychonic astronomy, or at least an encouragement to consider it, but Baldini (1992) and Lattis (1994) argue convincingly that Clavius was seeking a reformulation of the solid celestial orbs which he had always used, rather than a revolutionary replacement of the orb system; he never accepted Tycho's idea of fluid heavens. His successor Christoph Grienberger (1561-1636) wrote to Giuseppe Biancani (Josephus Blancanus, 1566-1624) in 1618: "...when he [Clavius] advised that other spheres should be considered, it seems he hoped more for an explanation of the new observations by the old theory than for a complete replacement."[10]

At the *Collegio Romano* Orazio Grassi (1583-1654) described the Tychonic system to students in his course on astronomy, as shown in the notebooks for the years 1617 and 1623 examined by Kraig Bartel. Grassi was circumspect on which of the four systems was preferable. He accepted that observations of the phases of Venus and the moons of Jupiter showed that they were satellites of the Sun and Jupiter respectively, but he continued to maintain the incorruptibility of the heavens in discussing the nature of the Moon and the spots on the sun.[11]

Grienberger's correspondent Biancani, however, did see an opportunity to reject solid celestial spheres, and despite Grienberger's worst efforts as censor, published a *Sphera Mundi* at Bologna in 1620, endorsing Tycho's system. He followed Iohannes Baptist Cysat (1586/7-1657), who one year earlier had adopted the Tychonic system to explain the comets of 1618, in his *Mathemata astronomica* (Ingolstadt, 1619).[12]

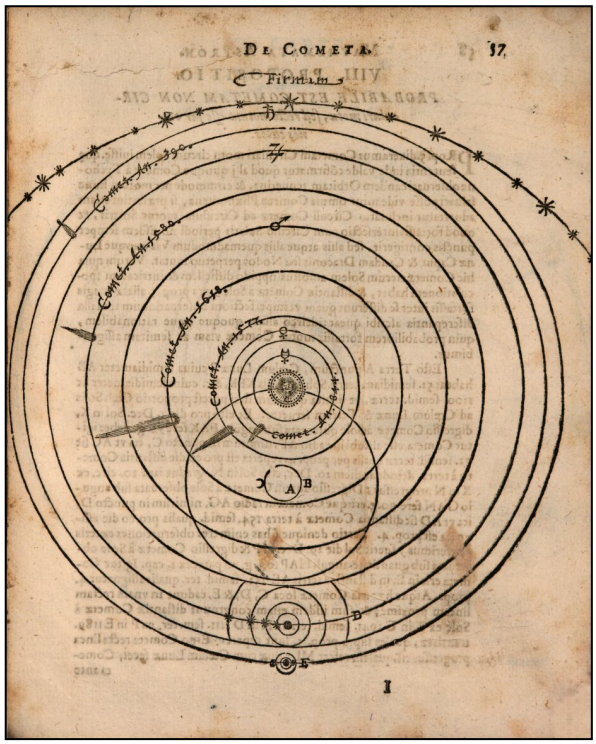

Figure 1: *Cysat (1619) page 57. How comets fit into the Tychonic system: The Earth, A, circled by the Moon, B, is the center of the cosmos and the orb of fixed stars. The sun is the center of all other motions, including comets. Note the comets of 1577 and 1618, on the left side of the Sun, between the paths of Venus and Mars. Note also the conspicuous rings of small objects immediately surrounding the sun – a common Jesuit explanation for sunspots that preserved the incorruptibility of the heavens. München, Bayerische Staatsbibliothek -- 4 Diss. 3786,26.*

Returning to Biancani, his support of Tycho is vigorous and extensive. In his preface he quotes the entire passage in which Clavius lists Galileo's discoveries and suggests finding new combinations of spheres.[13] Not only does Biancani support the Tychonic system as an alternative to Ptolemy and Copernicus, but he also accepts the unmodified form, arguing strongly for a stationary, non-rotating earth. Everything else revolves around the Sun, starting with the sunspots, which are small objects in stable orbits, as in Cysat. He gives mean motion tables for all the other planets and includes a Tychonic analysis of the moons of Jupiter. Last, he concludes that the epicyclic motions of the planets as they are carried around the sun create paths that are spirals.[14]

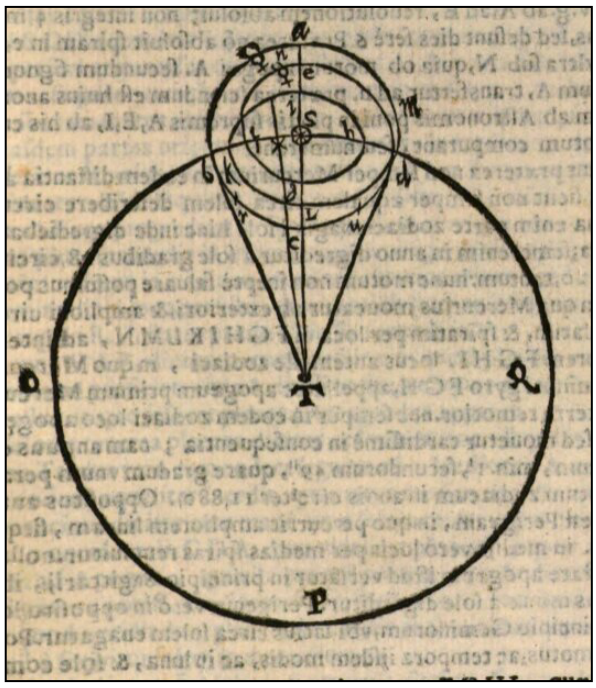

Figure 2 (right column, on the page before): *Biancanus (1620) page 255: The spiral path of the planet Mercury: The Earth, T, is the center of motion for the Sun, S, on its path SOPQ. Mercury follows a spiral path a,b,c,d,e,f,g,h,i,K,L,m,n. The effect of this motion over time is shown in the next figure. München, Bayerische Staatsbibliothek -- 4 Astr.u. 29.*

– an idea found in many later Jesuit astronomers. He reproduces Kepler's famous 'pretzel' diagram of the geocentric motion of Mars from the 1609 *Astronomia nova*

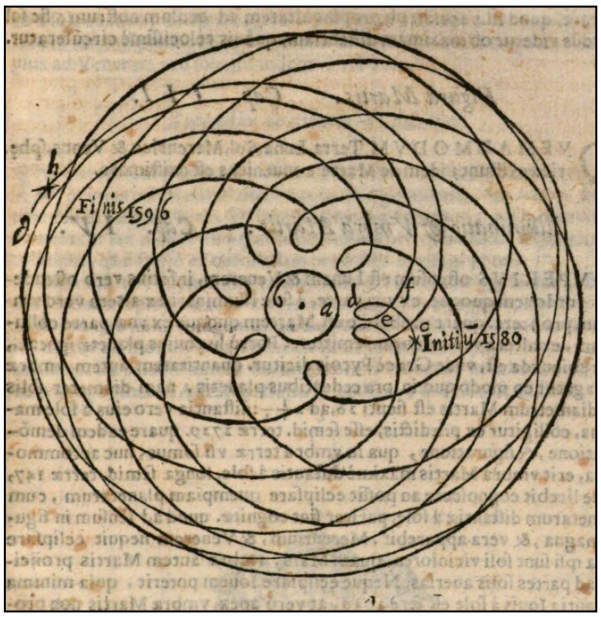

Figure 3: *Biancanus (1620) page 275: The motion of Mars from 1589 (c,d,e,f) to 1596 (h,g). Compare Kepler (1609) page 4. München, Bayerische Staatsbibliothek -- 4 Astr.u. 29. 309.*

but, unlike Kepler, does not conclude that such a motion is impossible; rather he gives it as an example of what he means by a spiral path.[15]

In a series of papers and now a book, Luis Miguel Carlino, presents a succession of Jesuit mathematicians who taught various versions of Tychonism in the introductory astronomy course at the College of Santo Antão in Lisbon. The book also contains valuable transcriptions and translations of primary sources.[16] The first in Carlino's list is Giovanni Paolo Lembo (1570–1618) from Italy, a student of Clavius and perhaps the first Jesuit to construct a telescope. He was also a participant in the Jesuit reception of Galileo in 1610-1611. He taught in Lisbon from 1615 to 1617. Next came Johann Chrysostomus Gall (1586–1643), from Germany who studied astronomy at Ingolstadt with Christoph Scheiner and, significantly, Cysat. Gall taught the *Sphaera* course from 1620–1627 and was succeeded by the Cristoforo Borri whose world travels I have already mentioned. Borri, however, taught in Lisbon for just one year (1627–8), before moving to Coimbra. The next Jesuit mathematician to teach the course was an Englishman, Ignacio Stafford (1599–1642), who taught from 1630–1636. He was followed by an Irish Jesuit, Simon Fallon (1604–42) who taught from 1638–1641.

There is considerable diversity among these Jesuit teachers of Tychonism. Lembo advocates a limited Tychonic system on the pattern introduced by Martianus Capella in antiquity.[17] For him only Venus and Mercury circle the Sun, and he retains celestial orbs as the path of Mars does not intersect the orb of the sun in this arrangement. Carlino's second figure, Gall, accepts Tycho as an authority in mathematics but not natural philosophy; although he presents the Tychonic system he does not endorse fluid heavens, but says he should not decide such questions.[18] As Carlino points out, this reinforces the traditional division between mathematics and natural philosophy.[19] However, this division was being erased by[20] other Jesuits elsewhere, for example Grassi in Rome.[21] The later Jesuits described by Carolino all adopted both some version of Tychonism, and the correlative doctrine of a fluid heavens, perhaps with a rotating central earth. In addition, Borri, Stafford, Fallon, and later Riccioli, all endorse the idea of spiral paths for the planets. Carlino traces the idea to a treatise on comets by Manuel Bocarro Francês (d.1668) published in Lisbon in 1619.[22] However, Victor Navarro Brotons calls this the doctrine "of remote origins" noting its adoption in sixteenth-century Spain by Jerónimo Muñoz (1515-1591) and Diego Pérez de Mesa (1563-1632). Later authors, for example Riccioli, the next Jesuit to be considered, attribute the origins of this doctrine to al-Biṭrūjī (fl. 1185-1192). Riccioli, incidentally, also reproduces an image of the spiral path in Figure 3.[23]

Later Jesuits modified the original Tychonic system in various ways. Perhaps the most celebrated is the Italian Giovanni Battista Riccioli (1598-1671), who in the *Almagestum novum* (1651) adopts a system in which the central earth has a daily rotation, the Moon and Sun rotate around the Earth, Mercury, Venus and Mars rotate around the Sun, but Jupiter and Saturn rotate about the earth.[24] However, fourteen years later in his *Astronomia reformata,* he reverted to the Sun as center of motion for all five planets.[25] Both Riccioli's books were written at Bologna. In the time between them another Jesuit, Melchior Cornaeus (1598-1665) at Würzburg defended the unmodified Tychonic system. In *Curriculum philosophiae peripateticae* (1657), he rejected Ptolemy as presented by Clavius, and also rejected Copernicus, denied the rotation of earth and fully supported the Tychonic arrangement of planets.[26]

Members of the Jesuit Order showed consistently strong support for Tychonism in both its original and modified forms. This support may be traced to two main reasons. The first is a genuine desire to accommodate the celestial novelties that appeared at the end of the sixteenth century and the beginning of the seventeenth. These included novae and comets (as we saw in the case of Cysat) as well as new discoveries made with the telescope (shown for example by the wide adoption of the explanation of sunspots as minor planets). The second reason is religious and has often been misunderstood. It is, of course, true that after the 1616 condemnation, Copernicanism was not an available option for Catholic cosmologists. However, Catholics did not adopt Tycho as a second best to Copernicus. Almost everyone understood and agreed with the reasoning of the 1616 decree. More fundamentally all natural philosophers at this moment in history expected that their religious and philosophical, or

physical, ideas would interpenetrate and mutually reinforce; it was inconceivable that science would contradict religion. This was true even for Copernicans like Kepler and Galileo, who went out of their way to prove the compatibility of their cosmological ideas with their religion.[27] For Catholics like the Jesuits, Tychonism was a way of accommodating celestial novelties in accord with their personal religious ideas, as it had been for Tycho himself. Any implausibility the modern reader feels, when asked to consider a planetary system dragged by the sun around a central earth, needs to be balanced by a recognition of the religious commitments that were central to the lives of all early modern Europeans. As we will see in the next section, this same reasoning explains the adoption of Tychonism even among scholars who were not subject to the 1616 prohibition.

3. Lutheran Tychonists

Carolino's list of Tychonists ends in 1641. Maija Kallinen has described a very similar series of academics, who taught Tychonism at the University of Turku, formerly part of Sweden but today part of Finland, between 1640 and 1720. Turku had been founded as a Gymnasium in 1630 and elevated to a university in 1640.[28] In contrast to the Catholic scholars of Lisbon, the academics at Turku were all Lutherans. By this time the internal strife between followers of Phillip Melanchthon and Mattias Flaccius had been resolved in favor of the latter, who now practiced an orthodox Lutheranism that, as Kallinen succinctly puts it, "…was characterized by fundamentalism, literal reading of the Bible and quarrelsome opposition to other religious confessions."[29] Despite a general intellectual environment hostile to earlier Philippists like Caspar Peucer, Michael Maestlin, and Johann Kepler, a variety of professors of mathematics and other disciplines at Turku endorsed Tychonic cosmic schemes, seemingly because they offered an intellectually respectable way of retaining a geocentric reading of the Bible.

The first entry in this series of Tychonists is Simon Svenonis Kexlerus (1602-1669), although it is difficult to date his adoption of Tychonism precisely. Kexlerus served as professor of mathematics from 1640 until his death in 1669. In 1649 he published a vernacular *Almanac* and in 1666 a Latin *Cosmography*, both at Turku.[30] Some time between 1648 and 1651 he was commissioned to write an introduction to astronomy, which despite its Latin name, the *Astronomia*, was written in Swedish, and is now counted as the earliest endorsement in Swedish of the daily motion of earth. The book survives in manuscript and is complete up to the heading for chapter 13. As for date, all we can say is that the draft we have must be from no later than 1669, the year of the author's death.[31]

Oddly, the manuscript begins with a title page that identifies the author as Andreas Thuronius (1632-65), professor of physics and botany from 1660 to 1665. From his publications Thuronius is a plausible candidate; he published almanacs for 1661 and 1664 in Turku and for 1665 in Stockholm.[32] This sequence likely indicates that he prepared other almanacs that have not been preserved or come to light. Moving the venue of publication from Turku to Stockholm would also have given him a larger and more lucrative market, and suggests serious plans to produce more almanacs, although, sadly, he was not able to capitalize on this success, as he died in 1665. In late 1664 and early 1665 he made observations of a comet, and located it in the celestial realm not the terrestrial realm.[33] He also adopted fluid heavens.[34] He published Latin texts on logic and metaphysics in Turku, and supervised many dissertations.[35] One of these, defended by J. G. Alanus in 1664, was on the universal influence of the heavens on the sublunar world.[36] So on this evidence Thuronius is a plausible candidate for Tychonism, although we lack decisive evidence.

However, Thuronius did not write the *Astronomia*. The handwriting throughout the main draft is consistent with what would be expected from Kexlerus, while the handwriting on the title page is different. Most importantly, in 1987 Jaakko Lounela found the correspondence between the patron who commissioned the work and Kexlerus, and later reports from Kexlerus on progress towards completing the book.[37]

The manuscript of the *Astronomia* consists of twelve complete chapters and the title page for chapter thirteen, and is written throughout in Swedish. It begins conventionally by rehearsing the geometrical tools needed for astronomy. After discussing the status of astronomy as a science distinct from astrology, Kexlerus addresses the reality of celestial orbs, and discusses the systems of Copernicus and Tycho in detail. He concludes, with Tycho, that there are no real spheres in the heavens, except as useful boundaries defined by mathematics, although he mistakenly attributes the same view to Copernicus.[38] In subsequent pages he endorses the Tychonic system on the grounds that is accords better with everyday experience and Scripture. However, he strongly favors modifying Tycho's system by giving the Earth a daily rotation, which he finds simpler and more physically plausible than having the entire cosmos rotate each day. He answers Tycho's physical and Scriptural objections to the daily motion. However, Kalinnen notes that he carefully avoids a direct endorsement of the motion of the earth, despite rehearsing a series of arguments that support the idea. These arguments are repeated in the *Cosmography* published in the year of his death.[39] So, in summary, Kexlerus appears to be a Tychonist who accepts the fluid heavens required by the cosmic scheme, with the addition of a rotating central earth.

Kexlerus died in 1669 and was succeeded by Johann Flachsenius (1633-1694) who served as professor of mathematics until 1692. Flachsenius published on pneumatics and logic, and 1679 sponsored a defense by J. Grimsteen on astronomical hypotheses.[40] Although, typically, there is no outright statement of which system is correct, Flachsenius presents the Ptolemaic, Copernican and Tychonic systems, and refutes the Copernican system. As the Ptolemaic system was generally agreed to be no longer defensible, by default this leaves Tychonism as the preferred view.[41]

At the same time Flachsenius held the chair in mathematics, the Bishop and Chancellor of the University was

Johannes Gezelius (1615-1690), a polymath who wrote students' editions of Cicero, and a Greek textbook, as well as theological works. In 1672 he published an *Encyclopedia Synoptica*, which describes five cosmic schemes corresponding to Ptolemy, the 'Egyptians', Copernicus, Tycho, and Riccioli. Following the pattern we have already noted he fails to state directly which scheme is best, Kallinen regards him as a geocentrist from other evidence. Given this additional information, then, the inclusion of Riccioli's scheme is best explained by the author's preference for it over the unmodified Tychonic scheme, which is in turn preferable to any of the others.[42] The preference for Riccioli is even clearer in another writer from the same period, Daniel Achrelius.

Daniel Achrelius (1644-1692) held the chair in Eloquence (or Latin Literature) from 1679-1692 and directed dissertations on natural philosophy between at least 1681 and 1689.[43] In 1682 he published *Contemplationum mundi dissertatio quinta*, which Kallinen counts as a textbook.[44] Here Achrelius clearly states a preference for a Tychonic system in the form modified by Riccioli, and even provides a picture.[45] The Earth is shown as the center of motion for the Moon and Sun, which in turn is the center of motion for Mercury, Venus and Mars. However, the outer planets Jupiter, with four moons, and Saturn, with two, are shown moving concentric to the Earth just inside the Sphere of Fixed Stars which is also concentric to the Earth. The Sphere of Fixed Stars is itself surrounded by the Biblically required "water above the heavens" in a final sphere, which is the boundary of the cosmos; beyond is "an imaginary space which is nothing."[46] The sphere of fixed stars is shown to be of finite depth with a "New Star" at one o'clock. In the intervening space two comets are shown with tails longer than the distances between planets. Oddly, although Achrelius acknowledges the important contemporary result that the tails of comets always point away from the sun, the tails of the comets in the picture are conspicuously not antisolar.[47]

Flachsenius retired from the professorship in mathematics in 1692, two years before his death, and was replaced by Magnus Steen (d.1697), until his own death. Steen is unusual for holding the chair for only half a decade, and even more unusual in being a heliocentrist and a Cartesian. In a dissertation defended in the year of his death, Steen described the Ptolemaic, Copernican, and Tychonic systems as well as a Tychonic system with a rotating Earth.[48] However, the Sun was placed at the center of a vortex, which carried the planets around it, making a Tychonic system impossible. He also adopted Descartes' explanation of the origin of comets. But again, he stopped short of a simple declaration in favor of one system over another, leaving the decision to the reader.[49]

From the death of Magnus Steen in 1698 until 1717 the professor of mathematics was Laurentius Gabrielis [Lars Gabriel] Tammelin (1669-1733).[50] He made almanacs that survive for the years 1700, 1705, and 1717-1725 inclusive.[51] It may well be that the run from 1717 to 1725 survived because they were all published in Stockholm, while the existing earlier almanacs appeared in Turku. Hence, it is possible that he made almanacs for the intervening years that have not survived because they were also published in Turku. According to Kallinen, Tammelin made a clear endorsement of Tychonism no later than 1707.[52] The almanacs and the endorsement of Tychonism may be connected, if, like Achrelius, Tammelin used his cosmology to support the practice of astrology.

With Tammelin it is clear that Tychonism was endorsed at Turku well into the eighteenth century, often in the form of the "improved" version introduced by Riccioli, with geocentric paths for Jupiter and Saturn, and perhaps a rotating earth. This commitment corresponded to an abandonment of solid celestial spheres to move the planets and the adoption of some form of fluid heavens. Tychonists at Turku were eager to regale their audiences with other astronomical novelties such as the moons of the outer planets, and do not seem to have defended the Aristotelian division between the celestial and terrestrial realms, which partially motivated the Jesuits. Achrelius, for example, considers the Sun to be made of fire.[53] At Turku, motivations seem to be balanced between keeping up with innovations in astronomy and retaining their geocentrist reading of the Bible. As Kalinnen puts it, in cosmology, "Most convincing of all arguments was … the authority of the Bible, which was interpreted as disproving Copernicanism."[54] It would be interesting to know whether the Turku Tychonists who wrote almanacs used the *Astronomia Danica*, but this is a matter for further research.

4. Was Maria Cunitz a Copernican?

What was going on in the rest of Europe, while all these Jesuits and Lutherans were employing variations on Tycho? According to Schofield, "Lutheran Germany ... displayed little interest in the planetary system of their fellow Lutheran Tycho,"[55] apart from the early interest by Ursus, Roeslin and Marius (who each claimed they had invented something like it).[56] I have to report a rather startling counterexample to this generalization, from the period of Riccioli: Maria Cunitz (1610-1664).

Kepler had developed a heliocentric system based on elliptical orbits announced in the *Astronomia nova* of 1609, but, according to the usual account, it made little headway until he published the *Rudolphine Tables* in 1627. As word of their accuracy spread, these became widely used, supposedly adding support to heliocentrism, which grew in acceptance through the next century. Kepler had presented the tables with the aid of logarithms – he had been an early adopter – but the logarithms were an obstacle to the use of the tables for many potential readers.[57] In 1650, Maria Cunitz published *Urania Propitia,* providing a simplified method for calculating positions from the *Rudolfine Tables,* and extending the audience for Kepler's heliocentrism. Except, she didn't. Yes, she simplified the use of the *Rudolphine Tables* by eliminating the logarithms. No, she did not endorse heliocentrism; she was a Tychonist.

Maria Cunitz spent her entire life in the Protestant parts of Germany. Born in Wohlau, her family lived in Schweidnitz, but the Thirty Years War obliged them to flee to Liegnitz and then Pitschen, and finally Lubnitz across the border in Poland. They were able to return to Pitschen as her main work was being printed. She was taught mathematics and astronomy by her mother and father, both accomplished scholars, and by Elias Crätsch-

mair (c.1602-1661),[58] whom she married in 1630.[59] Significantly, she learned to calculate planetary positions using Longomontanus' *Astronomia Danica,* the "Tychonic *Almagest*", which her husband "praised highly"[60] and it was also her husband who asked her to simplify the use of the *Rudolfine Tables* when he became dissatisfied with the accuracy of other tables. But let us pause for a moment to situate the *Astronomia Danica*.

In 1588, when Tycho announced his new system of the world in the *Recentioribus phaenomenis,* that book contained no detailed models for the movements of the Sun, Moon and planets in terms of the new hypothesis. Ten years later, in the 1598 *Astronomiae instauratae mechanica*, he claimed, "With regard to all five planets there remains only one thing to do, namely to construct new and correct tables expressing by numbers all that has been established by 25 years of careful celestial observations … thereby demonstrating the inaccuracy of the usual tables."[61] The theories of the Sun and Moon were sufficiently far advanced that Tycho prepared them for publication in the *Astronomiae instauratae Progymnasmata*, which appeared in 1603 after his untimely death. The *Progymnasmata* presented tables of mean motion for the Sun covering the years 1560 to 1619, and tables for the elements of the Moon's motion covering the years 1560 to 1660 (the latter probably mainly the work of Longomontanus).[62]

As for the "only one thing" that remained to do — extending the application of the new cosmic scheme to the five planets — how much work was really involved can be judged from the time it took to complete. This was, of course, the project that led to the *Rudolphine Tables* published by Kepler nearly a quarter of a century later in 1627, with prominent use of logarithms. But Kepler had abandoned Tycho's cosmic scheme. Five years earlier the first complete set of Tychonic planetary models, and tables, had appeared in Christian Longomontanus's *Astronomia Danica* (Amsterdam, 1622). Unlike Tycho, Longomontanus accepted a rotating earth; unlike Kepler he avoided using logarithms.

In the extended title of her book *Urania Propitia* (*Benevolent Urania*, the same muse celebrated by Tycho in the name of his castle-observatory on Hven) Maria Cunitz promised "...wonderfully easy astronomical tables, comprehending the power of the physical hypotheses brought forth by Kepler, satisfying the phenomena, by a very easy, brief way of calculating, without any mention of logarithms ..."[63] The text is presented first in Latin and then in not-entirely-parallel German. However, despite "the power of the physical hypotheses brought forth by Kepler" when she describes the system of the world, Cunitz follows Tycho:

Latin: "The orbit of a planet is not a mathematical circle but a kind of natural revolution (*gyrus*) that the planet, the sun and moon describe about the earth, but Saturn, Jupiter, Mars, Venus, and Mercury describe about the sun, by a nonuniform motion and libration in certain and fixed periods in the universe."[64]

This is clearly describing a Tychonic geo-heliocentric system, however the corresponding German is clearer on the shape of the orbit:

German: "Orbita Planetae, the orbit of a planet (*der umbkrais des Planetens*), is a somewhat elongated circle (*etwas abländlichter Circkel*), the Sun and Moon around the Earth, the other 5: Saturn, Jupiter, Mars, Venus, Mercury, around the Sun, moving unequally in a certain time, which they describe by approaching and receding unequally in infinite space."[65]

Cunitz is advocating Kepler's result that the orbits of the planets are ellipses with the Sun at one of their foci. She uses the term introduced by Kepler, 'orbit', to refer to their paths. But the Earth is the center of the cosmos. The Sun follows an elliptical path around it, and the other planets follow elliptical paths around the Sun.[66]

It should not be surprising to us that Cunitz is a Tychonist. Her husband and collaborator studied with David Origanus (1558-1628/9), who had been in Breslau, before studying and teaching in Frankfurt. Origanus published two major ephemerides, the first for 1599-1630 and the second for 1609-1655. In the second set, published in 1609, he gave both Tychonic and "Copernican" (i.e. Prutenic), treatments of the Sun and Moon, but only Prutenic treatments for the remaining planets. Recall from above that although Tycho's treatments of the Sun and Moon had appeared in 1603, treatments for all the remaining planets were not available until Longomontanus' work appeared in 1622. In the 1609 introduction Origanus adopted the Tychonic system with a rotating earth. Origanus is mentioned specifically by Longomontanus in the *Astronomia Danica* when he endorses the same arrangement.[67]

Origanus' student, Cunitz' husband Elias Crätschmair, also made almanacs, and followed the preferences of his teacher in cosmic systems. He constructed a perpetual table for finding planetary hours, the *Horologium zodiciale*, published in Breslau in 1626, in which he explicitly acknowledges Origanus and Longomantanus, and he again acknowledges Tycho and Longomontanus in his calendar for 1628.[68] At the end of the calendar he also considers a number of philosophical questions directly relevant to Tychoism, for example whether "whether there are certain and different spheres that move the heavenly bodies around, as is commonly philosophized?"[69] In 1627 he fled, like Cunitz' family, to Liegnitz, where he and Maria married in 1630.

It is also possible that Cunitz's father Heinrich (1580-1629) was a Tychonist. He had studied at Rostock and Frankfurt, which he attended at the right time to also be influenced by Origanus, and he later wrote on astrology and astrological medicine, as well as natural science and mathematics.[70] Taken together this evidence suggests that Cunitz's family were all Tychonists.

5. Conclusion: The Persistence of Tychonism

This paper began as a conference presentation in which I reported on the current state of my research into seventeenth-century Tychonism.[71] Although I have expanded the scope considerably for publication, I should begin this conclusion by emphasizing that this is still an outline. It is clearly incomplete, for example I have barely mentioned Tychonism in the most obvious place, Denmark.[72] And there is much more to say about Jesuit followers of Ty-

cho.[73] However, even in this preliminary state, the project suggests several important conclusions. These are the geographical extent of Tychonism, its surprising historical durability, and the persistent role of religion in the thinking of those who adopted Tycho's cosmic scheme.

In a recent paper Richard Kremer describes the work of Lorenz Eichstadt (1596-1660) who wrote annual prognostications for the city of Stettin, initially the capital of the re-united duchy of Pomerania, and later assimilated by Sweden. According to Kremer, Eichstadt wrote annual prognostications starting in 1630. He also wrote ephemerides for years between 1636 and 1665, which he self-published in Stettin, Danzig and Amsterdam.[74] Initially he took positions for the Sun and Moon from the *Astronomia Danica* and planetary positions from the *Rudolphine Tables* as presented by Jacob Bartsch in 1630. However, he finally gave up the *Rudolphine Tables* completely and based everything on the *Astronomia Danica*, ostensibly because they agreed better with his own observations.[75] Kremer discounts Eichstadt's explicit interest in cosmic schemes, and we should not conclude he adopted the Tychonic scheme from his use of the *Astronomia Danica*, any more than we can infer Maria Cunitz's adoption of heliocentrism from her support for the *Rudolphine Tables.* His actual preference might be determined by examining his *theorica*, published in 1644 or his book on the comet of 1653-4.[76]

Other almanac makers were explicit in their adoption of Tychonism, although, again, the evidence needs to be reevaluated since the work of Schofield. In England, which Schofield otherwise regards as lacking in Tychonists, she claims the almanac makers Arthur Hopton (1587/8-1614) and Walter Strof (active 1619-1652) both endorse the Tychonic system.[77] Hopton made almanacs for the years 1606-1608 and 1610-1614, the year of his death. But although he quotes Tycho's figures for sizes and distances of celestial objects, I have not yet found an explicit endorsement of Tychonism, and in his *Concordancy* from 1612 (reprinted 1615, 1616 and 1635) he gives a standard geocentric account of the planets and still speaks of celestial objects as being 'denser parts of their orbs' which is distinctly non-Tychonic.[78]

On the other hand Strof[79] in 1627 consistently prefers Tycho's values for parameters to those from Reinhold's *Prutenic Tables*,[80] and calls the "observations of Noble Tycho" "infallible", indeed, in choosing parameters: "… I follow him, whose only name is able to shield me both from contempt and contradiction - namely, the thrice noble Tycho Brahe: for from his grounds and observations are they calculated and set down, as they are delivered by him in lib. *Progymnas*. Cap. 7."[81] He goes on to clearly endorse Tycho's world system. In addition to abolishing solid orbs and sublunary comets:

> Many other truths have sprung out of the fruitful seminarie of Uraniburg, which shall ever memorize the founder, as that Venus and Mercury moove about the Sunne, that all other Planets except the Moone, respect the Sunne for their center. That Saturne in opposition to the Sunne is nearer the Earth than Venus in Apogeon. That Mars in opposition is nearer the Earth than the Sunne itselfe.[82]

In addition to Strof in England at the beginning of the seventeenth century, we can also probably count Crätschmair in Germany and definitely count Tammelin in eighteenth-century Finland as Tychonists. Some almanac makers used only the mathematical resources of the *Astronomia Danica* without endorsing its cosmic scheme. But cases like Strof and Tammelin show the spread of Tychonism to a much wider public than either astronomers or natural philosophers. Almanac makers were consumers rather than producers of new knowledge, and these initial results suggest that they adopted Tychonism all over Europe.

As already mentioned, it has been said that the spread of heliocentrism was supported by spreading use of the corresponding tables, that is the *Rudolphine Tables*, including Maria Cunitz's version. But this is much too simple. At the same time that use of the *Rudolphine Tables* was spreading, so too was use of the *Astronomia Danica* with its Tychonic tables. Should we say that use of the *Astronomia Danica* supported the spread of Tychonism? Just the small sample I have described refutes both views. Strof used Tycho's numbers and supported Tycho's cosmic scheme. Hopton used Tycho's figures but did not accept his cosmic scheme. Worst of all Cunitz accepted Kepler's numbers but Tycho's cosmic scheme, not the Copernican system she is often presented as helping to advance.

The durability of Tychonism and the corresponding general interest in astronomical novelties is apparent in Johan Meyer the Younger's print from Zurich in 1707.

Figure 4: '*Astronomia'. A celebration of the art of astronomy, etched and printed by Zurich native Johann Meyer the Younger and published by the Zurich Municipal Library on New Year's Day 1707 "for the benefit of the youth of the city." History of Science Collections, University of Oklahoma Libraries, Norman, Oklahoma.*

Updated versions of Galileo's telescopic discoveries are shown in smaller images around the edge. In the center we see the three main contenders for cosmic schemes, Copernicus, Tycho and Ptolemy, offering shields presenting their ideas to the muse of astronomy. If we look closely at the offering by Tycho, we see that the outer planets after Mars are moving on paths concentric to the fixed stars and the central Earth – in other words this is Riccioli's modification of the original Tychonic system, which has by now become sufficiently widespread that it is worth recording in a print for popular consumption.

Figure 5 (left column, on the next page): *Detail from Johann Meyer the Younger, Astronomia (Zurich: Municipal Library, 1706) showing, left to right, seated figures of Nicholas Copernicus, Tycho Brahe and Claudius Ptolemy with images of their cosmic schemes. History of Science Collections, University of Oklahoma Libraries, Norman, Oklahoma.*

As I have shown here, Tychonism survived well into the eighteenth century. In future work I hope to argue that Tychonism was only abandoned when Newton's physical arguments against it became available. The evidence for this includes the corresponding entries in Chamber's *Cyclopædia, or, An universal dictionary of arts and sciences* (London 1728) in England and the *Encyclopédie, Ou Dictionnaire Raisonné Des Sciences, Des Arts Et Des Métiers* (Neufchatel, 1751-72) in France.[83] However, this argument necessarily requires the consideration of the Cartesian version of heliocentrism as another alternative to Newton's version.

In the present paper I have been more concerned to demonstrate the persistence of Tycho's cosmology than the explain its success, but the following factors are clearly relevant to understanding the reception of Tycho's work. First, Tycho introduced new techniques for making astronomical instruments and observations, and set new standards for precision. In addition to increasing the accuracy of instruments with novel methods for dividing scales, Tycho made a lifelong study of how to improve the accuracy of observational results, for example by correcting for parallax.[84] He also popularized the prosthaphaeresis method for manipulating astronomical data, which used trigonometric identities to simplify calculations (although the key identities may have originated with itinerant mathematician Paul Wittich (c.1546 – 1586 or 1587) and Kassel instrument maker Joost Bürgi (1552-1632)).[85] As we have seen in the cases of Strof in England and several Bartolins in Denmark, the excellence of Tycho's observations was appreciated well into the seventeenth century.[86] But, as I have repeatedly emphasized, accepting observational results or astronomical tables from a particular source does not entail accepting that source's preferred cosmology. If this is not already clear, consider again the *Rudolphine Tables*, prepared from Tycho's data by a Copernican.

Tycho's ongoing fame was clearly a positive factor in the reception of his work, but it is important to see his reputation and public image as something he carefully cultivated, and defended, most notoriously in the persecution of Ursus (Nicholas Reimers, 1551-1600) for plagiarizing his cosmic scheme.[87] However, the Ursus affair is misleading. As John Christianson and Adam Mosley emphasize, Tycho's main aim was to establish collaborative working relationships with other astronomers and scholars, through exchanges of books, letters and visits, turning research from an individual to a community activity. This counts as both another innovation and a strategy for building his own fame and credibility.[88] Even the technical illustrations of his instruments were carefully constructed to further these ends, as Emma Perkins has argued in a study of their iconography.[89]

Astronomical discoveries during the seventeenth century benefitted both Tycho's reputation and his system. One of the most damning pieces of evidence against Ptolemy and Aristotle, the discovery that Venus showed the phases predicted for a Copernican system, could equally be explained in Tycho's cosmos, without the need to move the earth or overturn accepted physics.[90] Telescopic evidence provided two other strong supports for Tychonism. First, the standing objection to a moving Earth that there was no observable stellar parallax had been made more acute by Tycho himself with his unusually large and accurate instruments. It was made even worse by telescopic observations, which pushed the fixed stars further and further away. Copernicans who were prepared to accept this expanded and empty cosmos were further embarrassed by the apparent sizes of stars observed through telescopes. If the cosmos was on the scale that Copernicans needed to make parallax undetectable, then the correlative calculation for the sizes of fixed stars, as understood at the time, made them enormously larger than the Sun or indeed the entire solar system.[91] These problems were reviewed by Riccioli in 1651, who found in favor of Tychonism.

In this paper I have made many critical comments about Christine Schofield's *Tychonic and Semi-Tychonic World Systems*. To balance that, I would like to say here that when Schofield's work appeared it was unprecedented and that it was then and remains now enormously valuable. Schofield's book illuminated much previously unknown history. Read today it also preserves a snapshot of the historiography of science from the time it was written, including the belief that Tychonism was a brief aberrant phase of cosmology and that religion was a negative force in the history of science. In contrast, I have tried to make an initial case for Tychonism's geographical extent and historical durability. Schofield's view of the situation was this:

> Since from this time onwards ["the early decades of the seventeenth century"] many feared not only the uneasiness of their own conscience but also the judgment of their religious leaders, the system of Tycho acquired a band of fearful, half-hearted supporters, who would reject it in favor of the Copernican at the first sign that they might do so with impunity.[92]

Neither the Lisbon Jesuits nor the Turku Lutherans were fearful or half hearted. They believed that their religion

and their science should be mutually supportive, and they readily adopted Tychonism along with a host of other astronomical novelties that they were eager to convey to their students. The cases of Turku, Walter Strof in England and Maria Cunitz in Germany show that even Protestants, unfettered by the 1616 condemnation of Copernicanism, still preferred Tychonism. Their reasons were, at least in part, religious. As shown by figures like Kepler, Descartes, and Newton, early modern scientists expected their religious views to interpenetrate, complement and support their scientific work.[93] Similarly, I suggest, astronomers, natural philosophers, almanac makers and lay people in both Northern and Southern Europe saw Tychonism as a cosmic scheme that interpenetrated, complemented and supported their religious views, and we should accept their statements as honest affirmations from an age when science and religion were not yet in conflict.[94]

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Notes

[1] Here I am using “research tradition” in very much the way Thomas Kuhn used “normal science tradition”. Such traditions begin with an achievement, often presented in the form of a book, that “… was suffi-

ciently unprecedented to attract an enduring group of adherents away from competing modes of scientific activity. Simultaneously it was sufficiently open-ended to leave all sorts of problems for the redefined group of practitioners to resolve." Thomas S. Kuhn 1962 [1996]. *The Structure of Scientific Revolutions*. Chicago: University of Chicago Press, 10. While the normal science tradition lasts, problem solving is cumulative but avoids novelty (Kuhn 1962 [1996], 35-42.). For more details, see Peter Barker 2024, "Islamicate Astronomy as Kuhnian Normal Science." *Studia Historiae Scientarum*, in review.

[2] I postpone for another occasion the question of when and how Tychonism declined and died. However, I suggest that the answers to these questions must at least include a consideration of the conflicts between supporters of Descartes and Tycho, and the use of encyclopedias to refute Tychonism by supporters of Newton in Britain and France. See Le Lay and Passeron 2017. The history of Tychonism outside Europe has also not been sufficiently recognized. See Sayili 1958, Arjomand 2011, Brentjes 2014. On Tychonism in China see especially: Chapman 1984, Hashimoto 1987, Standaert 2003, Jimenez 2015 and Chu 2017. I would also like to draw attention to the important ongoing work of Chen Ji, of University of Science and Technology of China, on Tychonism in the Ming and Quing dynasties, some of which was presented at the Séminaire d'histoire des sciences astronomiques at the Observatoire de Paris, on Oct 1, 2024.

[3] Tycho Brahe 1588. *De mundi aetherii recentioribus phaenomena*. Hven: Sumptibus auctoris. Tycho Brahe 1603 *Astronomiae instauratae progymnasmata.* Prague: Typis inchoata Uraniburgi Daniae, absoluta Pragae Bohemiae: [s.n.], 1602; Christian Longomontanus 1609. *Astronomia Danica*. Amsterdam: Ex Officina Typographica Guiljelmi I. Cæsii.

[4] Luís Miguel Carolino**,** 2023**.** *Geo-Heliocentric Controversies: The Jesuits, Tycho Brahe and the Confession**a**lization of Science in Seventeenth Century Lisbon*. Knowledge Hegemonies in the Early Modern World, 3. Edizioni Ca'Foscari. Maija Kallinen, 1995. *Change and Stability: Natural Philosophy at the Academy of Turku 1640-1731*. Studia Historica 51. Helsinki: Suomen Historiallinen Seura (Finnish Historical Society).

[5] Perhaps the classic study of the history of Tychonism is Christine Schofield, 1984. *Tychonic and Semi-Tychonic World Systems.* New York: Arno Press.

[6] Carolino 2023, 4 n.6.

[7] G. Strano and G. Truffa, 2007. "Tycho Brahe cosmologist: An overview on the genesis, development and fortune of the geo-heliocentric world-system." In M. Bucciantini, M. Camerota, and S. Roux, eds., *Mechanics and cosmology in the medieval and early modern period*, Florence: Olschki, 73-94, at 90.

[8] A. Sayili, 1958. "An Early Seventeenth Century Persian Manuscript on the Tychonic System." Anatolia 3: 84-86; Kamran Amir Arjomand, 2011. "Transfer of knowledge in the Safavid era: A Persian treatise on the explanation of the New Science based on the opinion of Tico Brahe." *[Iranian] Journal for the History of Science* 10: 1-26. In Persian.; Sonja Brentjes, "Pietro della Valle's Persian Summary of Tycho Brahe's Cosmology for the Astronomer Zayn al-Din Lari." Presented at the Workshop der KG IV "Struktur und Wissenswandelt" organized by P. D. Omodeo (Teilprojekt B06), Berlin, August 11-12, 2014. https://www.academia.edu/1689302/Pietro_della_Valles_Persian_summary_of_Tycho_Brahes_cosmology_for_the_astronomer_Zayn_al_Din_Lari ; Strano and Trufa 2007, 90-1.

[9] "Quae cum ita sint, videant Astronomi quo pacto Orbes caelestes constituendi sint ut haec phaenomena salvari possint." C. Clavius, *Opera mathematica. Ab auctore nunc denuo correcta, et plurimis locis aucta ... 3 Complectens Commentarivm in Sphaeram Ioannis de Sacro Bosco, [et] Astrolabivm.* Mainz: A. Hierat, 1611, 75.

[10] Lattis 1994, 2020 & 261n.73, quoting Ugo Baldini, 1992. *Legem impone subactis: studi su filosofia e scienza dei Gesuiti in Italia, 1540-1632.* Rome: Bulzoni, 237-8.

[11] Kraig Bartel, *Orazio Grassi and a 1623* Treatise on the sphere: *Astronomy and physico-mathematics at the Collegio Romano in the early seventeenth century*. M.A. Thesis, University of Oklahoma, USA, 2016. For additional details see his Ph.D. dissertation, "Early modern Jesuit science education at the *Collegio Romano*: Orazio Grassi, Galileo Galilei and the Controversy over the Comets." University of Oklahoma, 2023.

[12] Carolino 2023a, 2, cf. Cysat, J.B. *Mathemata astronomica de loco, motu, magnitudine, et causis cometæ qui sub finem anni 1618. et initium anni 1619. in coelo fulsit: ex assiduis legitimisq́[ue] variorum phænomenorum observationibus derivata.* Ingolstadt: Ex Typographeo Ederiano, Apud Elisabetham Angermariam,1619, p. 56 [mispaginated as '36'].

[13] Giuseppe Biancani, *Sphaera mvndi, sev, Cosmographia demonstratiua ac facili methodo tradita: in qva totivs mvndi fabrica, vna cvm novis Tychonis, Kepleri, Galilaei, aliorum[que] astronomorum adinuentis continetur.* Bologna: H. Tamborini, 1620, Preface [v].

[14] Bianchani 1620, 255.

[15] Bianchani 1620, 275.

[16] Carolino, 2023 (note 4 above).

[17] Carlino 2023, 57-8.

[18] Carlino 2023, 76.

[19] Carlino 2023, 76 and 146.

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[21] Bartel 2016, 2023.

[22] Carlino 2023, 101-24.

[23] Víctor Navarro Brotons, 2003. "Tradition and Scientific Change in Early Modern Spain: The Role of the Jesuits." In M. Feingold (ed.) *Jesuit Science and the Republic of Letters*. Cambridge (MA): MIT Press, 2003, 331-388, at 347; Muñoz and Pérez de Mesa, n. 90, p. 379. Al-Biṭrūjī: Riccioli 1651, vol. 1: 504 col A, numbered para. 9; spiral path image vol. 1: 504 col B.

[24] Christopher M. Graney, 2015. *Setting Aside All Authority: Giovanni Battista Riccioli and the Science Against Copernicus in the Age of Galileo.* Notre Dame, IN: Notre Dame University Press; Trano and Strufa 2007, 92.

[25] "Quinque autem Planetae minores circa Solem, tanquam centrum suarum Excentricitatum, et fontem luminis ab eo recepti, et eo mediante circa Tellurem, tanquam centrum, et terminum luminis, et influxus reflectendi, movetur in Aethere per se immobili, sed permeabili, per Spiras versus Occidentem semper, ea lege de qua supra, descriptas;" Giovanni Battista Riccioli 1665. *Astronomia Reformata*. Bologna: V. Benatius, 8, col. B, numbered para. 9; Strano and Trufa 2007, 92.

[26] Melchior Cornaeus, 1657. *Curriculum philosophiae peripateticae, uti hoc tempore in scholis decurri solet*. Herbipoli: Eliae Michaelis Zinck. On the arrangement of the planets, 525-38, esp. 527 item 7; 528-9 and 538: Ad confirm I; denial of Copernicanism and rotation of earth, 529.

[27] In the case of Kepler, see the prefatory material in the *Astronomia Nova* (1609); for Galileo see, of course, the Letter to the Grand Duchess Christina (composed 1615, published 1636).

[28] Maija Kallinen, 1995 (above note 3). See p.42 and note 3.

[29] Kallinen 1995, 74.

[30] Simon Svenonis Kexlerus, 1649. *Almanach, På thet Åhret efter wår Herres och Frelsares Jesu Christi födelse, 1650.* [Almanac, On the year after the birth of our Lord and Savior Jesus Christ, 1650.] Turku: Peder Wald; Simon Svenonis Kexlerus, 1666. *Cosmographiæ Compendiosa descriptio et Geographiæ introductio, de Globi Terreni mapparum Geograph. meliori intellectu ac usu.* Turku: P. Hanson.

[31] Simon Svenonis Kexlerus, undated. *Astronomia*. Uppsala University Lib. Manuscripţ A 301. In Swedish; Kallinen 1995, 147-151.

[32] Andreas Thuronius, 1660. *Almanach, til thet året ... 1661.: Til Åbo horizont.* Turku: P. Hansson; Andreas Thuronius, 1663. *Almanach, til thet året ... 1664.* Turku: P. Hansson; Andreas Thuronius, 1664. *Almanach, til thet året ... 1665.* Stockholm: I. Meurer.

[33] Kallinen 1995, 160.

[34] Kallinen 1995, 141 n.97.

[35] Kallinen 1995, 422-3.

[36] Andreas Thuronius A.- J.G. Alanus, 1664. *Dissertatio Philosophica, De Influxu Astrorum in Mundum Sublunarem.* Turku: P. Hanson, esp. theses 2,3,7 and 8; Kalinnen 174-5 n. 218.

[37] Jaako Lounela 1987. "Ensimmäinen routsinkielinen tähtitieteen oppikirja." [The first astronomy textbook in Russian.] *Opusculum* 7: 51-66. Kallinen 1995, 49-50.

[38] Kallinen 1995, 151-152, corresponding to *Astronomia* pp. 17-20.

[39] Simon Svenonis Kexlerus, 1666. *Cosmographiæ Compendiosa descriptio et Geographiæ introductio, de Globi Terreni mapparum Geograph. meliori intellectu ac usu.* 1666. Turku: P. Hanson; Kallinen 1995, 153-156.

[40] Johannes Flachsenius - J. Grimsteen, 1679. *Dissertatio Philosophica De Hypothesibus Astronomicis,* Turku: J. Winter. Kallinen 1995, 416.

[41] Kallinen 1995, 163.

[42] Johannes Gezelius, 1572. *Encyclopaedia synpotica ex optimis & accuratissimis philosophorum scriptis collecta & in tres partes distributa, in usum studiosae juventutis, cui neque pretium prolixiores authores redimendi, neque …* . Turku: Johan Winter. Kallinen 1995, 28-9 & 162.

[43] Kallinen 1995, 25, 415.

[44] Daniel Achrelius, 1682. *Contemplationum mundi libri tres.* Turku: J. L. Wallius . https://www.google.com/books/edition/Danielis_Achrelii_Contemplationum_mundi/YZ1kAAAAcAAJ?hl=en; Kallinen 1995, 29.

[45] Kallinen 1995, 157-9; the picture is a foldout between pages 14 & 15 of Achrelius 1682, reproduced by Kallinen 158.

[46] Right hand margin, corresponding to letter N, "Aquae supercoelestes"; corresponding to letter "O" in four positions surrounding the figure, "Spatium imaginarium quod est nihil." Achrelius 1682, foldout between pages 14 & 15, reproduced by Kallinen 158.
[47] Achrelius 1682, p. 137. "Cur vero [cometa] cuadam semper a[b] Sole aversam teneat, …".
[48] Magnus Steen – Petrus Petreius, 1697. *De hypothesibus astronomicis copernici & ptolemaei, distribe mathematica, qvam ... praeside ... Magnus Steen, respondent: Petrus Petreius* Turku: J. L. Wallius.
[49] Kallinen 1995, 163-165.
[50] Kallinen 1995, 26.
[51] Kallinen 1995, 421, shows almanacs published in Turku for the years 1700 and 1705; WorldCat shows also 1717, 1718, 1719, 1720, 1721, 1722, 1723, 1724, 1725, published in Stockholm.
[52] Kallinen 1995, 165, citing L.G. Tammelin - S. Nidelström, S. 1706. *Dissertatio mathematica de solis et lunae motibus propriis*. Turku: J. Wall. Kalinnen gives the date as 1707 in the text, but 1706 in his bibliography. Cf. p. 165 and p. 421. I have been unable to resolve this inconsistency.
[53] Achrelius 1682, 112-120, esp. 114, corresponding to the marginal heading "Solum igneum esse probat".
[54] Kallinen 1995, 116.
[55] Schofield 1984, 304; repeated, Christine Jones Schofield, 1989. "The Tychonic and semi-Tychonic world systems." In R. Taton and C. Wilson (eds.), *Planetary Astronomy from the Renaissance to the rise of astrophysics.* Part A: *Tycho Brahe to Newton. The General History of Astronomy*, Vol. 2. Cambridge: Cambridge University Press, 33-44, p. 42 col. B.
[56] On these figures see: Miguel A. Granada, 1996. *El debate cosmológico en 1588: Bruno, Brahe, Rothmann, Ursus, Röslin*. Naples: Bibliopolis - Istituto Italiano per gli Studi Filosofici. Nicholas Jardine and Alain-Phillipe Segondes, 2008. *La guerre des astronomes: la querelle au sujet de l'origine du système géo-héliocentrique à la fin du XVIe siècle.* Paris: Les Belles Lettres.
[57] Swerdlow 2012, 83.
[58] Also Kretschmar, later ennobled as Elias von Löwen. His works are indexed under Crätschmair.
[59] Noel M. Swerdlow, 2012. "*Urania Propitia, Tabulae Rudophinae faciles redditae a Maria Cunitia. Beneficent Urania,* the Adaptation of the *Rudolphine Tables* by Maria Cunitz*."* In J.Z. Buchwald (ed.), *A Master of Science History*, *Archimedes* 30. New York: Springer Science, 81-121, p. 83. DOI 10.1007/978-94-007-2627-7_7
[60] Swerdlow 2012, 84, both quotes.
[61] Richard L. Kremer, 2020. "Longomontanus on Mars: The Last Ptolemaic Mathematical Astronomer Creates a Theory." In *Ptolemy's Science of the Stars in the Middle Ages,* ed. by David Juste, Benno van Dalen, Dag Nikolaus Hasse and Charles Burnett, PALS 1. Turnhout: Brepols, 2020, 407–443, on 411, n. 14.
[62] Kremer 2020, 42, n. 17; Dreyer 1915, 2:46-56 (sun) and 2:103-16 (moon).
[63] Maria Cunitz, 1650. *Urania Propitia* sive *Tabulae Astronomicae mirè faciles, vim hypothesium physicarum à Kepplero proditarum complexae; facillimo calculandi compendio, sine ulla Logarithmorum mentione, phaenomenis satisfacientes.* Oels, Silesia: Published by the Author, printed by Johann Seyffert.
[64] ORBITA PLANETAE non est circulus Mathematicus; sed quidam gyrus naturalis, quem planeta, [sol] et [luna] quidem circa Terram: [Saturnus] vero [Jove] [Mars] [Venus] et [Mercurius] circa [sol]em, motu et libratione inaequali, certis et statis temporibus, in universo describunt. Cunitz 1650, 7. Cunitz uses what are now called the astrological symbols for the planets, which I have indicated by the written names in square brackets.
[65] "Orbita Planetae, der umbkrais des Planetens / ist ein etwas ablänglichter Circkel / den Sonn / und Mond umb die Erde: die andern 5 [Saturn][Jupiter] [Mars] [Venus] [Mercury] umb der Sonn herumb / in gewisser Zeit / ungleich sich bewegende / und durch ungleiche zu näher und entfernung in dem unendlichen raum gleichsam beschreiben." Cunitz 1650, 184, cf. Swerdlow 2012, 88. This transcription and translation by PB, with thanks to KMC for assistance.
[66] Cunitz' adherence to Tychonism has also been noted by Ingrid Guentherodt, 2005. "Augenschein und Finsternisse: zur Sprache von Maria Cunitia (1604?-1664)."*Acta Universitatis Carolinae. Mathematica et Physica*, 46 (Supplement): 15-28 , p. 25.
[67] Longomontanus, 1622, 161; Pietro Daniel Omodeo, 2011. "David Origanus's Planetary System (1599 and 1609)."*Journal for the History of Astronomy*, 42(4): 439-454. Pietro Daniel Omodeo, 2014, *Copernicus in the Cultural Debates of the Renaissance: Reception, Legacy, Transformation.* Leiden: Brill. On Origanus 149, on Longomontanus 155 text to n. 108.
[68] Elias Crätschmair, 1626. *Horologium Zodiacale, Sive Tabulae perpetuae justam & veram singularum horarum planetariarum quantitatem per totum annum complectentes, &c., Das ist: Immerwehrender Magischer- oder Planeten-Stund Zeiger.* Breslau: Publisher: David Mueller, Printer: Georg Bawman. http://digital.slub-dresden.de/id263689395, fol. Aiii verso. On the 1628 calendar see Herbst, Klaus-Dieter 2019 "Crätschmair, Elias" *Biobibliographisches Handbuch der Kalendermacher von 1550 bis 1750* (https://www.presseforschung.uni-bremen.de/dokuwiki/ doku.php? id=craetschmair_elias).
[69] Elias Crätschmair 1628, *Kalendarium*, fol. 7, cited in Herbst 2019. Crätschmair also published calendars with prognostications for 1627 and 1629, all published by David Müller in Breslau and printed by August Gründer in Brieg. Herbst, 2019.
[70] Swerdlow 2012, 83. According to https://de.wikipedia.org/wiki/Heinrich_Cunitz, Heinrich claimed to have studied with Tycho at Uraniborg in 1598-9. If true this would clearly support my case. However, this is chronologically impossible, as Tycho left Uraniborg and Denmark in 1597. More work needs to be done to settle this question.
[71] See n. 93
[72] Briefly, the career of Tychonism in Denmark extends from Longomontanus (d.1647), who returned home and gained first a professorship at the University of Copenhagen and later the patronage of Christian IV. The best source for his life and works is Christianson 2000, 313-319. Support for Tychonism in Denmark continued through several members of the Bartholin family, which Longomontanus married into. Examples are Peter Bartholin (1586 - 1642) who in 1632 published *Apologia pro observationibus, et hypotesibus astronomicis nobilissimi viri Dn. Tychonis Brahedani.* Copenhagen: Joachim Moltken, and Erasmus Bartholin (1625 - 1698), who, assisted by Ole Roemer, edited Brahe's observations for publication between 1664-1670. Tychonism persisted at least through the career of Ole Rømer (d.1710), and perhaps beyond. In general see: Claus Thykier, Kjeld Gyldenkerne, and Per Barner Darnell (eds.) 1990. *Dansk astronomi gennem firehundrede år.* 3 vols. Copenhagen: Rhodos Forlag.
[73] More has already been said by Carolino and Kallinen, of which I have only been able to offer brief summaries. See also, especially Michel-Pierre Lerner's paper "L'entrée de Tycho Brahe chez les jésuites, ou le chante de cygne de Clavius." In *Les jésuites à la Renaissance: Système éducatif et production du savoir, ed. Luce* Giard (Presses Universitaires de France, Bibliothèque d'histoire des sciences, 1995), 145–85, and Christopher M. Graney, 2015. *Setting Aside All Authority: Giovanni Battista Riccioli and the Science against Copernicus in the Age of Galileo*. Notre Dame, IN: Notre Dame Press.
[74] Lorenz Eichstadt, 1634-1636. *Pars prima et secunda Ephemeridum novarum et motuum coelestium quinquennalis [resp. decennalis] ad annos 1636-1650.* Stettin: Laurentius Eichstadius.
Lorenz Eichstadt, 1644. *Ephemeridum novarum et motuum coelestium ab anno 1651 ad annum 1665 pars tertia.* Amsterdam: Laurentius Eichstadius.
Lorenz Eichstadt, 1645. *Ephemeridum novarum et motuum coelestium, ab anno 1651 ad 1665 pars tertia ... a Laurentio Eichstadio*. Gdansk: n.p.
[75] Kremer 2020, 407-9.
[76] Lorenz Eichstadt, 1644. T*abulae harmonicae coelestium motuum: tum primorum tum secundorum seu doctrinae sphaericae et theoriae planetarum.* Stettin (Szczecin): Laurentius Eichstadius; *Idem*, 1653. *Exercitatio astronomica exhibens locum, motum, magnitudinem, causas, effectus & significationes cometæ, qui sub finem anni æ.C.1652 & initium anni æ.C.1653 St. N. illuxit ...* . Gdansk, n.p.
[77] Schofield 1984, on Hopton: 306 and n. 146; Strof: 217 and n. 167.
[78] Arthur Hopton, 1612. *A concordancy of yeares: Containing a new, easie, and most exact computation of time, according to the English account.* [London]: Printed [by Nicholas Okes] for the Company of Stationers. Geocentric planetary system 38-41; stars defined as denser parts of their orbs 49.
[79] The author published the almanac under an anagram of his real name, which is Arthur Frost. I thank Kerr Petbear for pointing this out.
[80] Strof 1627, e.g. B3v-B4r.
[81] Strof 1627, B4v.
[82] Strof 1627, [C4r].
[83] On astronomy in the *Encyclopédie* see Miguel Angel Granada, 2009. "La revolucion, astronomico-cosmologica en la Encyclopédie." In Miguel Angel Granada et al. (éds.), *Filósofos, filosofia y filosofias en la Encyclopédie de Diderot y d'Alembert.* Edicions Universitat, Barcelone, 2009, 77-96; Colette Le Lay and Irène Passeron, 2017. « L'astronomie

dans l'Encyclopédie » Édition numérique collaborative et critique de l'Encyclopédie. HAL Id: hal-02381455, https://hal.science/hal-02381455

[84] Victor Thoren, with contributions from John R. Christianson, 1990. *The Lord of Uraniborg: A Biography of Tycho Brahe*. Cambridge: Cambridge University Press.Christianson 2020, esp. Ch. 5; Ann Blair 1990. "Tycho Brahe's critique of Copernicus and the Copernican system." *Journal for the History of Ideas* 51: 355-377.

[85] Victor Thoren 1988. "Prosthaphaeresis Revisited." *Historia Mathematica* 15: 32-39; Adam Morawiec 2020. "Itinerarium Wittichi Ex Calendarium Sculteti: New Biographical Evidence on the Breslau Mathematician Paul Wittich (ca. 1546–Ca. 1587)." *Centaurus* 62(3): 465-478.

[86] On Strof, see above; on the Bartolins see note 71.

[87] Jardine and Segonds 2008.

[88] Christianson 2020, esp. Ch. 7 and pp. 204-5; Adam Mosley 2007, *Bearing the Heavens: Tycho Brahe and the Astronomical Community of the Late Sixteenth Century.* Cambridge: Cambridge University Press.

[89] Emma Perkins 2018. "Instruments of authority: Tycho Brahe's technological illustrations." *History and Technology* 34(3/4): 259-272.

[90] Roger Ariew 1987. "The phases of Venus before 1610." *Studies in History and Philosophy of Science Part A* 18 (1): 81-92.

[91] Graney 2015, esp. Ch. 9.

[92] Schofield 1984, 264.

[93] On Kepler see Peter Barker, 2000. "The role of religion in the Lutheran response to Copernicus" in M. J. Osler (ed.) *Rethinking the Scientific Revolution*. Cambridge University Press, 59-88, and Peter Barker and Bernard R. Goldstein, 2001, "Theological foundations of Kepler's astronomy," in John Hedley Brooke, Margaret J. Osler, and Jitse van der Meer. (eds.), *Science in Theistic Contexts: Cognitive Dimensions*. *Osiris*, 16, 88-113. On Descartes, note simply the explicit role of God in the *Meditations* and elsewhere. For Newton see e.g. Snobelen, Stephen D. 2003. " "A Time and Times and the Dividing of Time": Isaac Newton, the Apocalypse, and 2060 A.D*" Canadian Journal of History/Annales canadiennnes d'histoire* 38: 537-551, esp. 545-550.

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Decoding narratives on halo phenomena: an approach to Tycho Brahe's Vision of Urania in *De nova stella* (1573)

Dagmar Luise Neuhäuser

Abstract: The booklet *De nova stella*, published by Tycho Brahe in 1573, contains various texts, some of which have little to do with the stellar explosion known today as a supernova: Towards the end there is a poem *In Uraniam Elegia Autoris*, 232 verses long, in which Tycho condenses a visionary encounter with the goddess of the muses, Urania. But who or what is "Urania"? Is it just a literary fiction, an allegory of the supernova, an epiphany in the style of Ovid, a self-reflection projected onto the outside world? In a *close reading*, text passages that have received less attention so far are decoded - the evidence found in the process makes it clear: Tycho's "Urania" has a *fundamentum in re*. An hitherto underexposed side of the Renaissance scholar becomes visible: Tycho Brahe as a gifted observer of rare meteorological phenomena, who stands in the tradition of halo visionaries. The first part of the article attempts to provide an introduction to this complex subject.

Keywords: Tycho Brahe; prophetic astrology; meteorology: halo phenomena; stella nova; SN 1572.

1. Decoding narratives on halo phenomena: an introduction

In our inter-disciplinary research project called Terra-Astronomy, we use *terrestrial archives*, both of natural as well as cultural provenance, as epistemic key to study astrophysical problems with secular time-scales.[1] Either way, whether examining comet orbits, nova/supernova explosions, or solar activity, our methods must guarantee a clean data set drawn from these archives - otherwise, sustainable conclusions are not possible.[2] *Historical* records of celestial observations in the day and night sky need to be reviewed regarding sources, transmission lines, dating issues, terminology, contexts, intentions, translations etc. Existing collections of the respective sightings often do not meet a sufficient hermeneutic standard, which is otherwise given in the humanities; nevertheless, scientific research sometimes relies on them uncritically.[3]

Our methodological efforts are aimed at a deep understanding of the textual basis - this can be reliably operationalized only through a close reading, so that the quantification of observed parameters for scientific needs can take place.[4] We also try to develop *criteria* for physical identification - because historical observations of *celestial signs* are often described phenotypically: However, with the help of categories - like position, time, appearance (color, shape and size), behavior, and duration, details that could in principle be mentioned in the records - the phenomena can be classified in today's sense. More precisely: whether and which criteria are fulfilled is checked by asking where, when, of what kind, how variable and for how long the reported sighting was in the sky, and by comparing this in each case with the typical characteristics of the suspected physical event.[5]

Fig. 1. Lunar halo feature on the evening of 2022 April 15, Alberta, Canada - shown here courtesy of photo author Alan Dyer, for more details see: https://www.amazingsky.com/Atmospheric/Atmospheric-Halos/i-69kHhJ8/A

Awareness of the problems involved in classifying the various *signs*, both astronomical and atmospheric, is widely underexposed: It is a danger signal, as happened a few years ago, when one report on a "red cross" that appeared in the sky, makes a career as nearby supernova, as aurora borealis during a severe solar storm, as airburst after a short gamma-ray-burst, all to explain somehow the detected C14-variation around 775 (all dates given in Christian era) - but what if the record from the Anglo-Saxon Chronicle was an unrelated sighting of a so-called halo phenomenon due to an incoming depression?[6] As an example of various halo effects, see *Fig.* 1: The upper and lower vertical pillar together with the horizontal (here paraselenic) circle form a - hardly discernible - cross of light. To the natural scientific community, we address our primary recommendation for dealing with historical transmitted observations: "Historical records must not be used as quarry: we have to approach the problem unbiased, we have to be aware of our modern interests."[7]

In fact, there is a further layer: many textual testimonies about heavenly events - in the form of myths, visions, poems, dreams - are interpreted as pure fiction.

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Sigmund Freud's dictum at the beginning of the 20th century that the unconscious projects itself into an imaginary outside is still powerful.[8] Also, Carl Gustav Jung (d. 1961) denies any external real factuality with the psychogenetic foundation of the archetypes.[9] On the other side, many natural explanations put forward in the 19th and early 20th centuries fall short.[10] Others *physicalize* these texts and impute far-reaching knowledge to them.[11] A currently dominant research approach is limited to examining the function(s) and meaning(s) within the textual conception, because one has - supposedly - nothing but the text (of the vision, the dream, the myth) whose truthfulness cannot be verified.[12]

A prime example here is the controversy about the "sign of the cross ... made by light ... across the sun", which, according to the church historian Eusebius of Caesarea (d. c. 339), Emperor Constantine the Great (d. 337) himself and together with others saw in the sky (note 60): Although newly advanced arguments (with recourse to previous considerations) have elaborated that an impressive halo feature may have been the natural basis, i.e., the *fundamentum in re* of the relevant textual evidences, a fictitious understanding is still being debated. The main counter-argument is that there would be no "test" to distinguish between real and constructed visions - in the second part of our approach, we will try to dispel this prejudice.[13] What is interesting here is that historians who - by chance - became observers of extended halo displays suddenly understood the lore better; they were thus also able to contextualize the aftermath of the sighting more appropriately.[14]

Fig. 2. Solar halo (22° ring) above Merano, Alto Adige/South Tyrol, Italy, on 2020 July 21 (photo DLN)

Studying historical celestial observations worldwide and systematically (within an inter-disciplinary team), one will find that various halo phenomena around the sun and moon have been carefully observed and noted since long ago.[15] In particular, the 22° ring - the halo par excellence - around sun (*Fig.* 2) or moon (*Fig.* 1) is a credible signal for rain within the next two days, thus it took attention as *portent*; for example, an omen from Assyria has: "If the sun is surrounded by a halo: it will rain; change of weather. From Rašil."[16] In *Meteorologica*, Book III, Aristotle (d. 322 BC) discusses in detail - what we call today - the rainbow (gr. ἶρις), which can occur around the opposite point of the sun or moon in the departing rain. The same book also treats the most common halo phenomena, such as the 22° ring (gr. ἅλως), as well as parhelia or paraselenae (modernly called mock suns/moons or sun/moon dogs), which can be seen as rainbow-colored or whitish glowing patches of light to the right and/or left of the sun or moon, about a hand span away with an outstretched arm (see *Fig.* 1).[17]

Despite Martin Luther's (d. 1546) scathing verdict "but all my life I have believed in no book less than this [*Meteorologica*], ... that everything in nature happens from natural causes"[18], the physical understanding was grown - based on Aristotle and Ibn Al Haytham ([Alhazen] d. 1040) via Willebrord Snellius (d. 1626) and René Descartes (d. 1650) and others to Christiaan Huygens (d. 1695). Here just a brief and general summary: Halo phenomena are atmospheric-optical, whitish-shiny or rainbow-colored brightenings in the form of spots, arcs, columns and circles caused by reflection or refraction, respectively, of sunlight or moonlight on floating or falling ice crystals (usually hexagonal plates or columns with certain orientations), which occur mainly in veil clouds (especially in cirrus, cirrostratus, see *Fig.* 2) at an altitude of about seven to twelve kilometers, but also in ground-level ice fog.[19]

As a sign of blessing, i.e., as a harbinger of rain, and at the same time of overwhelming size and beauty, the apparitions of halo effects are widely loaded with religious associations. The explanatory text of a broadsheet - for instance - printed for the German-speaking market, which refers clearly to a complex halo feature on 1630 April 19, probably above Nuremberg, expresses both aspects, the natural as well as the supernatural: it is a weather-indicator *and* it is a kind of divine presence, revelation, communication.[20] In the Reformation aftermath, the religious interpretation of such celestial spectacles was increasingly problematized. Martin Luther (d. 1546) rejects this *sign language* at least since his confrontation with Thomas Müntzer (d. 1525) and the bloody end of the Peasants' Wars (which does not rule out the possibility that he himself once considered them important). His opponent, on the other hand, believed primarily that the eternal Word *speaks* through the images on sky - it can be shown that his so-called "rainbow" banner and sermon are clearly based on halo apparitions.[21] Both strands can be traced further historically: *sola scriptura* or the actualized *experience* of the biblical writings - among the followers of the latter, the (Ana-)Baptists and the Dreamers, there are many other visionaries.[22]

Philipp Melanchthon (d. 1560) is less restrictive than Luther, as his Latin epigram on the broadsheet about an extended halo phenomenon he and others observed above the Elbe river on 1551 March 21 shows (*Fig.* 3).[23] Although he speaks of a "mendax imago" in the face of various bows and multiple suns, the apocalyptic concern about the significance of this apparition also resonates:[24]

As the sun alone spreads its light over the whole earth
and alone refreshes everything with revitalizing warmth,
the Son alone, through the mind of the eternal Father,
inflames our hearts with his rays.
Ah, why are several images of the sun nevertheless seen
and why is a false image in the empty sky deceiving?
Some may invent fabrications of doctrine
and throw more torches into the discord.
But you, Son of God, drive the lies far away,
may Your Light alone guide the unanimous hearts.

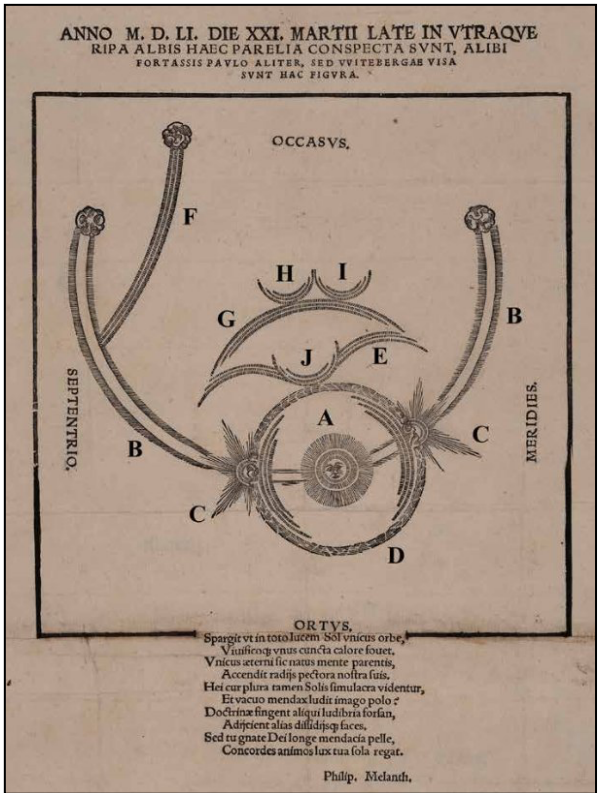

Fig. 3. Broadsheet with a solar halo phenomenon above Wittenberg/Elbe on 1551 March 21; Stiftung Schloss Friedenstein Gotha, "Fliegende Blätter", Band II, p. 502, No. 450, Inv. Nr.18,4 (explanations of the added letters, see note 23)

One of the greatest biblical apocalypticists is the Hebrew prophet Ezekiel, who had a number of visions during the Babylonian exile in the sixth century BC. According to Donald H. Menzel (1953), who was a professor of astrophysics at Harvard University, Ezechiel "proves to take top rank as an observing scientist and recorder of important meteorological phenomena"; "and - whatever religious significance one may wish to assign to it - the origin of the vision becomes clear."[25] As part of his critical examination of modern sightings of so-called *flying saucers* (UFOs), D. H. Menzel also "searched for early examples" - "the story of the wheels" from chapter one of the Book of Ezekiel came to mind.[26]

"And I looked, and, behold [!], a whirlwind came out of the north, a great cloud, and a fire infolding itself, and a brightness was about it", that is the beginning of Ezekiel's first vision - datable to June/July 593 BC - at the river Chebar in Chaldea/Babylonia: "out of the midst thereof came the likeness of four living creatures. And this was their appearance; they had the likeness of a man".[27] Menzel elaborates - from the further and more detailed description by Ezekiel - "we clearly see that the figure contained a cross, centered on the sun. The arms of the cross looked like the spokes of a wheel; each formed the body of a figure".[28] In his book "Flying saucers" (1953) Donald H. Menzel provides a re-visualization similar to the light pattern in *Fig.* 10, for instance. Indeed, Ezekiel's vision (not only this one) has its factual Sitz-im-Leben, its *fundamentum in re*, in the experience of a great halo phenomenon: Even if the textual analysis can be refined today - also thanks to numerous photographic documentations and media possibilities on the one hand, as well as excellent editions and commentaries of the biblical books on the other - someone who, like D. H. Menzel, masters atmospheric sign language, can re-translate the narratives and ensure that they meet the halo criteria and pass the halo test.[29]

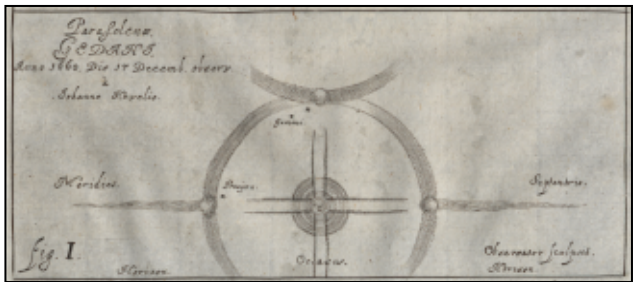

Fig. 4. Lunar halo cross and paraselenae with long tails above Gdansk on 1660 December 17, observed by Johannes Hevelius; *Mercurius in Sole Visus*, Gdansk 1662, fig. I (section), provided as a digital copy by ThULB Jena

Each halo display is unique (due to weather conditions, altitude of sun or moon etc.), but since the laws of reflection and refraction are always the same, figures, patterns, symmetries etc. can be re-cognized by experienced observers. The imaginative naming of effects is either self-explanatory (e.g., "the likeness of a man") and/or it already obeys certain fixed designations that are established for the respective appearances within the airy drama (just compare the biblical prophets with each other and with the later tradition).[30] It seems that the interpretation of the signs follows the more original mnemonic function - sometimes these set pieces have become whole, admittedly somehow irrational stories.[31] Many observational reports prove that such apparitions - even without primary religious charge - have an overwhelming aesthetic:

"If a Finnish halo enthusiast that were given a chance to get in to a time machine, the destination would probably be Kuusankoske on 10 March 1920. On that morning in southern parts of the country a spectacle developed in the sky that is still regarded as possibly the greatest halo display in Finland. ... The most important giving of the display may lie in what the several reports from people who had no experience on halo observing tell about the psychological factors that affect the observations."[32]

Halo phenomena are transcendent in a quasi natural way: Their numinosity, which in contrast to the term coined by Rudolf Otto (d. 1937) is by no means completely formless, is actually experienced as *mysterium fascinosum* or *mysterium tremendum* or simply as *augustum*.[33] Marcel Minnaert (d. 1970), the pioneer of popularizing atmospheric *wonders* as optical facts, gives in his book "Light and Color in the Outdoors" the following as an example of a disturbing halo feature:

"On 14 July 1865, the alpinist [Edward] Whymper and his companions were the first to reach the top of the Matterhorn, but on the way back four of the men slipped and fell headlong down a precipice. Toward the evening, Whymper saw an awe-inspiring circle of light with three crosses in the sky: 'the ghostly apparitions of light hung motionless: it was a strange and awesome sight, unique to me and indescribably imposing at such a moment'."[34]

Even an experienced observer such as Johannes Hevelius (d. 1687) seems to have been enthusiastic about the sighting of a moonlight cross above Gdansk on December 17, 1660 (see Fig. 4):

"across the real moon itself, which is extremely rare, spread an exceptionally large, shiny white or silver-colored cross ... it was so brilliant and full of light that it shone clearly even until the sun rose".[35]

2. Tycho Brahe's Vision of Urania in *De nova stella* (1573) - a close reading

The second section attempts to apply the outlined method of "decoding narratives on halo phenomena" to a text that has received philological attention as well as interest from natural philosophy and the history of science: "In Uraniam Elegia Autoris" is an extensive Latin poem found quasi at the end of "De nova stella" (1573) - this is the short title of Tycho Brahe's book-conglomerate about the supernova (now) named after him.[36] Anyone who deals with the stellar explosion of 1572, e.g., with regard to its brightness and color evolution (as we did within the framework of our inter-disciplinary research project, called terra-astronomy),[37] comes across this "elegy", at least in passing. A close analysis of the *Urania-vision* it presents will show that information about the new star and its observation by Tycho Brahe (1546 - 1601, *Fig.* 5) will be also given here - albeit only indirectly.[38] The more immediate question, however, is: what did Tycho *see* when he thought he had seen "Urania"? (And it is in this sense that this article speaks of "vision".)

A certain challenge may lie in the fact that poetic self-reflection, not to say self-stylization, is essentially (and rightly) identified here. Furthermore, the somehow irrational-seeming encounter with "Urania" undermines the text as a credible historical-factual source. So, for example, Victor E. Thoren (with contributions by John R. Christianson) in a detailed biography to Tycho Brahe, the "Lord of Uraniborg", published in 1990:

"Then in a 230-line poetic epilogue, … Tycho deprecated the glories esteemed by others of his class: ... What he hoped to achieve was the eternal glory of having successfully cultivated astronomy, and he would not be deterred by the opinions of others. ... What he did not accomplish by himself he would not call his own. The rest of his *Elegy* is allegorical, composed with the intent of capturing in verse the power of the star and the muse."[39]

During the Renaissance and Humanism, the ancient muse Urania was worshipped by lovers of the starry sky as the personification of astronomy: in the poem, she is explicitly introduced as one of the nine Apollonian muses who call home on Mount Olympus. But does one of the world's best observers of the supernova of 1572/73 conclude his multifaceted debut (previously he had only published touching verses about his stillborn twin), which should prove him to be a researcher capable of astronomical art in the broadest sense, with such abstract symbolism? In other words, is the "allegorical rest" of Tycho's elegy entirely fictitious? Is his linguistically sophisticated work above all an eclectic pastime of an ambitious scholar?[40] Or does his encounter with "Urania" not rather breathe the kind of genuine inspiration we know from other visions? When we read and listen, do we not become witnesses to a subtle experience that oscillates somewhere between outside and inside? John R. Christianson (2020) outlines the philosophical-spiritual cosmos in which Tycho moves:

"The final section of the book was an 'Elegy on Urania' composed by Tycho in the style of Ovid. ... Urania suddenly appeared and summoned Tycho to worship her instead of Vulcan. ... In her realm, however, 'high in the sky, above the clouds, I enjoy celestial ambrosia with Jupiter himself'. So then, why do you hesitate? *Ergo age, quid dubitas?* The phrase was echoed in Ripensis' opening poem. Tycho replied to this divine summons in the manner of Pico, as a Magus, a man made divine and able to participate in the intellect infused in nature".[41]

Fig. 5. Portrait of Tycho Brahe from 1586 framed by the family coats of arms, second (corrected) engraving by J. de Gheyn; British Museum (public domain)

Indeed, one must resist the temptation to read Tycho as a modern secularized researcher reduced to a narrow field. Even if his observations and measurements give new impetus to the empirical-inductive method (following on from Hipparchus and Ptolemy), he is nevertheless a scholar whose self-image is embedded in the broad and curious horizon of his time: alchemy, astrology and prophecy - to name just the most obvious *magical* residia - are also somehow part of this. Håkon Håkonsson (2004) has (re)exposed this side of Tycho Brahe, which is often ignored or neglected in historical research focusing on developments in the natural sciences.[42] On the other hand, the challenge also lies in not *psychologizing* and/or *literarizing* from the outset such ambitions and concepts that

are somehow incomprehensible or suspect to us today. Tycho believes - if one takes his elegy seriously as an authentic source - that he has truly experienced this divine election: as “Magus” he is "able to participate in the intellect infused in nature."[43]

Should this observational analyst and holistic practitioner really be content with the literary construct of an *allegory*, far removed from any living symbol of Urania's gifts - *now* that the new star in the sky is challenging traditional ancient knowledge and he feels called to be the high priest of measurement better than ever? Could this thoroughbred Latin-thinking humanist not have perceived the surprising experience of an awe-inspiring *sign* as a quasi supernatural event - even if it was caused by the reflection and refraction of moonlight on tiny ice crystals (the underlying optics were not yet fully understood in the 16th century); analogous to the new *miracle* star, which is nevertheless intensively researched according to all the rules of the art. Was it not a divine greeting and a human salutation (due to a phenomenon seen on sky) at the same time: "Behold, a goddess"? Could it not be that Tycho Brahe is paying homage to the ancient prophetic power of the *halo code* in his Urania-Elegy? In a close reading and with some cross-references, we want to give wings to this thesis.

Fig. 6. Map of Denmark, engraving by M. Jordan (later colored); Braun & Hogenberg: *Civitates Orbis Terrarum*, Vol. IV, Colonia 1585

This "test" (note 13) should be done: Is there any substantial evidence that the vision of the elegy is based on the sighting of a halo phenomenon, i.e., is it essentially a *halo narrative*? Which criteria are fulfilled? To what extent can the text be re-visualized? We will go through the poem, more specifically all those passages that shed light on what Tycho might have *seen* as "Urania". We use the Latin text of the Dreyer edition (1913), but in the slightly modified form by Peter Zeeberg (2007), which has the advantage of a continuous verse count; P. Zeeberg also provides a translation and detailed commentary in Danish, while some longer passages have been rendered into English by John R. Christianson (2000, 2024).[44] For identification purposes, those categories are queried that allow a critical comparison with other conceivable celestial phenomena (e.g., the *stella nova*, twilight, the starry sky as such), but above all help to clarify whether Tycho's "Urania" has an external reality at all. Information can be found more or less for all five categories (which have already been introduced in the first part): position, time, appearance (e.g., size, form), behavior, and duration, i.e., where, when, how (of what kind), how variable, for how long the sign was seen in the sky? Of course, the observational site limits these questions from the outset: So *where* was Tycho?

Est locus ad Rynae properantes fluminis undas, (1)
Aspicies, Musas hîc habitare putes;
Quo non fertilior, quo non iucundior extat,
Qua videt Arctoum SCANIA tota polum;
...
Hunc nemus umbroso circumdans undique flexu, (7)
Claudit in aprico mollia prata sinu.
In medio spectanda domus, cui prisca Vetustas
Concessit nomen HERRIS habere VADI.
...
HAC ego Stenonj, quòd noster Avunculus esset, (27)
Tempore dum longo, iunctus in aede moror;

In the first 28 verses of the poem, Tycho describes his current whereabouts: it is the former monastery of *Herrevad* (v. 10), which was secularized as a result of the Reformation and is now inhabited and administered by his uncle *Sten Bille* (vv. 19ff.). The extensive area stretches along the middle course of the Rönne (about 10 km upstream from Klippan), a smaller river with only a slight gradient that crosses Scania/Skåne from southeast to northwest; "properantes fluminis undas" in the first line apparently means less fast-flowing than wild-flowing. Tycho's statement that a forest provides shade all around and yet encloses soft meadows in an open, sunny embrace (vv. 7f.) is probably an allusion to the "locus" (v. 1) of Herrevad, but is also largely characteristic of the entire region. Scania, which at that time belonged to Denmark, lies in the extreme southwest of today's Sweden and is washed by the Kattegat, the Sound and the Baltic Sea (see *Fig.* 6); it is a mostly flat undulating landscape with few elevations of a maximum of 200 m - Herrevad lies at an altitude of about 50 m, barely 20 m higher than the nearby Rönne. (The map in Fig. 6 gives Scania as “Schania”, “Heratzcloster” is shown above the two first letters, but the river Rönne is missing.) Overall, the observing site offers a low horizon and, at a geographical latitude of about 56°, a good view of the vast polar region (v. 4), where *the bears* are circumpolar, i.e., never set below the horizon (v. 93). The higher humidity facilitates halo effects, including those that appear particularly bright in ice fog of cold winter months.

Fortè per umbriferae digressus limina Sylvae, (29)
Solus ad irriguas expatiabar aquas.
Sol erat Hesperias se tunc missurus in undas,
Lunaque nocturnos acceleravit equos. (32)
En DEA (nescio quae) coelo delapsa sereno,
Protinus hîc oculos constitit ante meos.

On the day Tycho sighted "DEA" (v. 33), a goddess, he leaves the boundaries of the shady forest - purely by chance or even by providence, as "fortè" suggests (v. 29).[45] He strolls alone "ad irriguas aquas" (v. 30), which

most likely refers to the untamed *Rönne* river and not to artificial irrigation systems, since Tycho describes this very river in the first sentence of his poem as "locus" *where the muses dwell* ("Musas hîc habitare putes"). Nota bene: This opening scene in particular is read as an allusion to some verses by the Roman poet Ovid.[46]

And *what time* did Tycho take his walk? The two following verses 31 and 32 make it clear that the sun *in the west* - described as "Hesperias" (while "Hesperus" means the evening star) - is just sinking into the waves of the Sound ("in undas" here certainly does not refer to the Rönne, cf. v. 1), while the moon accelerates its *nocturnal horses*, i.e., is already climbing the ecliptic in the east. And *where* and *when* exactly did Tycho see "Urania"? Since immediately after this last statement - the lunar horses will be discussed below - "DEA" (i.e., "Urania", vv. 39f.) emerged right in front of his eyes, we may conclude that the apparition is approximately in the direction of the moon (vv. 33f.). The moment is indicated by the setting sun - it is the beginning of civil twilight: the planets and also the brightest stars are becoming clearly visible. But on *which day* was "Urania" seen by Tycho?

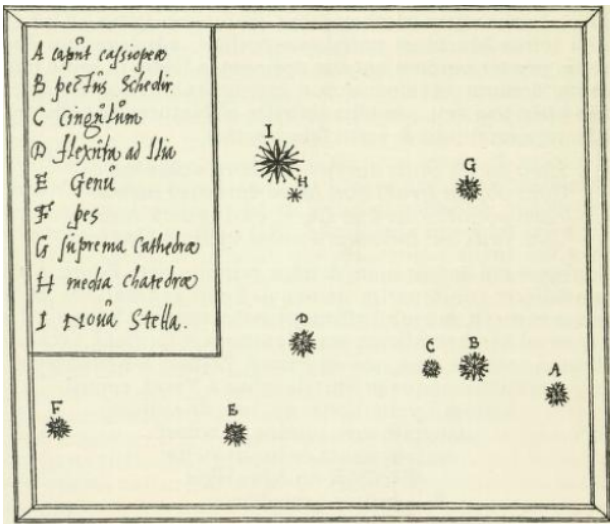

Fig. 7. The "new star" and the celestial "M/W" formed by the stars of Cassiopeia; Tycho Brahe, *De nova stella*, 1573 in: John L. E. Dreyer (ed.), Vol. I, Copenhagen 1913, p. 20

En nova sublimi spectatur in aethere Stella, (121)
Qua sedet ad boreum Cassiopea Polum.

There are initially two dates that narrow down the time period: The "nova" can already be seen (*Fig.* 7), where *Cassiopeia is sitting*, towards the *North Pole* (vv. 121f.); Tycho spotted it for the first time on November 11, 1572, as we know from his essay on the New Star. The completion of his book (including his most recent observations of the supernova) can be dated to May 5, 1573 at the latest, as explicitly stated in "De nova stella" (which does not rule out the possibility that it was already partly in print by then).[47] Moreover: In early 1573, he is said to have met in Copenhagen with his friends, who had not yet noticed the new star, but encouraged Tycho to publish his book project under his own name.[48]

Furthermore: In verse 121, "Urania" points to the new star: "En nova" - *Behold!* Since the apparition of the goddess began shortly after sunset, i.e., in civil twilight (which lasts until the sun is 6° below the horizon), the supernova mentioned soon must have been well visible - which would be given best in November and December as we know from Tycho himself: the "nova" was then at least as bright as planet Jupiter and thus far brighter than any other star. In January it was already less, although still brighter than fixed stars of the first magnitude, at the beginning of May it was no longer brighter than stars of the second magnitude - then one could not simply make it out in nautical twilight (the sun being 6° to 12° below the horizon).[49] Nota bene: An identification of the Urania apparition with the "new star" or an allegorization of the supernova as Urania (note 43) is against the statements in the text that presuppose two entities (e.g., v. 121). Are there any other hints as on which day exactly the encounter with "Urania" might have taken place?

Demonstrans alijs dirum non esse Cometam, (127)
Sed numero stellas hanc sociasse suo.
Nam quia nil veteres mortalia pectora tangunt,
Haec nova, quod veteres non monuere, monet.
Insuper Annus adest renovatis orbibus, ex quo (131)
Est Deus è casta Virgine natus Homo.
Huic volo designes labentia tempora coelo, (133)
Aptabisque suos ad vaga signa dies.
Astrorum positus Solis Lunaeque recursus
Lapsaque sub terras, ortaque signa nota.

The visible *performance* of "Urania" comprises a good 120 lines of verses (vv. 33-154), in the last third the specific tasks are set for Tycho; e.g., he is asked to prove that the *nova* is not a *comet*, but belongs to the *fixed stars* (vv. 127f.). However, the goddess demands even more: Tycho is commissioned to *adapt* ("aptabisque") the "labentia tempora" to the actual conditions in the sky (vv. 133ff.) - here, "labentia" is aimed more at the *errant* course of time (while "lapsaque" is in contrast to "ortaque", v. 136). The driving idea behind this desire is to provide astrological weather prognostications on an astronomically correct basis in future (vv. 137-144): Tycho completed the calculation for the example year 1573 in December 1572 at Herrevad *Museum* (in the classical sense of *temple*), as can be seen from the so-called *dedication letter* which was included in the first edition of “De Nova Stella” – in contrast to the extensive tables and figures.[50]

These "appendices", which "the author has worked out with unique diligence", as it says in the table of contents, clearly show that Tycho has implemented (already) Urania's order: What is immediately noticeable is that the solstices and equinoxes are all calculated astronomically, i.e., they are specified - starting with the beginning of winter in December 1572 - to the minute for the dates December 11, March 10, June 12 and September 13. It is known at the time that the Julian calendar was virtually ten days behind compared to the vernal equinox, which was set on March 21st under Emperor Constantine the Great (d. 337); the Gregorian calendar reform will remedy this lag in 1582, its establishment took centuries - but Tycho always had a positive attitude towards it, which was not a given in the Protestant camp.[51] Of course, he uses the common Julian calendar for his "new and learned method": but the empirical adaptation of the celestial conditions to the earthly data is carried out radically and consistently for all days of the year for the sun, moon,

planets as well as many stars - and the (traditional) astro-meteorological interpretations by Tycho are based then on this information.[52]

When "Urania" now says in verses 131 and 132 that the year - in astronomically *renewed or restored orbits* ("renovatis orbibus") - stands exactly where God once became man in the Holy Night ("Annus adest ... ex quo/ Est Deus è casta Virgine natus Homo"), then one has to conclude that the Julian calendar is just showing 1572 December 14; and in verse 134 a day-accurate adjustment is explicitly demanded. Tycho Brahe celebrated his 26th birthday on this very day - but in Urania's sky it is actually already Christmas, based on the tropical phase. It cannot be ruled out that the wording of "Urania" instead alludes to the Solemnity of the Nativity, then December 15 (Julian) would be meant.

If so, this quasi second birthday, the date of Tycho's re-naissance in Urania's realm (vv. 223ff.) should also fit the scenario outlined earlier: Indeed, on December 14, in the area of Herrevad at 3:25 p.m. local time, the three-quarter full moon was almost 18° high in the ESE when the sun was setting in the SW; on December 15, the 85% illuminated moon stands 15° above horizon in the east at sunset; (NB: on Dec 24 and Dec 25, Julian style, the moon would not have been in the evening sky). A walk - mainly during civil twilight and beginning nautical twilight, i.e., until around 4:30 p.m. - upstream along the Rönne would take Tycho straight to *Luna's horses* and to "DEA" (vv. 32f.).[53]

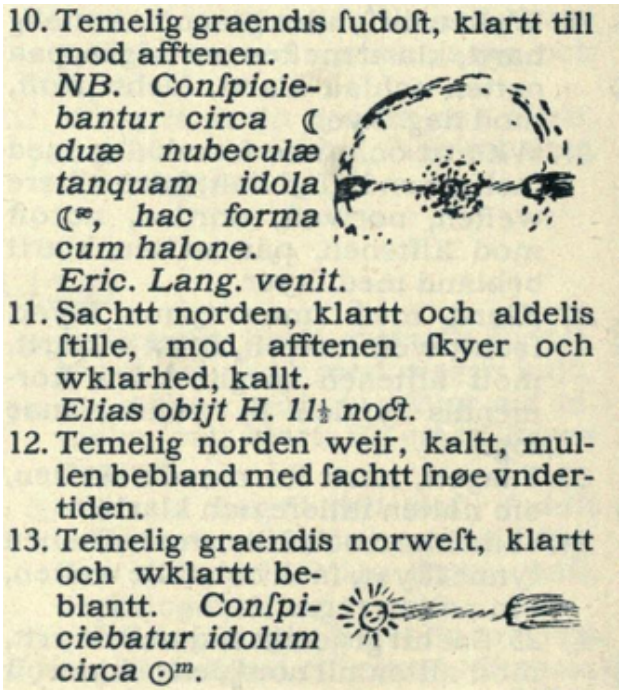
10. Temelig graendis ſudoſt, klartt till mod afftenen.
NB. Conſpiciebantur circa ☾ duæ nubeculæ tanquam idola ☾∞, hac forma cum halone.
Eric. Lang. venit.
11. Sachtt norden, klartt och aldelis ſtille, mod afftenen ſkyer och wklarhed, kallt.
Elias obijt H. 11½ noct.
12. Temelig norden weir, kaltt, mullen bebland med ſachtt ſnøe vndertiden.
13. Temelig graendis norweſt, klartt och wklartt beblantt. *Conſpiciebatur idolum circa ☉m.*

Fig. 8. Details from the meteorological diary of March 1590 - including halo phenomena; Tycho Brahe, *Mutationes Aeris*, in: John L. E. Dreyer (ed.), Vol. IX, Copenhagen 1927, p. 82

Sol erat Hesperias se tunc missurus in undas,
Lunaque nocturnos acceleravit equos. (32)

Now verse 32 is examined more closely, it is roughly rendered by Thoren (with Christianson, 1990) as "and the great chariot of Luna was mounting the sky".[54] Even if there is no real mention of the *great chariot*, but only of "nocturnos equos", the association is the same: the moon comes with company. The only possible companions of the moon that could somehow be associated with *horses* are the 22° paraselenae with pronounced long tails (they can reach up to about 20° if the moon has an altitude below 30°): These usually whitish glowing halo effects, which extend the (sometimes colorful) patches of the paraselenae and resemble somewhat a typical comet's tail, obviously represent them as *pars pro toto*.

In *Fig.* 4 the "tails" are depicted, each directed away from the real moon and its satellites, while *Fig.* 8 shows details from the meteorological diaries that Tycho Brahe kept together with his colleagues and collaborators for the years 1582 until 1597: The paraselenae on 1590 March 10 (Julian) are described as "two cloudlets like shadow images (*idola*)"; the parhelion on March 13 (Julian) as a "shadow image (*idolum*)"; the “tails” are not particularly long here (even if moon and sun were sufficiently low - the length also depends on the conditions in the atmosphere).[55]

If the moon also has a 22° ring, which is optically possible (see *Fig.* 8), it could be said that the moon in its chariot is pulled by two horses along the ecliptic - perhaps Tycho's formulation includes Luna's chariot. At least, the moon Tycho saw on 1572 December 14 or 15 had two mock moons, each with a distinct tail.

The idea of horses connected to the moon or, analogously, to the sun can be found in many figurative texts - as here by King James VI of Scotland after a visit to Tycho in Uraniborg on the Island of Hven (which took place only a few days after the observations of the halo phenomena, see *Fig.* 8, namely on 1590 March 20):[56]

What Phaethon dared was by Apollo done,
Who ruled the fiery horses of the sun.
More Tycho doth, he rules the stars above,
And is Urania's favorite, and love.

In Greco-Latin antiquity, the so-called Dioscuri motif was widespread, which already has its roots in the Orient: the two Dioscuri (sons of Zeus) are heavenly combat assistants who ride on *white horses*. After a decisive victory at the beginning of the 5th century BC, the Romans have consecrated a temple to them (who were known there as Castor and Pollux). The Dioscuri motif can be found well into the Early Modern Period, although it has been overwritten several times.[57]

Broadsheets from the 16th and 17th centuries clearly show that these transmissions are a mythical appropriation of specific halo effects beside sun or moon: Now two young men with long swords or sabers fight for a heavenly victory, for example, as seen on 1546 February 26 above Ofen (Budapest), *Fig.* 9. The accompanying text builds a whole suspenseful story based on the sign-language of various halo phenomena which appear and disappear over the course of around an hour and a half - albeit with a blatantly political interpretation. Even if the depiction is more of an illustration of this message, the 22° halo is rendered correctly in terms of color: the inner arc of the so-called "Regenbogen" shimmers red; cataloging this event as "Fiktion" is not justified (even if there was a similar sighting ten years earlier).[58]

Anno 1546. den 26. Februarij vmb 8. vhr vormittag/ ist dises wunderbar vnnd
seltzam gesicht/ von einem Ersamen vnd wolweysen Burger/ in der Stat Bascha genant/ gelegen im Land zu

Fig. 9. Broadsheet giving a "Gesicht" above Ofen (Budapest) on 1546 February 26; Stiftung Schloss Friedenstein Gotha, *Fliegende Blätter*, Band II, p. 501, No. 449, Inv. Nr.18,52

If Parhelia or Paraselenae have pronounced tails, there is already a significant concentration of tiny hexagonal ice crystals in very high air layers - and further halo effects are likely. But how does this fit together, since the text speaks of "coelo sereno" (v. 33), which Thoren (with Christianson, 1990) renders roughly as "cloudless sky"?[59] In verse 107, the term is specified in principle: "Nostra oculis coelo fulgent spectanda sereno", i.e., if the sky is *serene*, the stars in the sky can be seen. In relation to the situation on December 14 or 15, when night was falling, this means that despite the halo apparition, stars should also become visible: In verse 121, "Urania" refers directly to the supernova ("En nova"), but the starry sky is also mentioned in passing.

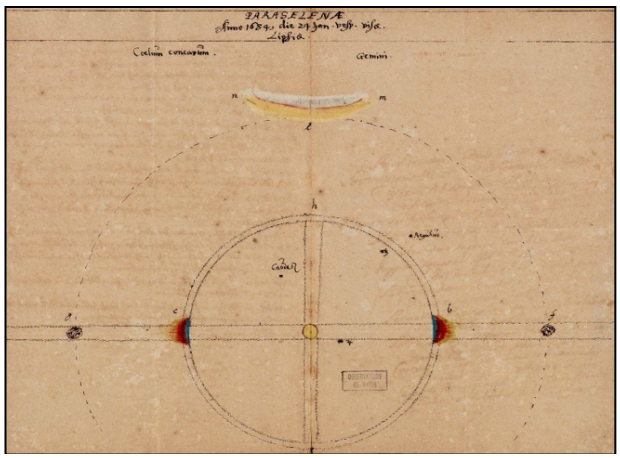

Fig. 10. Lunar halo cross above Leipzig on 1684 January 24, drawn by Gottfried Kirch in a letter to Johannes Hevelius (K.-D. Herbst 2006, no. 256); provided as a digital copy from Paris Observatory, C.1.16, no 29, folio 2299r-v and no 30, folio 2300

The lunar halo features observed with the naked eye by Johannes Hevelius (*Fig.* 4) and Gottfried Kirch (*Fig.* 10) show that this does not have to be a contradiction: Both have included some bright stars and planets in their illustrations, probably for reasons of orientation and completeness (as well as following old traditions). Overall, halo phenomena can also occur when the impression of a (still) almost clear sky prevails, i.e., the upcoming cirrus clouds have not yet developed their typical milky-white veil (see difference between *Figs.*1 and 2).

En DEA (nescio quae) coelo delapsa sereno, (33)
Protinus hîc oculos constitit ante meos.
Extimui, et rigido stabant horrore capillj;
...
HAEC ubi Diva Poli, celsis quae praesidet astris, (151)
Dixerat, humanos sic imitata sonos,
Protinus ex oculis fugiens repetivit Olympum,
Ingenio sensi numen adesse meo.

Before attempting to (re-)visualize the size and shape of the "goddess" - the behavior and duration of the presence should be constrained with the help of statements in the elegy: *How variable* and *how long* was Tycho's "Urania" vision? Verse 34 - "protinus hîc oculos constitit ante meos" - emphasizes the suddenness and immediacy of the apparition, which took place directly in front of Tycho's eyes. Despite the great distance from the light-reflecting and -refracting ice crystals, halo phenomena are characterized by the fact that they radiate a relative proximity. Especially, when such effects emerge near the horizon, they seem to touch the earthly world - comparable to the rainbow that appears around the opposite point of the sun or moon.

The description that the phenomenon suddenly *glides into* the sky or *descends from* the serene sky ("coelo delapsa sereno", v. 33, cf. v. 113) is also typical for these ice crystal images; and just as (more or less) instantly such a light image pops up, it also disappears again - in verse 153 "protinus" is used again: "protinus ex oculis fugiens repetivit Olympum". At first, Tycho is surprised and somewhat shocked by this heavenly performance - even if he exaggerates a little (v. 35), current and historical observational reports make his genuine emotion understandable (see end of first part).

The impression is that Tycho did not see his "Urania" for too long - it is neither an event of a second nor an hour. If one takes the reading length of around 120 lines of verse as a guide, it is a matter of several minutes, perhaps up to a quarter of an hour. In principle, the progression of halo phenomena is slow, but due to atmospheric conditions (wind speed etc.), changes can also occur in a short time-scale; for example, one or the other halo effect can light up, but also disappear quickly - the text certainly leaves room for some associative speculation here.

But *what* did Tycho see as "Urania"? "En DEA" - *behold, a goddess* - is obviously his first association. To put it soberly: What he saw and initially called "DEA" must have spontaneously left a somehow figuratively feminine and particularly beautiful and at the same time overwhelming impression: "Urania" is *really* standing before his eyes - she is suddenly facing him (v. 34). Although Tycho reveals a lot about his vision through this divine name alone, and some other characteristics (cf. vv. 53f.,

83f.), including the fact that "Urania" somehow speaks, support this quasi personal note, we would like to know more. An example will illustrate this, even if it dates back many centuries; but it obviously belongs - in a convoluted way - to the same intelligible world to which Tycho also pays homage towards the end of his Urania Elegy (after he had realized his calling and said goodbye to a purely earthly life, he gives the following two verses, 223 and 224): "But there are few, indeed, far too few, to whom the gentle Apollo gave the gift, that they can see what Olympus possesses."

Sed pauci, heu nimiùm pauci, quibus almus Apollo (223)
Hoc dedit, ut videant id quod Olympus habet.

As mentioned in the first part of this article, Emperor Constantine the Great and his soldiers witnessed a solar halo phenomenon in 310, most likely above the Apollonian source sanctuary of Grand (Vosges). Church Father Eusebius of Caesarea recounts the vision in his Vita Constantini (c. 340) as follows:

"Around the southernly/midday hours of the sun, when the day began to wind down, he had seen with his own eyes, as he said, that on sky the victorious sign of the cross, which was made by light, lied across the sun, and with it a text phrase was connected: 'Win with this!' He was astonished by the spectacle, as was the entire army that followed him when he was on the march somewhere and became spectators of the miracle."[60]

Historical research has shown that there is a second, earlier source about this event (note 14). An unnamed Panegyricus took the same vision as the occasion for a laudation in 310 and interpreted it in the context of the Roman religious Pantheon:

"... after you had turned off from the large street, taking the path to the most beautiful *templum* on the whole Earth, to the One, as you have seen, the really present God. Namely, as I believe, Constantine, you have seen your Apollo, who - accompanied by Victoria - presented to you laurel wraths ... And why do I say 'I believe'? You have seen him and recognized yourself in the vision [specie] of the One to whom power belongs throughout the world, as the divinely inspired poets sang."[61]

Both strands of transmission emphasize that the emperor himself (and others) could *see* something - "the ... sign of the cross, ... made by light, ... across the sun", on the one hand, "the really present God ... your Apollo", on the other: If we combine these two pieces of descriptions, which is supported by the fact that a cross of light can obviously bring a visual-figurative impression (as associated, for example, by the alpinist Edward Whymper, see end of the first part), then we can imagine Tycho's "Urania" in a analogous way - as a goddess, made of moon light crystals.

Last considerations: Could Tycho have seen a more extended and complex halo feature than just two - not so rare - paraselenae? Although Tycho Brahe later carried out daily weather observations, which he also published (note 55), unfortunately no such data is available for the period 1572/73 - perhaps they are just missing in the same way that the original hand-written records of the supernova have not come down to us. What can be said is that the winter of 1572/73 was particularly cold and severe; there may also have been conditions for ice fog halos, but these *diamond dust* features are not even necessary.[62]

On the evening of December 14 or 15, 1572, a few days before full moon (Dec 19 at 9:48h UT), the illumination of the lunar disk would be already more than 75%. Observational records from the Babylonian Diaries (note 16) show that halos can reliably occur up to seven days before and after the full moon, so that even the light of the half moon is sufficient. The huge halo spectacle, see *Fig.* 10, that Gottfried Kirch witnessed above Leipzig in the first half of the night of 1684 February 3 (given in the Julian calendar for 1684 January 24) appeared almost three days after full moon (Feb 1 at 6:03h UT).[63]

Johannes Hevelius' information about the sighting on 1660 December 17 above Gelansk underlines that he was able to see the lunar halo *cross* "until the sun rose" (see end of first part). This is similar to the situation described by Tycho in his elegy: immediately or soon after sunset he saw the moon with its paraselenae-*horses*. The difference, however, lies in the altitude of the moon, for Hevelius it is at the end close to the horizon, for Tycho it stands at least 15° above the horizon.

The display observed by Gottfried Kirch reveals that crosses of light can also appear when the moon is already higher than, for instance, at the beginning of Hevelius' sighting: Johannes Hevelius states that his isosceles cross had a maximum extension of 30° (note 35), which roughly corresponds to the depiction (see *Fig.* 4), so the moon was at most 15° high, while Kirch's drawings show a lunar altitude of about 22° and more (*Figs.* 10 and 11). The higher the moon, the rarer such crosses are, but they are nevertheless possible under appropriate weather conditions.[64]

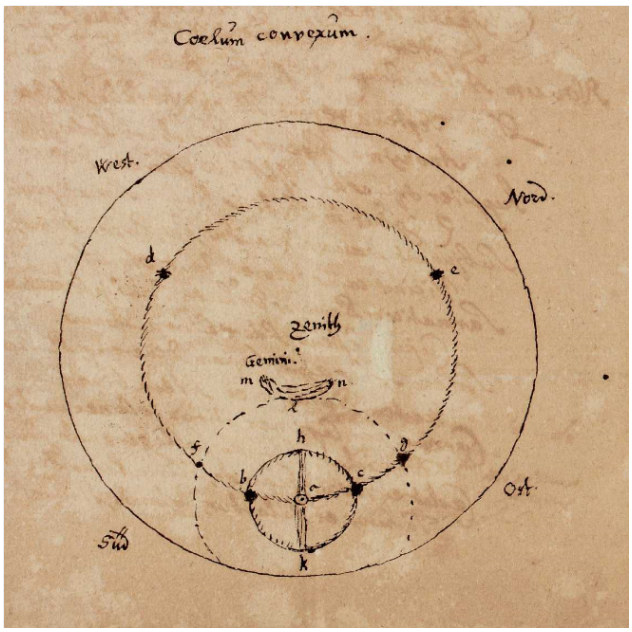

Fig. 11. Lunar halo cross above Leipzig on 1684 January 24 (all-sky view), drawn by Gottfried Kirch in a letter to Johannes Hevelius (K.-D. Herbst 2006, no. 256); provided as a digital copy from Paris Observatory, C.1.16, no 29, folio 2299r-v and no 30, folio 2300

Since paraselenae with pronounced tails were obviously seen by Tycho and almost certainly also a figurative cross of light, very small hexagonal ice crystals - thin plates as well as longer columns - should have been present in high concentrations, floating, rotating, and falling with different orientations in more or less turbulent air. Similar to Gottfried Kirch's display (*Figs.* 10 and 11), the brightly colored circumzenithal arc, which looks like an inverted rainbow but smaller and made of the same crystals as the paraselenae, may also have been visible. At its apex, this arc is at least 46° above the moon and is still powerful at a lunar altitude up to 25°. In the evening of December 14 or 15, 1572, this *diadem*-bow of Urania could have almost touched the "new star"; the moon was in the ecliptic range of Taurus where the supernova appeared. It is very likely that the 22° ring was visible (the "chariot" associated with the "horses") and also other effects, such as the 22° upper tangent arc (see *Fig.* 4), a light pattern that could shape the head, especially the mouth of "Urania", who has so much to say to Tycho. Such a halo phenomenon has quite impressive dimensions, as the image by Alan Dyer demonstrates (see *Fig.* 1): even if this is photographically exposed for a while - lunar halo displays can be observed very well and also safely with the naked eye (note 64).

Fig. 12. Front view and floor plan of Uraniborg; Tycho Brahe, *Astronomiae instauratæ mechanica*, Self-published, Wandsbek bei Hamburg 1598, p. 80

Addendum: If Tycho truly stands in the subtle and time-honored poetic tradition of the halo visionaries, more inspirations should be found than just his wonderful elegy "In Uraniam": Did he not call his later observatory *Uraniborg* a temple of the muses? And if one look at the floor plan of this *museum* (see *Fig.* 12), formed by an isosceles cross and symmetrically arranged arcs, one can get the impression that it is a concrete realization of his spiritual vision on that Holy Evening in 1572: when Tycho was welcomed by Urania as a friend and priest on Earth and called to be her worshipper (and worker).

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Notes

[1] Ralph Neuhäuser, Dagmar L. Neuhäuser, Thomas Posch, "Terra-Astronomy - Understanding historical observations to study transient phenomena", in: Teresa Lago (ed.), *Astronomy in Focus - Proc. Focus Meetings IAU GA* (held August 2018, Vienna, Austria), Cambridge: University Press, 2020, pp. 145-147. Further information, an introduction and all publications on Terra-Astronomy: https://www.astro.uni-jena.de/terra-astronomy

[2] E.g., Dagmar L. Neuhäuser, Ralph Neuhäuser, Markus Mugrauer, Amir Harrak, Jesse Chapman, "Orbit determination just from historical observations? Test case: The comet of 760 CE is identified as 1P/Halley", *Icarus International Journal of Solar System Studies* 364, 114278, 2021, pp. 1-29; recently also mass and age of Betelgeuse could be constraint due to color changes in historical time: Ralph Neuhäuser, Guillermo Torres, Markus Mugrauer, Dagmar L. Neuhäuser, Jesse Chapman, Daniela Luge, Matteo Cosci, "Colour evolution of Betelgeuse and Antares over two millennia, derived from historical records, as a new constraint on mass and age", *Monthly Notices of the Royal Astronomical Society* 516, 2022, pp. 693-719.

[3] E.g., Ralph Neuhäuser, Dagmar L. Neuhäuser, Jesse Chapman, "'Novae, supernovae, or something else?' - (Super-)nova highlights from Hoffmann & Vogt are quite certainly comets (AD 668 and 891)", *Monthly Notices of the Royal Astronomical Society* 501, 2021, pp. L1-L6; cf. Dagmar L. Neuhäuser, Ralph Neuhäuser, Jesse Chapman, "New sunspots and aurorae in the historical Chinese text corpus? Comments on uncritical digital search applications", *Astronomical Notes* 339, 2018, pp. 10-29.

[4] E.g., Ralph Neuhäuser & Dagmar L. Neuhäuser, et al., "The Mira discovery problem - Observations by David Fabricius in 1596 and 1609 (and by others before?): Positional accuracy, brightness, color index, and period", *Astronomical Notes* 345, 2024, e20230131; Ralph Neuhäuser & Dagmar L. Neuhäuser, "Sunspot numbers based on historic records in the 1610s - early telescopic observations by Simon Marius and others", *Astronomical Notes* 337, 2016, pp. 581-620.

[5] E.g., to distinguish between (super)novae and comets: Ralph Neuhäuser & Dagmar L. Neuhäuser, "Critical comments on publications by S. Hoffmann and N. Vogt on historical novae/supernovae and their candidates", *Astronomical Notes* 342, 2021, pp. 675-695; or between auroral and meteoritic phenomena: Dagmar L. Neuhäuser, Ralph Neuhäuser, Amir Harrak, "Reports and drawings of celestial observations in the 8th century Syriac Chronicle of Zuqnin (auroral and meteoritic phenomena)", *Journal of the Canadian Society for Syriac Studies* 18, 2018, pp. 67-90.

[6] Dagmar L. Neuhäuser & Ralph Neuhäuser, "'A red cross appeared in the sky' and other celestial signs: Presumable European aurorae in the mid AD 770s were halo displays", *Astronomical Notes* 336, 2015, pp. 913-929. https://arxiv.org/pdf/1508.07955.pdf - Cf. Ralph Neuhäuser & Dagmar L. Neuhäuser, "Solar activity around AD 775 from aurorae and

radiocarbon", *Astronomical Notes* 336, 2015, pp. 225-248; Ralph Neuhäuser & Dagmar L. Neuhäuser, "Variations of 14-C around AD 775 and AD 1795 - due to solar activity", *Astronomical Notes* 336, 2015, pp. 930-954.

[7] Ralph Neuhäuser, Dagmar L. Neuhäuser, Thomas Posch, "Terra-Astronomy - Understanding historical observations to study transient phenomena", in: Teresa Lago (ed.), *Astronomy in Focus - Proc. Focus Meetings IAU GA* (held August 2018, Vienna, Austria), Cambridge: University Press, 2020, pp. 145-147, cit. p. 146.

[8] Sigmund Freud, *Die Traumdeutung*, Leipzig/Wien: Franz Deuticke, 1900, pp. 30ff.: "Die vorwissenschaftliche Traumauffassung der Alten stand sicherlich im vollsten Einklang mit ihrer gesamten Weltanschauung, welche als Realität in die Außenwelt zu projizieren pflegte, was nur innerhalb des Seelenlebens Realität hatte." - "Es war bei ihnen Voraussetzung, daß die Träume mit der Welt übermenschlicher Wesen, an die sie glaubten, in Beziehung stünden und Offenbarungen von seiten der Götter und Dämonen brächten. Ferner drängte sich ihnen auf, daß die Träume eine für den Träumer bedeutende Absicht hätten, in der Regel, ihm die Zukunft zu verkünden."

[9] Carl Gustav Jung, *Die Archetypen und das kollektive Unbewußte*, Gesammelte Werke 9/1, Zürich: Rascher/ Olten: Walter, 1976, e.g., § 261: "Die Mythen sind ursprünglich Offenbarungen der vorbewußten Seele, unwillkürliche Aussagen über unbewußtes seelisches Geschehen, und nichts weniger als Allegorien physischer Vorgänge." Cf. note 26.

[10] E.g., Leo Frobenius, *Das Zeitalter des Sonnengottes*, Band 1, Berlin: Georg Reimer, 1904, pp. 34f.: Frobenius sketches an "Zeitalter des Sonnengottes" (title), particularly with regard to the "Erhaltung der Mythologie", because "das Problem der Mythologie beruht ja nicht in der Entstehungsgeschichte allein": "Ich glaube nur eine einzige Lösung dieses Problemes gefunden zu haben. Die Geschichten, die die Menschen zu so großartiger Gedächtnisstärke erzogen haben, müssen einerseits von einer enormen Eindruckskraft gewesen und anderseits noch durch ständige Befruchtung des Gedächtnisses am Leben erhalten worden sein. Und da komme ich eben darauf, wohin ja jede Erkenntnis in zehnjähriger Arbeit am Stoffe geführt hat, daß es nämlich in der Natur kein so großartiges Schauspiel gibt, wie Sonnenauf- und -untergang und Nachtgröße für ein Volk in den Tropen. Hat sich hier wirklich die Mythologie ausgebildet, war wirklich die Sonnenfahrt die Anregung, dann verstehen wir auch die Erhaltung der Mythologien durch die vielen, vielen Jahrtausende bis auf unsere Zeit. Denn an jedem Tage wurde die Sonne einmal verschlungen, an jedem Morgen wurde sie einmal geboren, und wenn die ehrfurchtsvolle Scheu und die Empfindung für die Heiligkeit überhaupt erst geweckt war, dann konnte jede einzelne Geschichte aus dem schicksalsreichen Dasein des Sonnengottes täglich, ja stündlich mit dem Anblick der Sonne in das Gedächtnis zurückgerufen werden."

[11] E.g., Giorgio de Santillana/Hertha von Dechend, *Hamlet's Mill*, Boston: Gambit, 1969, German edition, *Die Mühle des Hamlets*, Wien: Springer, 1994 - in "Hamlet's Mill/Die Mühle des Hamlets" the authors attempt to understand various mythological traditions, including Platonic "visions" and "cosmologies" ("who could still speak the language of archaic myth", p. 6, translated from the preface in the German edition), *cosmographically*, in the sense that they communicate the knowledge of precession, more precisely, "the secular shift of the points of the year along the zodiac, whereby the ages of the world are determined" (p. 2). - Cf. Laetitia Rimpau, *Visionen neuer Wissenschaft, Zur dialogischen Dichtung von Dante Alighieri und Johannes Kepler*, Heidelberg: Universitätsverlag Winter, 2021, pp. 20f.: "*Dichtung, Aschenputtel der Wissenschaftsgeschichte*. Die Bedeutung, die man der Dichtung innerhalb ... der Astronomie beimisst, ist ... äußerst gering. Unter Wissenschaftshistorikern überwiegt die Auffassung, dass ausschließlich die exakte Naturwissenschaft durch Experimente seriöse Erkenntnisse produziere. Die Literatur greife diese dann auf und reflektiere sie nur. Die vorliegende Arbeit widerspricht dieser Auffassung ... Dialogische Dichtung stellt eine 'Bühne' für Hypothesen, einen 'Speicher' von Hypothesen und einen 'Verteiler' von neuem Wissen dar. Insofern sind die Funktion und die Leistung der Dichtung weit mehr als nur eine reaktive. Die literarische Wissenschaftsgeschichte muss erst noch geschrieben werden. Das vorliegende Buch stellt erste Bausteine bereit." Among other things, Laetitia Rimpau attempts to show that Dante Alighieri (died 1321) already developed a heliocentric view of the world in his *Divina commedia* and disseminated it through his poetry in Italian.

[12] E.g., Gregor Weber, *Kaiser, Träume und Visionen in Prinzipat und Spätantike*, Stuttgart: Franz Steiner Verlag, Historia Einzelschriften 143, 2000, pp. 11f.: "[Es] ist in Rechnung zu stellen, daß die vorliegenden Träume und Visionen primär *Texte* sind, d.h. uns liegt immer nur der *Bericht* von einem Traum oder einer Visionserfahrung und niemals, selbst wenn man das Erlebnis als authentisch einstuft, der Traum bzw. die Vision selbst vor." "Hieraus ergeben sich nachhaltige Konsequenzen für die Behandlung des Materials: Es geht nicht um den Versuch, möglichst viele der überlieferten Träume als *tatsächlich* geträumt oder möglichst viele Visionen als *tatsächlich* erfunden [!] zu klassifizieren, sondern im Zentrum muß die Frage nach der Bedeutung und der Funktion oder besser: nach den *Bedeutungen* und *Funktionen* von Träumen und Visionen stehen, die ihnen in den Augen der sie Aufschreibenden, der überlieferten Autoren sowie möglichen Lesern … zukam." - Cf. Christoph Jamme & Stefan Matuschek, *Handbuch der Mythologie*, Darmstadt: Wissenschaftliche Buchgesellschaft, 2014, pp. 12f.: "Mythen sind historisch nicht überprüfbare oder durch ihren fantastischen Charakter wunderbare Erzählungen, die dennoch als Erklärungen, Deutungen oder Sinnstiftungen funktionieren. Der Begriff hat damit eine negative und eine positive Seite: Negativ ist er, wenn er als Hinweis auf die Unwahrheit des Erzählten verstanden wird. … Positiv ist der Begriff dagegen dort, wo er als Hinweis auf die Wirkung einer Erzählung verstanden wird." "Mythen als Mythen zu verstehen heißt nicht, sie zu beseitigen, sondern ihre spezifische Funktion und Wirksamkeit zu erkennen."

[13] E.g., Gregor Weber, *Kaiser, Träume und Visionen in Prinzipat und Spätantike*, Stuttgart: Franz Steiner Verlag, Historia Einzelschriften 143, 2000, pp. 274-300; cit. "test", see pp. 10f.: "[Es] gibt für den modernen Historiker keinen stichhaltigen Test, mit dem zwischen echten und fiktiven Träumen [und Visionen] unterschieden werden kann. Es stehen somit keine *formalen* Kriterien zur Verfügung, etwa im Bereich der Struktur oder der sprachlichen Gestalt, mit Hilfe derer entschieden werden kann, ob ein Traum oder eine Vision wirklich in der vorliegenden Form auf ein reales Erlebnis des Träumenden zurückgeht oder eine Erfindung bzw. "Konstruktion" - durch den vorgeblich Träumenden oder durch einen antiken Autor - vorliegt." - Cf. note 12.

[14] Peter Weiss (translated by A. R. Birley), "The Vision of Constantine", *Journal of Roman Archaeology* 16, 2003, pp. 237-259, contains a discussion that arises after an earlier version of the article in German: *id.*, "Die Vision Constantins", in: Jochen Bleicken (ed.), *Colloquium aus Anlaß des 80. Geburtstages von Alfred Heuß[Heuss]*, Kallmünz/Opf.: Verlag Michael Lassleben, 1993, pp. 143-169; Klaus-Martin Giradet, *Der Kaiser und sein Gott, Das Christentum im Denken und in der Religionspolitik Konstantins des Großen*, Berlin/New York: Walter de Gruyter, 2010, pp. 34-43.

[15] E.g., Ho Ping-Yü, Joseph Needham, "Ancient Chinese observations of solar haloes and parhelia", *Royal Meteorological Society* 14, 1959, pp. 124-134.

[16] Hermann Hunger (ed.), *Astrological Reports to Assyrian Kings*, State Archives of Assyria VIII, distributed by Penn State University Press, 1992, cit. 413. - the recognition of recurring weather patterns, such as those found in the astronomical diaries of Babylon, may have led to such omina, see: Abraham Sachs/Hermann Hunger (eds.), *Astronomical diaries and related texts from Babylonia*, Wien: Österreichische Akademie der Wissenschaften, 1988, Vol. I., BCE 652 (month unknown): "The 1st, the sun was surrounded by a halo (*šamáš* TÙR NIGÍN). Night of the 2nd, (and) the 2nd, overcast. The south wind blew. The 3rd, very overcast. In the afternoon it rained. Night of the 4th, (and) the 4th, it rained". - Cf. Marcel G.J. Minnaert, *Light and Color in the Outdoors*, first edition 1937 in Dutch, translated and revised by Len Seymour, New York: Springer-Verlag, 1993, pp. 213f.: "According to a popular belief, the small halo [22° ring] is a forerunner of rainy weather, and the saying 'the larger the halo, the sooner we shall have rain', means that the small halo, and not the corona, predicts rain. And, indeed, cirrostratus clouds are often the forerunners of a region of depression."

[17] Aristotle, *Meteorologica*, translated by H. D. P. Lee, Cambridge/ London: Harvard University, 1952, see Book III, Chapter II, III, VI.

[18] Martin Luther/Johann G. Walch: *Martin Luthers sämtliche Schriften: Auslegung des Ersten Buches Mose*, Groß-Oesingen: Verlag der Lutherischen Buchhandlung, 1986, cit. No. 56, slightly modified translation from German: "Ich aber habe keinem Buche mein Leben lang weniger geglaubt, als diesem 'Ueber die Meteore' darum, daß es durchaus aus diesem Grund daher geht, als trage sich in der Natur Alles aus natürlichen Ursachen zu"; cf. No. 57: "wiewohl sie sagen, daß [der Regenbogen, see No. 58] bedeute dreier Tage Regenwetter, welches ich auch zugebe". - In No. 58, Luther then gives his (unconvincing) argument against Aristotle: "[Es] können wohl solche Wolken sein, wenn kein Regenbogen wird; wie aus dem Mittel, nachdem es dick oder dünn ist, der Regenbogen auch größer oder kleiner werden kann. So habe ich allhier zu Wittenberg einen Regenbogen gesehen, der gar rund und in einander geschlossen war, nicht also abgeschnitten auf der Ebene der Erde, wie er gemeiniglich erscheint. Wie geht es denn zu, daß die Regenbogen anders und aber anders gesehen werden?"

[19] Cf. Marcel G.J. Minnaert, *Light and Color in the Outdoors*, first edition 1937 in Dutch, translated and revised by Len Seymour, New York: Springer-Verlag, 1993, pp. 208ff.

[20] Michaela Schwegler, *"Erschröckliche Wunderzeichen" oder "natürliches Phänomen"? Frühneuzeitliche Wunderzeichenberichte aus der Sicht der Wissenschaft*, München, 2002, pp. 63 f., broadsheet on p. 65 (Germanisches Nationalmuseum GNM, HB 838/1204).

[21] Dagmar L. Neuhäuser & Ralph Neuhäuser, "Himmelspredigt: Halo-Erscheinungen in der Reformationszeit", in: Sascha Salatowsky & Karl-Heinz Lotze (eds.), *Himmelsspektakel. Astronomie im Protestantismus der Frühen Neuzeit*, Gotha: Universität Erfurt, Forschungsbibliothek Gotha, 2015, pp. 12-23, see ch. 5, pp. 20-22. https://www.astro.uni-jena.de/images/stories/aiu/terra/Neuh%C3%A4user-Halo.pdf

[22] Cf. Hans-Jürgen Goertz, "Träume, Offenbarungen und Visionen in der Reformation", in: Rainer Postel & Frank Kopitzsch (eds.), *Reformation und Revolution. Beiträge zum politischen Wandel und den sozialen Kräften am Beginn der Neuzeit*, Stuttgart: Franz Steiner, 1989, pp. 171-192.

[23] Dagmar L. Neuhäuser & Ralph Neuhäuser, "Himmelspredigt: Halo-Erscheinungen in der Reformationszeit", in: Sascha Salatowsky & Karl-Heinz Lotze (eds.), *Himmelsspektakel. Astronomie im Protestantismus der Frühen Neuzeit*, Gotha: Universität Erfurt, Forschungsbibliothek Gotha, 2015, pp. 12-23, see figure 4, p.15, with Latin text and explanations to the added letters, ch. 2, pp. 14-16, https://www.astro.uni-jena.de/images/stories/aiu/terra/Neuh%C3%A4user-Halo.pdf (A: Sun, B: horizontal/parhelic arc/circle, C: 22° parhelia, D: 22° ring, E: upper tangent arc, F: unclear, G: part of 46° ring or - more likely - part of the supralateral arc, H: circumzenithal arc, I: unclear, J: Parry arc). - Cf. Bernd Schäfer/ Ulrike Eydinger/ Matthias Rekow, *Fliegende Blätter. Die Sammlung der Einblattholzschnitte des 15. und 16. Jahrhunderts der Stiftung Schloss Friedenstein Gotha*, Stuttgart: arnoldsche ART PUBLISHERS, 2016, Band I: Katalog, p. 333, No. 450, Inv. Nr.18,4; Band II: Abbildungen, p. 502.

[24] Own translation into English. Cf. Dagmar L. Neuhäuser & Ralph Neuhäuser, "Himmelspredigt: Halo-Erscheinungen in der Reformationszeit", in: Sascha Salatowsky & Karl-Heinz Lotze (eds.), *Himmelsspektakel. Astronomie im Protestantismus der Frühen Neuzeit*, Gotha: Universität Erfurt, Forschungsbibliothek Gotha, 2015, pp. 12-23, Melanchthon is even more explicit in a letter to the Hildesheim preacher Laurentius Mollerus, ch. 5, ref. in footnote 65: "Heute hat dein Bote vor meinem Haus eine Parhelia-Erscheinung gesehen, die fast über zwei Stunden hinweg von einer großen Menge Gelehrter und Bürger beobachtet worden ist. Denen gegenüber waren verkehrte Regenbögen, die weniger physische [physikalische] Ursachen haben. Gott möge uns beistehen und das Unheil lindern". Cf. note 18.

[25] Donald H. Menzel, *Flying saucers*, London: Putnam, 1953, cit. p. 132; also, p. 125: "The agreement between Ezekiel's vision and a [halo display] is, to my mind, completely convincing. The correspondence is so unique that it seems to me someone cannot have failed to note it and point it out. But, so far, I have not been able to find a reference."

[26] *Ibid.*, cit. p. 125; preface vii: "I shall use the phrase 'true flying saucers' to refer to the 20 per cent that the Air Force lists as unexplained. And in this sense I have adopted the thesis that: flying saucers are real; people have seen them; they are not what people thought they saw. I present evidence to show that this mysterious residue consists of the rags and tags of meteorological optics: mirages, reflections in mist, refractions and reflections by ice crystals [= halo-phenomena]. Some phenomena are probably related to the aurora; others are unusual forms by shooting stars. A few … probably represent natural phenomena that we still do not fully understand." - The late C. G. Jung (1958) refers among others to D. H. Menzel (1953) in: *Ein moderner Mythus. Von Dingen, die am Himmel gesehen werden*: "Als Psychologe entbehre ich der Mittel und Wege, um zu der Frage nach der physischen Wirklichkeit der Ufos Nützliches beizutragen" (preface); nevertheless Jung later states: "[Dem] Astrophysiker, Professor Menzel, [ist es] nicht gelungen, trotz aller Mühe, die er sich in dieser Hinsicht gegeben hat, auch nur einen einzigen beglaubigten Bericht mit rationalen Mitteln befriedigend zu erklären" (p. 105).

[27] Donald H. Menzel, *Flying saucers*, London: Putnam, 1953, cit. p. 126 (Book of Ezekiel, Chapter 1, verses 4 f.). - A classification as a Aurora borealis was suggested, e.g., František Link, "Observations et catalogue des aurores boréales apparues en Occident de -626 à 1600", in: *Geofysikalni Sbornik*, 1962, 10, pp. 297-392, but is not justified: The phenomenon itself - which occurred most likely during daytime - did not emerge in the north, which would be required for low-latitude northern lights, but it is only said that the "whirlwind" comes from the north, which is typical for this region in summer.

[28] Donald H. Menzel, *Flying saucers*, London: Putnam, 1953, cit. p. 130.

[29] Cf. note 13 regarding the "test".

[30] E.g., Dagmar L. Neuhäuser, "Halo-Visions: From Ezekiel in Mesopotamia via John on Patmos to the Early Modern Period", paper presented at 33. Deutscher Orientalistentag (DOT) "Asien, Afrika und Europa", Jena, 18-22 Sep 2017, Panel 12: *Stars, gods, and rainbows: Relevance of historical observations* (convenors: Dagmar L. Neuhäuser & Ralph Neuhäuser). - Cf. Regarding similarities and differences in the visions of Ezekiel and John on Patmos: Dagmar L. Neuhäuser & Ralph Neuhäuser, "Himmelspredigt: Halo-Erscheinungen in der Reformationszeit", in: Sascha Salatowsky & Karl-Heinz Lotze (eds.), *Himmelsspektakel. Astronomie im Protestantismus der Frühen Neuzeit*, Gotha: Universität Erfurt, Forschungsbibliothek Gotha, 2015, pp. 12-23, ch. 4 ("Regenbogenartige Halos in der Bibel") - https://www.astro.uni-jena.de/images/stories/aiu/terra/Neuh%C3%A4user-Halo.pdf

[31] Re-visualizations by Mark Vornhusen (details can be disputed): See "Die Offenbarung des Johannes", but also "Hildegard von Bingen" on https://www.meteoros.de/themen/halos/geschichte

[32] Marko Riikonen, *Halot. Jääkidepilvien valoilmiöt [Halos. The optical phenomena of ice crystal clouds]*, Helsinki, URSA, 2011, cit. of translation into English (by MR, private communication).

[33] Cf. Rudolf Otto, *Das Heilige*, 1917 (English version: *The idea of the Holy*, 1923).

[34] Marcel G.J. Minnaert, *Light and Color in the Outdoors*, first edition 1937 in Dutch, translated and revised by Len Seymour, New York: Springer-Verlag, 1993, cit. pp. 222f.; No.168, p. 222: "When a vertical pillar and a part of the horizontal circle occur at the same time, we see a cross in the sky. Needless to say, the superstitious have made the most of this!" The impression of three crosses appears, when the horizontal circle or arc also crosses the 22° ring.

[35] Johannes Hevelius, *Mercurius in Sole Visus*, Gdansk, 1662, cit. p. 173 (own translation), fig. I (between pp. 172/173) provides three observations of halo displays; Latin text: https://www.digitale-sammlungen.de/de/view/bsb10861023?page=197 - Cf. Dagmar L. Neuhäuser & Ralph Neuhäuser, "'A red cross appeared in the sky' and other celestial signs: Presumable European aurorae in the mid AD 770s were halo displays", *Astronomical Notes* 336, 2015, pp. 913-929, fig. 6; https://arxiv.org/pdf/1508.07955.pdf

[36] Tycho Brahe, "De nova ... stella, ...", 1573, in: John L. E. Dreyer (ed.), *Tychonis Brahe Dani Opera Omnia* [collected works of Tycho Brahe the Dane], Vol. I, Copenhagen: Havniae in libraria Gyldendaliana, 1913, pp. 1-72; pp. 65-70: "In Uraniam Elegia Autoris". - John R. Christianson, *Tycho Brahe and the Measure of the Heavens*, London: Reaktion Books, 2020, sums up the book as follows, p. 58: "Latin poetry, epistolary dialogue, astronomical *observatio*, astrological prophecy and humanist oration: all these genres of Renaissance rhetoric came together in Tycho's slender, elegantly printed volume." - Cf. note 44.

[37] Cf. Dagmar L. Neuhäuser & Ralph Neuhäuser, "The shifting hues of Betelgeuse", *Astronomy & Geophysics* 64, 2023, p. 1.38-1.42, in it, we also discuss historical key observations by Tycho Brahe regarding the supernova of 1572.

[38] In this article, "Tycho" is often mentioned without his surname "Brahe" - this is not meant to be disrespectful, but is only due to a culture that gives the first name its individual weight.

[39] Victor E. Thoren (with contributions by John R. Christianson), *The Lord of Uraniborg - A Biography of Tycho Brahe*, Cambridge: Cambridge University Press, 1990, cit. p. 71.

[40] Cf. Peter Zeeberg, "Tycho Brahes Urania Elegi, Nyoversættelse, tekst og kommentarer" (The Urania Elegy by Tycho Brahe: New Translation, Critical Edition and Commentary) in: Marianne Pade i samarbejde med / in collaboration with Eric Jacobsen, Hannemarie Ragn Jensen, Lene Waage Petersen, Lene Schøsler, Minna Skafte Jensen, Peter Zeeberg, Lene Østermark-Johansen (eds.), *Album Amicorum, Festskrift til Karsten Friis-Jensen i anledning af hans 60 års fødselsdag / Studies in Honour of Karsten Friis-Jensen on the Occasion of his Sixtieth Birthday*, Renæssanceforum (now: Nordic Journal of Renaissance Studies) 3, 2007; https://www.njrs.dk/3_2007/19_zeeberg.pdf - In the English abstract, the fictional-literary approach becomes clear: "The 'Elegy on Urania by the author' ... is an allegorical description of the astronomer's decision to devote his life to science, specifically astronomy. ... The introduction analyzes the function of the poem within the book as a whole. Whereas the introductory correspondence between Tycho and his friend Johannes Pratensis presents Pratensis as the initiator to the publication, thus safeguarding Tycho against criticism from his fellow noblemen, the elegy attacks the ideals of the nobility as opposed to his own scientific ideals."

[41] John R. Christianson, *Tycho Brahe and the Measure of the Heavens*, London: Reaktion Books, 2020, cit. pp. 57-58. The fact that Tycho

wrote his Urania-Elegy in the style and model of Ovid is often emphasized in recent research, cf. note 46.

[42] Håkon Håkonsson, "Tycho the Apocalyptic: History, Prophecy and the Meaning of Natural Phenomena", in: J. Zamrzlová (ed.), *Science in Contact at the Beginning of the Scientific Revolution*, Prag: National Technical Museum, 2004, pp. 211-236.

[43] Citation given as in note 41. In *On Tycho's Island: Tycho Brahe and his assistants, 1570-1601*, Cambridge: Cambridge University Press, 2000, ch. 3, pp. 44-57, John R. Christianson circles around the problem of "Urania", it seems that he understands the appearance as an allegory of the supernova, pp. 52f.: "When Tycho Brahe told in poetic language about the epiphany of Urania at Herrevad Abbey, he was using allegory to describe the appearance of the supernova of 1572. He did not literally mean that a goddess in human shape had come down from the skies to chat beside Rönne Brook. On the other hand, he certainly did believe that the stars exerted influence upon the lives of human beings, and that the supernova did indeed play the role of divine messenger in his own life, reshaping its whole direction. Tycho did also truly believe that there was a spark of divine power in the human intellect, and that the person who used his or her mind could penetrate to a knowledge of the hidden, nonmaterial, forces within nature. ... In his poetry, Tycho Brahe used the language, imagery, and convention of Augustan Rome, but this poetry was not mere fantasy or play. His vivid, allegorical language expressed what Tycho considered to be truth about man and nature." Cf. note 46.

[44] Tycho Brahe, "De nova ... stella, ...", 1573, in: John L. E. Dreyer (ed.), *Tychonis Brahe Dani Opera Omnia* [collected works of Tycho Brahe the Dane], Vol. I, Copenhagen: Havniae in libraria Gyldendaliana, 1913, pp. 1-72; pp. 65-70: "In Uraniam Elegia Autoris". - Peter Zeeberg, "Tycho Brahes Urania Elegi, Nyoversættelse, tekst og kommentarer" (The Urania Elegy by Tycho Brahe: New Translation [into Danish], Critical Edition and Commentary), in: Marianne Pade i samarbejde med / in collaboration with Eric Jacobsen, Hannemarie Ragn Jensen, Lene Waage Petersen, Lene Schøsler, Minna Skafte Jensen, Peter Zeeberg, Lene Østermark-Johansen (eds.), *Album Amicorum, Festskrift til Karsten Friis-Jensen i anledning af hans 60 års fødselsdag / Studies in Honour of Karsten Friis-Jensen on the Occasion of his Sixtieth Birthday*, Renæssanceforum (now: Nordic Journal of Renaissance Sudies) 3, 2007; Latin text on: https://www.njrs.dk/3_2007/20_zeeberg_norm.pdf "med normaliseret interpunktion". In this article, however, the following small changes are made: if the "v" means a "u", then this letter is specified; and also "æ" is written "ae". - Longer sections of Tycho's elegy (vv. 53-66, 81-108, 221-232) are rendered into English (sometimes a little freely) and discussed in some aspects in John R. Christianson, *On Tycho's Island: Tycho Brahe and his assistants, 1570-1601*, Cambridge: Cambridge University Press, 2000, ch. 3, pp. 44-57, but only a few of the verses that are the focus of this article are reproduced there; the previous translations by John R. Christianson and, in addition, verses 1 to 52 (copyright by J.R. Christianson) - of which some lines considered in detail in this study - are presented now in Clifford J. Cunningham, "Tycho's Conversation with Urania, and other engagements with the Muse", *Journal of Astronomical History and Heritage*, 27(1), 2024, pp. 105-125.

[45] E.g., Victor E. Thoren (with contributions by John R. Christianson), *The Lord of Uraniborg - A Biography of Tycho Brahe*, Cambridge: Cambridge University Press, 1990, p. 71: "Tycho reported having been wandering along a brook in the forest of Herrevad". Similar: John R. Christianson, *On Tycho's Island: Tycho Brahe and his assistants, 1570-1601*, Cambridge: Cambridge University Press, 2000, pp. 46 and 51: "... Tycho himself, wandering one evening at sunset in the forests of Herrevad along Rönne Brook", "the divine Muse, Urania, speaking to him in the forests of Herrevad along Rönne Brook". It seems that these formulations emphasize "in the forest" - but Tycho's verses point in a slightly different direction: At the very least, it can be assumed that the edge of the forest is meant - he moves away ("digressus") from the borders ("limina") of the shady forest (v. 29) to stroll by the refreshing water (v. 30); the next verses - the setting of the sun, as well as the rising moon - also do not fit with a stay within the forest, but need a low, free horizon; the "Rönne" is more of a (small) river ("Rynae ... fluminis", v. 1) than a "brook" (this is also what the current Swedish name "Rönne å" refers to). - John R. Christianson's translation in Clifford J. Cunningham, "Tycho's Conversation with Urania, and other engagements with the Muse", *Journal of Astronomical History and Heritage*, 27(1), 2024, pp. 105-125, p. 110 has: "One day, while I was strolling on the shaded forest edge / All by myself, along the bubbling stream" (vv. 29 and 30).

[46] Karsten Friis-Jensen & Minna Skafte Jensen, "Tycho Brahes elegier", in: Peter Brask (ed.), *Dansk litteraturhistorie, Bind 2: Lærdom og Magi 1480-1620*, Copenhagen, [1984] 1990, pp. 404 - 412, regarding the Urania-Elegy see pp. 404 - 407; this short article, which does not offer a precise comparison of Ovid's poem with Tycho's Urania Elegy, is cited in the secondary literature as assuming that Tycho based his vision on Ovid's epiphany (*Amores 3, 1*), e.g.: John R. Christianson, *On Tycho's Island: Tycho Brahe and his assistants, 1570-1601*, Cambridge: Cambridge University Press, 2000, cit. p. 46: "Two Danish scholars have shown that Tycho based this elegy on a poem by Ovid that used the theme of "epiphany", the appearance of a divine being. Ovid's poem described the author wandering in an ancient forest by a spring, where he suddenly meets the Muses of Elegy and Tragedy, who ask him to dedicate his life to them. ... The poem moved on to a picture of Tycho himself, wandering one evening at sunset in the forests of Herrevad along Rönne Brook. Suddenly, the Muse Urania comes down from the heavens, ...". - Cf. Minna Skafte Jensen, "Tycho Brahe's double identity as a citizen of Denmark and of the world", in: Dirk Sacré & Jan Papy (eds.), *Syntagmatia: Essays on neo-Latin literature in honour of Monique Mund-Dopchie and Gilbert Tournoy*, Supplementa Humanistica Lovaniensia XXVI, Leuven: University Press, 2009, pp. 569-577, cit. p. 570: "Already as a young man he decided to dedicate his life to the study of astronomy, and he became famous right from the start for his observation of a new star. He published his discovery in a small book in 1573, De nova Stella, and one of the texts in this publication is an elegy closely modelled over one of Ovid's Amores (3, 1). Just as the young Roman poet had met his protectress, the goddess Elegy, and taken orders from her personally, young Tycho Brahe met the muse Urania on an evening's walk in the woods of his homeland Scania, and promised her to spend his life in her service." - Cf. Peter Zeeberg, "Tycho Brahes Urania Elegi, Nyoversættelse, tekst og kommentarer" (The Urania Elegy by Tycho Brahe: New Translation, Critical Edition and Commentary), in: Marianne Pade et al. (eds.), *Album Amicorum, Festskrift til Karsten Friis,* Renæssanceforum 3, 2007, on pp. 19-21 the author gives possible further examples of dependence on Ovid. - Peter Zeeberg (2007) and Minna Skafte Jensen (2009) are also referred to by Clifford J. Cunningham, "Tycho's Conversation with Urania, and other engagements with the Muse", *Journal of Astronomical History and Heritage*, 27(1), 2024, pp. 105-125, and ch. 2.3 emphasizes further dependencies on Hellenistic and Roman influences. -

Some reflections: The situation given by Ovid at the beginning of *Amores 3, 1* is different and altogether less real than the seemingly corresponding verses in Tycho's elegy. The forest Ovid speaks of is uncut and old (v. 1); where it is assumed that there is a "numen" (2). Then there is talk of a sacred spring in the middle, a cave, which seems to be somewhat special, and of birds that somehow complain (3 f.). In Ovid's poem appears "Elegy" (7) and then soon also "Tragedy" (11); in particular, the appearance of "Elegy" is described in some detail, but both are obviously not *earthly*. It is not so clear whether the poetic "I" really walks through the shady forest (5), how often the verse is rendered, or whether the poet does not rather secretly spread out in the shadow of the forest, whereby "umbris" could also mean *nocturnal apparitions* – the next verse would also fit in with this (6); the context also suggests that the cave, the spring and the birds are already apparitions. In contrast, Tycho leaves the (real) forest to stroll along the (real) riverside of Rönne. There is no mention of a cave, a spring, or birds. Although the Rönne and its landscape are described as so beautiful that the muses live there, the vision of "Urania" is not connected to the river, the meadows or the forest, but instead to the sky. In Tycho's elegy the goddess Urania suddenly appears and disappears, and there are clear clues to the place, the time of day and indirectly also to the date and other circumstances - as will be shown in this article. Of course, Tycho has been familiar with Latin poetry since his youth and may also draw inspiration from Ovid in his own poems. While the Dane clearly delineates the apparition, Ovid provides much more detail about what appears. It is beyond the scope of this article, but the verses by Ovid show typical elements of a halo narrative.

[47] Tycho Brahe, "De nova ... stella, ...", 1573, in: John L. E. Dreyer (ed.), *Tychonis Brahe Dani Opera Omnia* [collected works of Tycho Brahe the Dane], Vol. I, Copenhagen: Havniae in libraria Gyldendaliana, 1913, p. 15; this date, 1573 May 5, would be consistent with the information in the chapter on size, brightness and color: the beginning of May is given twice, p. 29.

[48] Gábor Almási, "Tycho Brahe and the Seperation of Astronomy from Astrology: The Making of a New Scientific Discourse", *Science in Context*, 26(1), Cambridge: Cambridge University Press, 2013, pp. 3-30, reflects also in depth on the process of creating "De nova stella", in particular on how Tycho wanted to see himself when "entering the public domain", pp. 7-10; cf. Victor E. Thoren (with contributions by John R. Christianson), The Lord of Uraniborg – A Biography of Tycho Brahe, Cambridge: Cambridge University Press, 1990, pp. 61ff.

[49] Tycho Brahe, "De nova ... stella, ...", 1573, in: John L. E. Dreyer (ed.), *Tychonis Brahe Dani Opera Omnia* [collected works of Tycho Brahe the Dane], Vol. I, Copenhagen: Havniae in libraria Gyldendaliana, 1913, pp. 28-30.

[50] *Ibid.*, p. 3, pp. 35-44; originally envisaged with appendices: pp. 73-130. - Cf. Victor E. Thoren (with contributions by John R. Christianson), *The Lord of Uraniborg – A Biography of Tycho Brahe*, Cambridge: Cambridge University Press, 1990, pp. 59f.: "In his salutation, Tycho invoked the classical muse of astronomy, Urania, ... Tycho expressed the traditional Renaissance conviction that God created humans in his image and placed them on earth in the center of the universe to contemplate, as in a mirror, the nature and constitution of the whole of creation, so that during their mortal life they might learn to know the majesty and wisdom of the invisible, incorporeal God through the visible objects of his creation."

[51] E.g., Tycho Brahe ad Iohannem Maiorem [Epistolae astronomicae], 1584, in: John L. E. Dreyer (ed.), *Tychonis Brahe Dani Opera Omnia* [collected works of Tycho Brahe the Dane], Vol. VII, Copenhagen: Havniae in libraria Gyldendaliana, 1924, pp. 86f.

[52] Cf. Victor E. Thoren (with contributions by John R. Christianson), *The Lord of Uraniborg – A Biography of Tycho Brahe*, Cambridge: Cambridge University Press, 1990, pp. 59f.: Interestingly, Tycho was particularly preoccupied with the moon towards the end of 1572 - partly because he wanted to predict the lunar eclipse in December 1573 (the one of December 19, 1572, was almost invisible in Herrevad) and partly because he believed that the moon might have an influence on the weather. - For a general review, see, Craig Martin, *Renaissance meteorology: Pomponazzi to Descartes*, Baltimore: The Johns Hopkins University Press, 2011; chapter 1 is recommended as an introduction to this important but neglected topic.

[53] Times and altitudes obtained with the Software *Stellarium*, Version 0.18.1.

[54] John R. Christianson in Clifford J. Cunningham, "Tycho's Conversation with Urania, and other engagements with the Muse", *Journal of Astronomical History and Heritage*, 27(1), 2024, pp. 105-125, p. 110 gives here: "Just as the Moon began to speed its nightly ride" (v. 32).- Cf. Peter Zeeberg, "Tycho Brahes Urania Elegi, Nyoversættelse, tekst og kommentarer" (The Urania Elegy by Tycho Brahe: New Translation, Critical Edition and Commentary), in: Marianne Pade et al. (eds.), *Album Amicorum, Festskrift til Karsten Friis,* Renæssanceforum 3, 2007; https://www.njrs.dk/3_2007/19_zeeberg.pdf - p. 7: "nocturnos equos" is translated in Danish as "natlige spand" (v. 32).

[55] Tycho Brahe, "Mutationes aeris a mense Octobri anni 1582 ad mensem Aprilem anni 1597", in: John L. E. Dreyer (ed.), *Tychonis Brahe Dani Opera Omnia* [collected works of Tycho Brahe the Dane], Vol. IX, Copenhagen: Havniae in libraria Gyldendaliana, 1927, pp. 3-146, cit. p. 82 (own translation). - Cf. Dagmar L. Neuhäuser & Ralph Neuhäuser, "In den Himmeln erschien ein rotes Kruzifix: Halo-Code und Halo-Vergessenheit", in: Gudrun Wolfschmidt (ed.), *Der Himmel über Tübingen. Barocksternwarten - Landesvermessung - Astrophysik*, Hamburg: tredition, 2014, pp. 470-517, fig. 23.1, p. 470, translation from Latin into German on p. 478; for April 6, 1660, the Gdansk astronomer Johannes Hevelius noted, among other things: "In these (arcs) two pseudo-suns were seen on either side, also colorful, with rather long and white shimmering tails, which were turned away from the sun" (own translation into English).

[56] John Robert Christianson, *On Tycho's Island: Tycho Brahe and his assistants, 1570-1601*, Cambridge: Cambridge University Press, 2000, cit. p. 141; regarding date, see: Tycho Brahe, "Mutationes aeris a mense Octobri anni 1582 ad mensem Aprilem anni 1597", in: John L. E. Dreyer (ed.), *Tychonis Brahe Dani Opera Omnia* [collected works of Tycho Brahe the Dane], Vol. IX, Copenhagen: Havniae in libraria Gyldendaliana, 1927, p. 83.

[57] Dagmar L. Neuhäuser & Ralph Neuhäuser, "'A red cross appeared in the sky' and other celestial signs: Presumable European aurorae in the mid AD 770s were halo displays", *Astronomical Notes* 336, 2015, pp. 913-929, ch. 5 to the ideological background of the motive "two young men on white horses". https://arxiv.org/pdf/1508.07955.pdf

[58] Bernd Schäfer/Ulrike Eydinger/Matthias Rekow, *Fliegende Blätter. Die Sammlung der Einblattholzschnitte des 15. und 16. Jahrhunderts der Stiftung Schloss Friedenstein Gotha*, Stuttgart: arnoldsche ART PUBLISHERS, 2016, Band I: Katalog, No. 449, Inv. Nr.18,52, p. 332: "... Erstlich einen scheinbarlichen Regenbogen/ darinnen an yedweder seyten/ ein klar scheinende/ vnd helle Sonnen/ vnd ob dem selben Regenbogen/ auß etlichen schwebenden wolcken/ haben sich zwen Jüngling herfür gethan/ hefftigklich mit einander streytende/ vngeferlich zwu oder drithalbe stund lang/ welche bayd in der Rechte hand ein schwert/ ..." (spelling slightly modified); Band II: Abbildungen, p. 501. - Cf. Dagmar L. Neuhäuser & Ralph Neuhäuser, "Himmelspredigt: Halo-Erscheinungen in der Reformationszeit", in: Sascha Salatowsky & Karl-Heinz Lotze (eds.), *Himmelsspektakel. Astronomie im Protestantismus der Frühen Neuzeit*, Gotha: Universität Erfurt, Forschungsbibliothek Gotha, 2015, pp. 12-23, see figure 5. https://www.astro.uni-jena.de/images/stories/aiu/terra/Neuh%C3%A4user-Halo.pdf

[59] Victor E. Thoren (with contributions by John R. Christianson), *The Lord of Uraniborg - A Biography of Tycho Brahe*, Cambridge: Cambridge University Press, 1990, cit. p. 71, verbatim: "Suddenly from the cloudless skies a goddess appeared"; John R. Christianson in Clifford J. Cunningham, "Tycho's Conversation with Urania, and other engagements with the Muse", *Journal of Astronomical History and Heritage*, 27(1), 2024, pp. 105-125, p.110, gives the two verses (33 and 34) as follows: "And look! A goddess descended - I didn't know who - / From the clear heavens and suddenly stood before me."

[60] Gregor Weber, *Kaiser, Träume und Visionen in Prinzipat und Spätantike*, Stuttgart: Franz Steiner Verlag, Historia Einzelschriften 143, 2000, p. 288, footnote 251, Eusebius of Cesarea, *Vita Constantini*, 1,27,1-29,1, own translation of the corresponding sentences from Greek.

[61] *Ibid.*, p. 279, footnote 192, Panegyrici Latini, here 6(7), 21, 3-6, own translation of the corresponding sentences from Latin.

[62] E.g., Christian Pfister & Rudolf Brázdil, "Climatic variability in sixteenth-century. Europe and its social dimension: A synthesis", *Climatic Change*, 43: 5-53, Kluwer Academic Publishers, 1999; this comprehensive study focuses on Central Europe, but is also likely to be valid for southern Scandinavia.

[63] Moon phases courtesy of Fred Espenak, www.Astropixels.com

[64] Robert Greenler, *Rainbows, halos, and glories*, Cambridge: Cambridge University Press, 1980, pp. 65-72, with regard to the problem that "sun/moon pillars" due to flat-plate-crystals are optically only possible when the sun/moon is low; if the sun or moon is more than ~10° above the horizon, the light pillars are created with the help of ice crystal columns that are aligned horizontally with their longitudinal axis and are randomly oriented in rotation; cf. p. 72: "I recall one crisp evening many years ago when, on the last run down a ski slope, I watched the rising moon's shimmering column of light, formed by myriad crystals sparking in the moonlit air. It was the first pillar - sun or moon - I had ever seen. I wonder if my vivid memory of the beauty of that scene sparked my later interest in understanding these effects."

Francesco Ingoli's *Relazione delle Quattro Parti del Mondo*: Charting New Pathways in the History of Political Thought

Alberto Fabris

Abstract: In this paper, I explore new research paths to reevaluate the significance of Francesco Ingoli as a political thinker. This reassessment is conducted through a philosophical and conceptual analysis of his work as the General Secretary of the Congregation de Propaganda Fide. I focus particularly on his *Relazione delle Quattro Parti del Mondo* (circa 1631), a text where Ingoli merges data from missionary reports and scholarly treatises with his own insights on global geography, politics, and anthropology proposing an innovative perspective on newly discovered regions. Despite the importance of Ingoli's work, attesting to the deep resemantisation of political space that resulted from 16th and 17th-century geographical discoveries, an in-depth assessment of his political thought from the perspective of political philosophy is still largely missing. In particular, by means of an enquiry into the Church's efforts in adapting evangelization strategies across different regions of the world, including the development of a cosmopolitan and multilingual clergy, and the gathering of detailed information on the geographical, cultural, and ethnic characteristics of each area, sometimes even through indigenous correspondents, I intend to point out possible ways to explore the global interconnections that emerged at the dawn of early modernity. Finally, this paper aims to shed new light on the impact of extra-European contributions on Western culture, as well as on Early Modernity as a global and multipolar phenomenon, characterized by cultural hybridization and reciprocal transfer.

Keywords: Francesco Ingoli; Congregatio de Propaganda Fide; Counter-Reformation; Political Thought; First Globalization; Cultural Hybridization; Ethnogeography.

1. Introduction: "A Comprehensive Ecumenical Vision of the Universe"

On June 5, 2022, a pivotal shift occurred within the Catholic Church's structure for global evangelization: the Apostolic Constitution *Praedicate evangelium* came into effect. This significant reform, initiated by Pope Francis, led to the dissolution of the Congregation for the Evangelization of Peoples and the establishment of the Dicastery for Evangelization. This change superseded the *Immortalis Dei* bull of 1967, enacted by Pope Paul VI, which itself had transformed the ancient Congregatio de Propaganda Fide. The latter was originally founded by Gregory XV in 1622 through the bull *Inscrutabili Divinae*. Despite the Congregation's critical role in shaping and managing missionary activities across varied political, cultural, and religious contexts globally, a comprehensive historical analysis of the Propaganda Fide had not been undertaken until recent years.

The lack of a holistic history of the Congregation was noted as early as 1935 by Giuseppe Monticone in his article for the *Enciclopedia Italiana*.[1] This gap was only bridged in 2018 with Giovanni Pizzorusso's seminal work, offering the first thorough reconstruction of the Congregation's inception, structure, and operational mechanisms. Pizzorusso's research also illuminated the Congregation's influential figures and its extensive global communication networks[2] Although these studies are contributing to the historiographical debate on the government of the missions at the time of the Counter-Reformation, much remains to be done in the field of intellectual history and the history of political thought.

For example, it would be worth reconstructing the impact that the term 'propaganda' – a neologism introduced by Gregory XV – had on the intellectual lexicon of the 17th century, its evolution that led Niccolò Tommaseo to criticize its degenerate use in the vocabulary he edited in 1861[3] and the attempts to attenuate its meaning that appeared increasingly compromised by the Church in the 20th century.[4] This lacuna is even more remarkable as Propaganda's input was fundamental in promoting a truly global apprehension of the world and in forging conceptual and administrative tools to ensure a government (expressed certainly not as *imperium,* but as *cura*) of universal – and therefore authentically Catholic – scope. In this way, the new curial dicastery fully embodied that correlation between geographical knowledge and political discourse that had been maturing since the 16th century (particularly in Italy)[5] and that led Jean Amsler to argue that "around 1600, it is likely that only Church leaders had a truly ecumenical vision of the universe".[6]

Similar considerations apply to Francesco Ingoli, the man who led the Congregation from its foundation for three decades until his death shortly after the end of the Thirty Years' War.[7] Educated as a civil and canon jurist, with a doctorate in Law from Padua in 1601, Ingoli was also a polyglot, proficient in French, Spanish, Greek, and Arabic, as noted by his contemporaries[8] and a keen student of astronomy. After having taught law in Ravenna, he served as secretary to prominent cardinal families, in-

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cluding the Caetani, Lancelotti, and Ludovisi. This role facilitated his move to Rome, immersing him in the city's prominent academies and astronomical circles.

Ingoli's intense polemical activity began with his 1616 work *Disputatio de situ et quiete Terrae*, in which he challenged the theories of Copernicus, Kepler, and Galileo. Historiographical focus has often been on this aspect of his career, particularly his refutations, drafted frequently as an advisor to the Index, of scientific positions considered heterodox, especially after the 1616 condemnation of Copernicanism. Critiques have often highlighted Ingoli's perceived lack of competence compared to the scientists he opposed.[9]

However, his intellectual contributions extend beyond these polemics. Following the ascension of his patron Alessandro Ludovisi (Gregory XV) to the papacy, Ingoli was entrusted with key responsibilities, including collaborating on Conclave reform, reorganizing court ceremonial, and notably, serving as Secretary-General for the Congregatio de Propaganda Fide. In this capacity, Ingoli's role has often been undervalued, portrayed merely as a bureaucratic functionary, without due recognition of the significant impact of his initiatives.

Among these initiatives were the establishment of the Polyglot Typography and the Urban College,[10] the creation of an archive for comprehensive understanding of various evangelization contexts, and the authorship of the *Relazione delle quattro parti del mondo* (Report of the Four Parts of the World). Each of these contributions played a critical role in the propagation and management of missionary activities, showcasing Ingoli's multifaceted and influential role within the Congregation and the broader intellectual and ecclesiastical spheres.

This research agenda starts precisely from these gaps and intends to present some avenues of research that, building on the intellectual figure and work of Ingoli, could offer new elements for reflection on early modern political thought. More specifically, the intention here is to seek insight into 17th-century political thought through the lens of a *practise-orientated* text with considerable operational and conceptual repercussions on the Church's approach, rather than to do so through the frame of one of the main contemporary theoretical formulations. Furthermore, by means of an enquiry into Ingoli's efforts to adapt evangelization to the various regions of the world, provide the Church with a cosmopolitan and polyglot clergy, and collect data about the geographical, cultural and ethnic specificities of each province (even through indigenous correspondents), I intend to point out some possible ways to explore the global interconnections underlying early modern political thought. Finally, I would like to draw attention to some methodological aspects that emerge when the historian of ideas focusses on texts where the conceptual drive is combined with unquestionable practical aims, just like the *Relazione*. The selection of sources and interlocutors, their categorizing in the Propaganda archive that his secretary was carrying out and their exposition in a text that had the dual ambition of describing the state of an ever-expanding world and constructing the gaze necessary to contemplate and govern it offer an unparalleled testbed for studying the continuous tension between conceptual apprehension of reality and the operational dimension that it discloses.

Ultimately, the goal is to demonstrate how a text such as Ingoli's serves as an exemplary case study for applying critical analytical tools. This approach resonates with perspectives like those in Yves Lacoste's *La géographie, ça sert, d'abord, à faire la guerre* (Geography Serves, First of All, to Make War), which advocates for an examination of the operational and ideological power of knowledge. Ingoli's work, reflecting the challenges and tensions of early globalization, offers a valuable framework to understand the dynamic relationship between knowledge, power, and global expansion in the early modern era.

2. Francesco Ingoli's *Relazione delle quattro parti del mondo*: science and 'care' of the new *terra universalis*

The outcome of a long gestation, the *Relazione delle quattro parti del mondo* is particularly intriguing for its editorial history. Fabio Tosi,[11] who edited and published the text in 1999, posits that the *Relazione* was finalized around 1631. Ingoli, in this process, compiled and organized numerous letters detailing the progress of Catholic missions worldwide, initially directed to Capuchin Valeriano Magni, the nuncio to Emperor Ferdinand II. The work comprises five letters, with four dedicated to different continents and a fifth focusing on "the efforts accomplished in Rome for the Promotion of the Faith" This compilation was a refinement of the Secretary's correspondence, undertaken with the assistance of Giovanni Battista Agucchi, the apostolic nuncio to the Republic of Venice. The latter, according to Ingoli himself, was a man well versed in eloquence and politically very prudent (as evidenced by his diplomatic career and duties at the Serenissima) and would have amended his friend's writing on several occasions. Magni's interest in garnering economic and political support from the German princes for Rome shaped the *Relazione's* initial purpose. It was intended as a pamphlet to advocate for missionary activities, especially in regions where political-religious tensions underscored the necessity of rallying rulers to the Catholic cause. The initial version of the work, based on correspondence between Ingoli and the imperial nuncio, examined challenges faced by Catholic missions, including widespread heretical influence among sovereigns and populations, internal resistance, conflicts between orders, and political disputes necessitating compromise and "reason of State" strategies.

Concerns arose within the Congregation regarding the publication of such a sensitive document, which risked becoming a tool for Rome's adversaries. Ingoli, in fact, highlighted with great lucidity the fragilities and fault points on the European and world chessboard, suggesting a shrewd policy of infiltration and instigating divisions in Protestant countries such as Holland or England, but also clashing with the resistance to Roman intrusions into Spanish and Portuguese colonial policy.

Despite these concerns, the Secretary's insights on global evangelization and the Congregation's innovative missionary strategy garnered significant interest within the Curia. Ingoli's correspondence with Agucchi reveals that the cardinals' eagerness to review the manuscript drafts led to numerous delays, with many urging the

transformation of what was initially a simple pamphlet into a more comprehensive and ambitious treatise. It is precisely this transition – from a public writing aimed at gaining the Church the political support of the imperial establishment to a restricted document for the Curia itself – that explains the current status of the text and is crucial to understanding its use and influence.

In the first place, therefore, the *Relazione* is a report for the internal use of the Congregation, acting as a confidential document that shaped the thoughts and practices of ecclesiastical hierarchies well into the 18th century. Comparable to the ambitious cartographic projects of the era – such as the Gallery of Maps commissioned by Gregory XIII – Ingoli's text aims to present a detailed portrayal of the world. To do so, it theorizes and applies a specific paradigm, aligning with the efforts of cartographers, literati, and thinkers (emblematically labelled 'Worldmakers' by Ayesha Ramachandran)[12] who, from the most diverse perspectives, endeavored to 'shape the world' in those years. If, as we shall see, the importance of Ingoli's writing deserves to be examined for the peculiar world-mapping it performs and for the specific discourse on geographical knowledge it deploys, the operational horizon in which the text is situated also needs to be investigated. Indeed, the *Relazione* offers the historian of ideas and the scholar of 17th-century political thought the opportunity to confront a work whose influence on the mindset and practical functioning of an institution has few parallels in contemporary literature. In this regard, a careful analysis of this writing may shed new light on the importance that works often excluded from conventional expositions on the history of political thought, such as the treaties of the secretariats, diplomatic legations, or missionary reports, also had on a theoretical level, and may offer new insights into the mutual relationship between intellectual production and administrative activities promoted by the bureaucratic apparatuses that became increasingly important with early modernity.

In this regard, reconstructing the intellectual profile of Francesco Ingoli is indeed a worthwhile endeavor. Ingoli, as the first secretary, left a lasting impact on the Congregation, ensuring its endurance as noted by Metzler.[13] Beyond his vital role in the institution, he also served as a consultant to the Index and was a dedicated proponent of the cultural policies of the Tridentine Church. Even though scholarship has mainly focused on his epistemological controversies – analyzed, it must be said, exclusively from the point of view of the scientists he intended to oppose – Ingoli actively collaborated with the main ecclesiastical congregations he often helped to reform and was one of the figures most capable of combining the intellectual effort the Reformed Church took on with practical commitment.

For Ingoli, the utility of scientific knowledge became paramount for the Roman Church as it faced opposition from various political and cultural fronts, a reality that became particularly evident during the Protestant Reformation. This period was marked by a heavy reliance on philology and history from the Protestant side,[14] which necessitated a strategic response from the Catholic Church. In reaction, the Catholic world began to employ the sciences in an openly ideological manner.

This strategic use of science was part of a broader historiographical effort by the Church in territories newly discovered by Europeans. Here, Rome undertook early cultural assimilation, which included not only the development of historical accounts (for peoples who had previously not conceptualized their history in such terms) but also the appropriation of indigenous pasts.[15] This process of 'colonizing the imaginary' and the pursuit of innovative geographical knowledge by the Church's intellectuals were critical aspects of this approach. In line with Antonio Gramsci's keen observation, the Counter-Reformation heralded a shift in the role of prelates, increasingly transforming them into "politicians of the Catholic religion".[16] Francesco Ingoli epitomized this transformation.

The aim of this study is not to juxtapose Francesco Ingoli's roles as an ecclesiastical reformer and a culturally attuned secretary of the missionary Church against his function as a polemicist and advisor to the Index. On the contrary, it is essential to grasp the unity of his profile to understand how attention to the circulation and control of ideas and the need to promote a careful cultural policy were essential aspects of missionary activity, which often, it must be remembered, took the form of a *reconquista* against the ground lost under the pressure of new ideologies. Such unity of purpose emerges fully in the *Relazione delle quattro parti del mondo* and can be highlighted from several angles.

Firstly, the *Relazione* serves as a comprehensive mapping of cultural geography on a global scale. It examines the influence of ideas across different socio-political landscapes, turning the Catholic *Kulturkampf* into an effective tool for penetrating various territories. An illustrative example is Ingoli's thoughts on the role of seminaries in training Irish clergy in exile, not just as educational institutions but also as centers for fostering national consciousness among communities oppressed in their homeland.

Secondly, the work provides key insights into some of Propaganda Fide's initiatives under Ingoli's leadership, particularly the establishment of the Polyglot Press and the Urban College. These institutions aimed to position Rome as a global hub for training an intellectual elite, centralizing knowledge and ethno-geographical information from around the world and cultivating a culture capable of engaging with all peoples in their languages. Investigating Ingoli's contributions offers fresh perspectives on how Counter-Reformation Rome sought to develop new tools for becoming the epicenter of cultural globalization.
Finally, from a different angle, this paper highlights the importance of placing the *Relazione* within the broader political and cultural discourse of its time. Given the work's practical significance and its direct impact on the leadership of the Congregation, it is valuable to explore the intricate network of connections linking the *Relazione* to other contemporary political theories. This exploration can enrich the ongoing debate about the influence of theoretical works by figures like Botero, Bodin, Ramusio, or Sansovino on governing bodies, thereby contributing to a deeper understanding of the interplay between theoretical ideas and their practical applications in governance.

This latter point, in particular, necessitates an in-depth analysis of how Ingoli organized the multiple sources – coming from diverse contexts and ethnic and intellectual backgrounds – that constitute the *Relazione*. Based, for

example, on recent scholarship in the field of History of Knowledge (Burke, Lässig, Blair), it will be interesting to reconstruct how Ingoli gathered, examined, and organized *information* from different types of sources (first-hand correspondents or erudite treatises) to create *knowledge* capable of guiding and supporting the Church's political and ideological project. As its compositional process shows, the *Relazione* offers a peculiar example of a heteroclite text combining the author's personal analyses with missionary correspondence (received from very different intellectual profiles), geographical treatises and theological and political texts. In light of the growing awareness of the fact that data configuration inevitably creates biases that affect the results of data analysis, a systematic study of the *Relazione* would contribute to highlight the importance of methodological attention to data organization in the study of political doctrines. Rather than simply collecting heterogeneous materials, Ingoli has always been interested in the organization of his sources, which he sorted out and combined to build the archive of the Propaganda. This operation unveils an implicit but unmistakable political vision, in the form of an overall (biased) gaze which acted as an ordering principle looming over his considerable and composite corpus. This gaze deserves to be reconstructed and situated among contemporary works of political theory, especially since the *Relazione* had a notable practical impact thanks to its use as a handbook for the evangelizing mission of Propaganda around the world.

Finally, far from being a mere collection of texts and correspondences, Ingoli's work presents original theoretical insights, often inseparable from the practical implications they aimed to promote. In this regard, it is worth quoting in full one of the opening passages of the text, where the Secretary reflects on the nature and specificities of pastoral governance in a rapidly expanding global scenario.

> The vigilance and pastoral care of the Congregation embraces the whole world and will increasingly extend to parts of it hitherto unknown and unvisited. Certainly, since the world was created, no special and diligent care of a single head and a small number of members, such as that of our Congregation, has been extended to the whole world at the same time.[17]

Extracts such as this one, and others that could be cited, fully testify to the degree of awareness of functionaries in an administration that, for the first time, considered the entire world within its operational purview, a scope further anticipated to encompass imminent new discoveries.[18] Moreover, the fact that these remarks were promoted by the head of a body intent on devising tangible tools for a government with global reach elevates them beyond mere rhetoric, necessitating careful scrutiny by the historian of political thought. Since Amerigo Vespucci's initial letters dramatically influenced Italian culture and political thought, "knowledge and the very concept of the earth changed profoundly; thanks to explorers, missionaries, and geographers, the world became visible and, for the first time, apprehensible in its entirety. But the novelty of this understanding, as presented by Ingoli, is not so much epistemological as political: it has now become possible to attribute to a single institution, and to the few people who run it, a mission whose extension coincides with that of the Earth".[19] Compared to the 'competing' political forms, which aspired to varying degrees of global governance, the Counter-Reformation Church exhibited notable specificities. Indeed, the Petrine universalism that had been conceptually forged through theological and juridical treatises during the Middle Ages found a peculiar testing ground in the age of the great discoveries. Texts such as Ingoli's are therefore fundamental to understanding the specificities of the Roman model, which in many ways was more attentive to the ethnic and anthropological specificities of the new peoples and even incorporated them into its governance structures more effectively than other nation-states. From a political philosophical standpoint, it will be interesting to contrast Ingoli's concept of 'cura universale' (universal care) with contemporary notions such as *potestas*, *imperium* and sovereignty to show that many of the concepts deployed in the *Relazione* contrast with those elaborated by theorists of sovereignty (e.g. Bodin).

3. *Terra universalis*: New Perspectives on Early Modern Political Spatiality

The new concept of space that emerged across the 16th-17th century has been studied from several angles. Historians of science,[20] epistemologists, and historians of geography[21] analyzed the genesis of both the concept of 'universal Earth' and the emerging science of modern geography. In particular, the mutual implications between geographical and cosmological discoveries, and their influence on the elaboration of epistemological tools to conceptualize the new spatiality that has been taking shape since the 16th century, have been the focus of numerous contributions in the field of philosophy and history of science. The finding of new territories led to a reconceptualisation of spatiality, transforming the way it was described, mapped, and thought.[22] The encounter with a space perceived as fluid, unstructured, and in any case to be rationalized, and with cultures endowed with other paradigms (whose contribution to modern thought was strongly misunderstood until recent years) led to singular phenomena of hybridization. Among them, works such as *Les Singularitez de la France antarctique* or the *Cosmographie universelle* by the French cosmographer and explorer André Thevet (1516-1592) show the peculiar fruits of the crossbreeding of classical literature, theological sources, and scientific knowledge following contact with new lands and the culture and socio-anthropological specificities of their populations. As Lestringant argues, the chaos wrought by the crumbling of many of the hitherto valid certainties had the singular effect of making men like Thévet more receptive to the cultural diversity of the indigenous peoples with whom he came into contact. This, for example, prompted the geographer to look for aspects in the native myths that could complement classical sources and European beliefs (which, it should be noted, did not completely re-absorb the indigenous elements). This reconceptualisation underpins the approach of European thinkers to 'newly discovered' populations, which planted the seeds of what will become modern anthropology,[23] and laid the indispensable premises for the

forthcoming rise of capitalism.[24] Thus, as different disciplines have shown from distinctive perspectives, the pervasive renovation of the 16th-century *episteme* constructed a new concept of the Earth, conceived as "the universal space of human existence".[25] Despite the great attention these issues have received in recent years, Ingoli's reflection on the emergence of the new *Terra universalis* has been substantially neglected by those historians who have traced the political implications of 17th-century spatiality. In this contribution, I therefore want to point out some avenues of research to show how certain aspects inherent in his thought (in particular, what can be described as an anthropogeographical and geopolitical awareness) can provide new elements for understanding premodern political spatiality.

In the coeval years and immediately preceding the Secretary, especially in the Italian area, the implications between geographical knowledge and political thought had become so close that some scholars were prompted to speak of the "territorialization of power" with a consequent "politicization of space".[26] Certainly, the influence of the 'spatial turn' resulting from disruptive scientific discoveries and the extension of the geographical horizon affected practically every aspect of thought between the end of the 15th century and throughout the 17th century. However, as several researchers have pointed out, the Italian area was particularly precocious in measuring the political consequences of a space that appeared increasingly 'striated' and marked by a great complexity of variables (historical, economic, cultural, etc.). Indeed, if it is true that "the link between history and politics is not an invention of the 16th century", it must also be said that until that date "no geographical texts were written for direct political use".[27] From then on, however, the undermining of many previous assumptions and the shattering emergence of knowledge that had been precluded to the Ancients made the authors of the time particularly sensitive to this 'call to territorialization'. By this, one should not only understand the fascination for travel tales and accounts of newly discovered lands (which often lingered in the exotic and fabulous), but also the growing attention to the influence of the territory in the construction of cultures and human identities. In this regard, in addition to the frequent observations of philosophers such as Giordano Bruno on the generative influences of the country on the constitution of its inhabitants, mention should also be made of the strong relativistic charge that Montaigne derived by situating his thought at other latitudes. Moreover, the splintering of European religious and political identity and the emergence of lands with uncertain connotations but characterized by an apparent cultural (and even anthropological) irreducibility made the borders drawn on maps increasingly fragmented and porous, and the attempt to provide adequate political responses to such a fluid situation more problematic. In addition to the technical difficulties faced by cartographers such as Mercator, the new spatiality compelled those authors engaged in the construction of the concept of universal Earth[28] to address the social, economic, and cultural factors that intersected it. Space, in short, appeared less and less as a homogeneous extension but became charged with interactions and power relations due to the interplay of its variables. From the 16th century onwards, and with increasing insistence, political thought was to map a chessboard where power relations and strategies were thought of as functions of space and its qualities (both in terms of resources and human geography). In other words, as the way of understanding and defining space grew more complex, this element became increasingly charged with a political character. This fact is all the more remarkable in that some of the greatest contributions to the constitution of a geography with strong political connotations came from an area that the Age of Discovery would make increasingly subordinate and peripheral. Countless factors certainly contributed to this: the risk of increasing marginalization perceived by those states, such as Venice, that had built their supremacy in a geographical space that threatened to be overturned;[29] the great fragmentation of the territorial realities of the Peninsula; the peculiarity of the political form assumed by the Church, especially after the Council of Trent, to name but a few of the most relevant. Therefore, in a certain sense, the Italian point of view (despite the differences between the local actors) stemmed from a reaction feeling and, faced with the 'loss of its own space', made new knowledge the tools with which to recover lost ground.

The figure of Francesco Ingoli must therefore be placed in this context and within the framework of the Catholic Church, which, following the Reformation and the loss of its unchallenged dominance over European spirituality and politics, attempted to radically rethink itself.[30] As scholarship has abundantly shown, the immense work of reshaping Catholicism involved a formalization of doctrine and an extensive restructuring of the organization of the institution. However, among the aspects on which recent research is placing increasing emphasis is the unprecedented use of knowledge and the sciences, which were at the center of an ever more ideological polarization. In this regard, the philological criticism developed by Humanism had been a key tool in the hands of Protestants to refute a certain exegesis of Scripture and counter Roman primacy. Similarly, Rome's ability to centralize information on newly discovered land and its ability to elaborate a vision and government model with a global scope[31] seemed, for an author like Botero, the best tool to "repair the damage that the Church had had to suffer because of heresy in Germany and throughout the North". In the eyes of many Counter-Reformation thinkers, the immense territorial expansion the world was witnessing therefore seemed a gift of providence to restore the losses "Religion" had suffered in Europe. To take advantage of this opportunity – and preserve the New World from the contaminations of heresy – it was necessary, however, to equip oneself with the conceptual and operational tools to subject this new scenario to Roman supremacy. Such considerations are fundamental in order to grasp the militant tone that underlies the intellectual production of Giovanni Botero, author of the *Relazioni Universali*, a work to which recent critics have recognized a resolutely geopolitical stance.[32] With that epitome – which the author triggered by the request of his patron, Cardinal Federico Borromeo, to report on the state of Christianity in the world – Botero inaugurated a singular genre. The *Relazioni* are, in fact, at a time, a geographical mapping of the world, an assessment of the power of states and their mutual balances, and a religious and

ethnographic profile of different populations. Works such as this, to which must be added the better-known *Della Ragion di Stato*, testify to how heated and lively the debate was around the need to explore the emerging political spatiality and the ideological status of the sciences.

Forty years later, when Ingoli put pen to paper on his *Relazione delle quattro parti del mondo*, the great epistemological armamentarium developed by the Counter-Reformation had combined with an advanced practical and administrative apparatus to transform the sophisticated geopolitical knowledge Rome now possessed into an instrument of universal government. Obviously, Catholic prominence had not failed to provoke violent reactions, and not only on the Reformed side, as evidenced by the fierce controversy over state sovereignty or the strenuous defense of the prerogatives enjoyed by the *Patronato real* opposed by the Iberian powers against Roman interference.[33] In the 16th century, and at least in the first part of the 17th century, in fact, the colonial possessions of Spain and Portugal stretched over an immense area, administered with wide margins of autonomy even in spiritual matters. Especially in the American continent, the two Iberian crowns were very reluctant to authorize the passage of foreign missionary personnel and imposed centralized administrative divisions that in most cases took no account of the ethnic, linguistic, and cultural specificities of the native peoples. Therefore, the objective of this contribution is to draw attention to the need to reconstruct the innovative approach of Ingoli to political space (that went through a careful examination of all the factors attributable to human geography). Such a reconstruction passes from an analysis of those concepts employed by the author that denote the 17th-c. reconceptualization of space, such as that of *nationes*, used to indicate the interconnection between territory, population, and culture (ethnos, language, religion, etc.). The use of such conceptuality shows the irreducibility of the spatiality theorized by Ingoli with that promoted by other contemporary theorists of modern statehood and produce new insights on the reconceptualisation of 17th-century space from the perspective of political philosophy. Furthermore, the Secretary's considerations on the 'fluidifying' effects of migration, cultural hybridization and mestizo offer us an innovative perspective on the way these phenomena were first theorized. Therefore, the figure and work of Ingoli offer a valuable perspective for a better understanding of the issues arising from the first globalization, shedding new light on the emergence of concepts that played such a large part in the formation of modern thought.

4. De-Europeanize Christianity and Making It a Global Religion

Having mentioned the active role that Propaganda and its secretary played in promoting a conception and policy of space that was different and contrary to that implemented by the colonial states of the time (also through a singular recourse to the tools offered by scientific knowledge), it is now time to consider another aspect of Ingoli's thought worthy of interest. Indeed, it is necessary to highlight the great importance Urban College and Polyglot Press had in Ingoli's missionary strategy, in the establishment of which he was actively involved. Next, I will conclude with some observations on the role that non-European sources and correspondents played on the *Relazione*, pointing out some compositional peculiarities of the text and hinting at future paths of research.

As the Secretary also emphasizes in the final part of his writing – the already mentioned *Quinta lettera sulle cose fatte a Roma per la Propagazione della Fede* – the establishment of the College and the Polyglot Press was crucial for the Congregation. With the creation of the Urban College in 1627, Propaganda was in fact endowed with an institution especially dedicated to the training of native students from the very countries where they would be employed as missionaries. This would have had the double advantage of having missionary personnel familiar with the contexts in which they would work but would also have emancipated the Congregation from clergy aligned with the positions of the Iberian monarchies or religious orders, which were not always in accordance with Propaganda's directives. Of course, as many have pointed out, the hostilities that projects like this found were many and "widespread resistance to the ordination of indigenous candidates to the priesthood from the mid-sixteenth century to the very end of the seventeenth (and beyond) stands as one of the more spectacular missed opportunities in the history of Roman Catholicism".[34] In any case, the importance of institutions such as these in fostering interactions between European culture and other milieus is considerable, and certainly not limited to a one-way transfer that reduces non-European interlocutors to mere receivers. On the contrary, figures such as the Franciscan missionary, historian, and linguist Diego de Valadés (1522-82?), of Tlaxcalteca mother but nephew of the eponymous conquistador, show how, in reality, the contribution of the natives who built a bridge between European and local cultures was extremely original and is of great importance for reconstructing the intellectual history of the Counter-Reformation. After training at a college for indigenous elites in Mexico City and contributing to the evangelization of Nahua, Tarascan, and Otomi-speaking peoples, he authored a *Rhetorica Christiana* that hybridized the argumentative tools widely used by preachers with the use of images used as a cognitive medium by Mexica culture. The work is an innovative reformulation of the *ars memoriae* parallel to other refinements that this discipline enjoyed in the same period (for instance, Giordano Bruno)[35], an apologetic of the successes of evangelization in the New World, but also a valuable glimpse to shed light on ethnoanthropological aspects such as imagery and the use of cognitive support by Mesoamerican civilizations.[36] After editing the text in Perugia in 1579 (it was the first work published in Europe by a Native American), its author collaborated with the Roman Curia by promoting the expertise he had gained regarding the evangelization of Central American populations and fundamental aspects of their cultures (including their language, calendar and pedagogical methods). Aware of the importance of these tools for missionary work, Ingoli has always actively promoted the entry of intellectuals of indigenous extraction into ecclesiastical hierarchies.

In parallel to the College, the Polyglot Press was also dedicated to the study of the languages and cultures with which Rome was in dialogue. As has already been noted,

the missionary impetus of those years represented an unprecedented momentum for the study of linguistics and sowed the seeds for anthropological and cultural studies.

Thanks to a large number of scholars and the dense network of correspondents made possible by the development of the papal administration, the Church became the institution best able to convey its message in the largest number of idioms, including those of the Asian empires and American nations. In those years, Rome attempted to exert its cultural hegemony by publishing and translating all sorts of didactic, historical, and theological works aimed, depending on the context, at training missionaries and providing them with adequate support for evangelization, but also – as Ingoli repeatedly emphasizes – at legitimizing the Catholic faith and opposing its detractors. To this end, often having to interact with intellectually refined interlocutors (whether it was to refute the Qur'an' or obtain permission from local authorities to preach) it became increasingly urgent to educate missionaries in the study of the texts and systems of thought of the various contexts. The intellectual ferment of those years was certainly not without consequences. Today, in fact, historiography increasingly claims the multipolar character of the Counter-Reformation, showing how, far from being the emanation of a doctrine imposed from the center to the periphery, it was instead the fruit of exchanges and mediations. Thanks in part to the activism of its Secretary, the Congregation became an important node in the economy of these exchanges, acting not only as an organ of emanation of the Catholic message, but also as one of the main circuits through which non-European thought became part of the European identity.

In recent years, the historiographical debate on missionary activities and the multipolar character of early globalization and Counter-Reformation has benefited from important contributions.[37] Among them, Simon Ditchfield[38] has repeatedly questioned the possibility of speaking of Tridentine Catholicism as a *world religion* enquiring the meaning to be attributed to this expression. Certainly, as he points out, in purely numerical terms, the very small increase in the percentage of the world's Christian population between 1400 and 1700 (from 15% to 23%)[39] means that "Christianity, let alone Roman Catholicism, was not yet a world religion at the end of the *twentieth* century".[40] In the same way, even the demographic growth of Europe or the territorial and economic expansion of its political entities confirm that in the same period it was mainly Central and East Asia that experienced the greatest development. It was not until the 19th century that the Old continent boomed. In any case, the greatest increase in the Christian population occurred not so much in the age of the great discoveries as in the evangelization of large parts of sub-Saharan Africa in the postcolonial era. However, what makes it possible to consider Christianity – particularly Tridentine Catholicism – as a global phenomenon well before its massive planetary spread does not lie so much in the Christianization of the new Latin American contexts nor in the alleged 'Triumph of the West over the Rest'.[41] On the contrary, if this sentiment arose as early as the 16th century, "this was largely the result less of the *physical* return of missionaries from the New World, sub-sarahan Africa and Asia, but of the tsunami of *written* reports that flooded from printing presses from Mexico to Madrid, and Macau to Milan".[42] Rather than the actual outcome of evangelization (which is certainly not to be denied), the feeling that the challenge and rebirth of Catholicism depended as much on its ability to meet the challenge of the new *terra universalis* can be seen in the great flowering of missionary literature and the emphasis placed on the reorganization of the Church's missionary apparatus.

The intellectual figure of Francesco Ingoli stands precisely at the convergence of these two occurrences: a pivotal figure in the implementation of Propaganda fide, the Secretary conceived his mandate and the dicastery he led as the point of irradiation and return of global missionary activity. Retracing the explicit and implicit sources of the *Relazione* will allow us to shed new light on the impact of extra-European contributions on Western culture, as well as on Early Modernity as a global and multipolar phenomenon, characterized by cultural hybridization and reciprocal transfer. Ingoli's attempt to build a universal Church capable of adapting to various contexts will give us the opportunity to analyze a concrete example of cultural mestizo, described by scholars such as Gruzinski. In this sense, such research can concur with the historiographical debate aimed at studying reciprocal influences during the first globalization, as it investigates the fundamental role that the contacts with extra-European populations played in shaping modernity and the idea of Europe.

Notes

[1] The article is now available on the online portal of the Treccani Institute at the following link*: https://www.treccani.it/enciclopedia/ propaganda-fide_%28 Enciclopedia-Italiana%29/*. This is also confirmed in F. Tosi's introduction to F. Ingoli, *Relazione delle quattro parti del mondo*, Urbaniana University Press, Roma, 1999, p. VIII note 7. Henceforth this text will be referred to simply as *Relazione* and English translations will be mine.

[2] Cf. Giovanni Pizzorusso, *Governare le missioni, conoscere il mondo nel XVII secolo. La Congregazione pontificia De Propaganda Fide*, Sette Città, Viterbo, 2018. The same author contributed a very recent work that is destined to be an important reference for the study of the Congregation: *Propaganda Fide. 1. La congregazione pontificia e la giurisdizione sulle missioni*, Edizioni di Storia e Letteratura, Roma, 2022.

[3] "Ma, perchè gli avversarii delle cose sacre prendono volentieri così le parole come le cose agli usi proprii, Fare una propaganda, Far propaganda, dicesi anco di Società o impresa o azione cospirante di più pers. per fondare o distruggere checchessia, per piantare e spiantare, per affermare e negare. Sarebbe da smettere". The electronic version of the Tommaeso-Bellini is now freely available. For the cited entry see *https://www.tommaseobellini.it/#/items*

[4] My upcoming article *Worldwide Vigilance and Pastoral Care: A Genealogy of the Concept of 'Propaganda'* delves into a detailed genealogical analysis of the concept of propaganda, specifically within the context of the Reformed Church and the Congregatio de Propaganda Fide.

[5] Cf. Romain Descendre, "Dall'occhio della storia all'occhio della politica. Sulla nascita della geografia politica nel Cinquecento" in E. Mattioda (ed.), *Nascita della storiografia e organizzazione dei saperi*, Olschki, Firenze, 2010, p. 155-179 where the author states that "until the 16th century no geographical texts were written for direct political use" (p. 157).

[6] J. Amsler, La Renaissance (1415-1600), in *Histoire Universelle des Explorations*, Paris 1959, II, p. 405.

[7] For a biographical profile of Ingoli, see G. Pizzorusso, "Ingoli, Francesco", in Dizionario biografico degli italiani, available online (*https://www.treccani.it/enciclopedia/francesco-ingoli_(Dizionario-Biografico)*) and F. Tosi's introduction to F. Ingoli, Relazione, (op. cit), which also contains the Italian translation of the contribution "Francesco Ingoli, der erste Sekretär der Kongregation" published by J. Metzler in *Sacrae Congregationis de Propaganda Fide memoria rerum*. 1622-1972, Roma-Friburg-Wien, 1971-1976, vol. I/1, pp. 197-243. For further

contributions, see footnote 9 in F. Ingoli, *Relazione*, (op. cit), p. X.

[8] On this point, see Girolamo Fabbri's account reported by F. Tosi, op. cit. p. XI.

[9] See M. Bucciantini, *Contro Galileo. Alle origini dell'affaire*, Olschki, Firenze, 1995, p. 90, and G. Pizzorusso, "Ingoli, Francesco", op. cit.

[10] On the satellite institutions of Propaganda Fide, see Giovanni Pizzorusso, "I satelliti di Propaganda Fide: il Collegio Urbano e la Tipografia poliglotta. Note di ricerca su due istituzioni culturali romane nel XVII secolo", *Mélanges de l'École française de Rome*, 2004/ 116-2, pp. 471-498.

[11] Cf. *Relazione*, p. XVII sg.

[12] Ayesha Ramachandran, *The Worldmakers. Global Imagining in Early Modern Europe*, Chicago University Press, Chicago and London, 2015.

[13] Cf. Metzler "Francesco Ingoli, der erste Sekretär der Kongregation" now available in *Relazione*, p. 293.

[14] On this subject, see R. Descendre, "Une géopolitique pour la Contre-Réforme: les *Relazioni universali* de Giovanni Botero (1544-1617)". Bruno Toppan and Denis Fachard (eds.), Esprit, lettre(s) et expression de la Contre-Réforme en Italie à l'aube d'un monde nouveau, Nancy, CSLI, 2005. p. 47-59; "Dall'occhio della storia all'occhio della politica. Sulla nascita della geografia politica nel Cinquecento", in E. Mattioda (ed.), *Nascita della storiografia e organizzazione dei saperi*, Olschki, Firenze, 2010, p. 155-179 and the introduction to *L'état du monde. Giovanni Botero entre raison d'état et géopolitique*, Droz, Geneve, 2009.

[15] See S. Gruzinski, *La colonisation de l'imaginaire : Sociétés indigènes et occidentalisation dans le Mexique espagnol (XVI^e^-XVIII^e^ siècle)*, Gallimard, Paris, 1988; *The Mestizo Mind: The Intellectual Dynamics of Colonization and Globalization*, Routledge, London, 2002; *La machine à remonter le temps. Quand l'Europe s'est mise à écrire l'histoire du monde*, Fayard, Paris, 2017.

[16] This definition appears in Quaderno VIII, "For a History of Italian Intellectuals. Miscellanea and Notes on Philosophy III", 1269.

[17] *Relazione*, p. 12. Original text: "Abbraccia la vigilanza e la cura pastorale della Congregazione tutto il mondo, e sempre più alle parti di esso, sin'hora incognite, o non praticate si andrà estendendo. Né per certo, da poi che il mondo istesso è creato, alcuna cura così spetiale, e diligente d'un capo solo, e di un piccolo numero di membra, com'è quella della nostra Congregazione si è per tutto il mondo nel medesimo tempo distesa." Translation by the author.

[18] In this respect, to define the universal spiritual jurisdiction of Propaganda, the formula of Carta and Descendre, who spoke of "the statehood of the government of souls", seems very pertinent. Cf. Paolo Carta and Romain Descendre, « Présentation », *Laboratoire italien* [online], 8 | 2008, p. 4.

[19] Ibid., p. 3.

[20] See A. Koyré, *From the closed World to the infinite Universe*, Johns Hopkins University Press, Baltimore, 1957; E. Grant, *Much Ado about Nothing: Theories of Space and Vacuum from the Middle Ages to the Scientific Revolution*, Cambridge University Press, 1981; M. Jammer, *Concepts of Space: The History of Theories of Space in Physics*, Courier Corporation, Dover, 1954; M.A. Granada, "New visions of the Cosmos," in J. Hankins (ed.), *The Cambridge Companion to Renaissance Philosophy*, Cambridge University Press, 2007, 270-86; K. Vermeir and J. Regier (eds.), *Boundaries, Extents and Circulations: Space and Spatiality in Early Modern Natural Philosophy*, Springer, Cham, 2016.

[21] See J.-M. Besse, *Les grandeurs de la terre: Aspects du savoir géographique à la Rennaissance*, ENS Editions, Lyon, 2003; J. Short, *Making Space. Revisioning the World (1475-1600)*, Syracuse University Press, Syracuse, 2003.

[22] See. F. Lestringant, *L'atelier du cosmographe ou l'image du monde à la Renaissance*, Albin Michel, Paris, 1991; D. Buisseret, *Monarchs, Ministers, and Maps: The Emergence of Cartography as a Tool of Government in Early Modern Europe*, Chicago University Press, Chicago, 1992; J.B. Harley, *The New Nature of Maps: Essays in the History of Chartography*, Johns Hopkins University Press, Baltimore, 2002. See also A. Ramachandran, op cit. About the new spatiality's impact on political thought, see: C. Galli, *Spazi politici: l'età moderna e l'età globale*, il Mulino, Bologna, 2011. See also, more broadly, works by R.Descendre, J.-L.Fournel, J.-C.Zancarini.

[23] G. Gliozzi, *La scoperta dei selvaggi. Antropologia e colonialismo da Colombo a Diderot*, Principato editore, Milano, 1971; *Le teorie della razza nell'età moderna*, Loescher editore, Torino, 1975; *Adamo e il Nuovo mondo: la nascita dell'antropologia come ideologia coloniale: dalle genealogie bibliche alle teorie razziali (1500-1700)*, Franco Angeli, Milano, 1977.

[24] I. Wallerstein, *The modern World-System: Capitalist Agriculture and the Origins of the European World-Economy in the Sixteenth Century*, vol. I, Academic Press, New York-London, 1974; I. Wallerstein, *Historical Capitalism*, Verso, London, 2011; P. Linebaugh, M. Rediker, *The many-headed Hydra: Sailors, Slaves, Commoners, and the Hidden History of the Revolutionary Atlantic*, Beacon Press, Boston, 2002; S. Gruzinski, *Les quatre parties du monde: histoire d'une mondialisation*, Editions de La Martinière, Paris, 2004; S. Federici, *Caliban and the Witch: Women, the Body and Primitive Accumulation*, Autonomedia, New York, 2004; G. Maifreda, *From Oikonomia to political Economy: Constructing Economic Knowledge from the Renaissance to the Scientific Revolution*, Ashgate, Farnham, 2012.

[25] J.-M. Besse, Ibid, 378.

[26] Carta and Dezcendre, op. cit.

[27] R. Descendre, *Dall'occhio della storia all'ochhio della politica*, op. cit., p. 157.

[28] Cf. J.-M. Besse, *Les grandeurs de la terre*, op. cit. In this study, Besse analyses the emergence of a geographical rationality during the 16th century and studies the construction of a new object – the universal Earth – as a consequence of the evolution of geography as an autonomous discipline.

[29] For a close examination of the Venetian context (and Ramusio's thinking in particular), see the works of Fiona Lejosne: *Écrire le monde depuis Venise au XVIe siècle. Giovanni Battista Ramusio et les Navigationi et viaggi*, Genève, Droz, 2021; « Les compilations géographiques vénitiennes du début de l'époque moderne : savoirs politiques et politique des savoirs », Etudes Epistémè : revue de littérature et de civilisation (XVIe - XVIIIe siècles), n°39, 2021 ; « Se substituer à Ptolémée ? Modèles, sources et mise en forme de la géographie dans les Navigationi et viaggi de Giovanni Battista Ramusio », *Revue de géographie historique*, n°17-18, novembre 2020-mai 2021 : « Penser les savoirs géographiques à l'époque moderne (XVe-XIXe siècle) » ; « Production du savoir géographique à Venise au début de l'âge moderne : entre centralité vénitienne et spatialisation européenne », Cahiers d'études italiennes, 31 | 2020.

[30] For a general profile of the age of the Counter-Reformation, see Mario Bendiscioli, Massimo Marcocchi, *Riforma Cattolica. Antologia di documenti*, Studium, Roma, 1963; Marvin O'Connell, *Counter-reformation, 1550–1610*, Joanna Cotler Book, 1974; Hubert Jedin, "Riforma e controriforma: crisi, consolidamento, diffusione missionaria (XVI - XVII sec.)", in Elio Guerriero (ed.), *Storia della Chiesa*, vol. 6, Jaca Book, Milano, 1993; Martin D. W. Jones, *The Counter Reformation: Religion and Society in Early Modern Europe*, Cambridge University Press, Cambridge, 1995; Robert Bireley, *The Refashioning of Catholicism, 1450–1700: A Reassessment of the Counter Reformation*, Catholic University of America Press, Washington, 1999; Michael A. Mullett, *The Catholic Reformation*, Routledge, London, 1999; John W. O'Malley, *Trent and All That: Renaming Catholicism in the Early Modern Era*, Harvard University Press, Cambridge, 2000; Elena Bonora, *La Controriforma*, Laterza, Roma, 2001; Anthony D. Wright, *The Counter-reformation: Catholic Europe and the Non-christian World*, Routledge, London, 2005; Tadhg Ó hAnnracháin, *Catholic Europe, 1592–1648: Centre and Peripheries*, Oxford University Press, Oxford, 2015.

[31] Cf. Giovanno Pizzorusso, "La Sede apostolica tra chiesa tridentina e chiesa missionaria: circolazione delle conoscenze e giurisdizione pontificia in una prospettiva globale durante l'età moderna", *Rechtsgeschichte - Legal History*, 2012(20), pp. 382-385.

[32] See in this regard Blythe Alice Raviola's introduction to Giovanni Botero, *Le Relazioni universali*, Aragno, Torino, 2015 as well as Romain Descendre, "Une géopolitique pour la Contre-Réforme", op. cit. ; "Une monarchie 'presque universelle'. Géopolitique de l'Empire dans les *Relazioni universali* de Giovanni Botero", in F. Crémoux et J.-L. Fournel (éd.), *Idées d'Empire en Italie et en Espagne : XIVe-XVIIe siècle*, Publications des universités de Rouen et du Havre, 2010, p. 217-232 and *L'état du monde*, op. cit.

[33] On the Patronado real system, see Giovanni Pizzorusso, "Problematizando el Patronato Regio. Nuevos acercamientos al gobierno de la Iglesia Ibero-Americana desde la perspectiva de la Santa Sede", in Thomas Duve (ed.), *Actas del XIX Congreso del Instituto Internacional de Historia del Derecho Indiano* (Berlín 2016), Instituto Internacional de Historia del Derecho Indiano, Madrid 2017; "Il padroado régio portoghese nella dimensione "globale" della Chiesa romana", in Giovanni Pizzorusso, Gaetano Platania, Matteo Sanfilippo (eds.), *Gli archivi della Santa sede come fonte per la storia del Portogalllo in età moderna*, Sette Città, Viterbo, 2012, pp. 177-220. See also the Max Planck Joint Project coordinated by Benedetta Albani "A new look at the Patronato Regio. The Roman Curia and the Government of the Ibero-American Church in the Early Modern Period": *https:// www.lhlt.mpg.de/ 1864608/02-albani-patronata?c=1863727*

[34] Simon Ditchfield, "The 'Making' of Roman Catholicism as a 'World Religion'", in Jan Stievermann and Randall C. Zachman (eds.), *Multiple*

Reformations? The Many Faces and Legacies of the Reformation, Colloquia historica et theologica, Mohr Siebeck, Tübingen, p. 194.

[35] Just like the philosopher from Nola, Valdés carefully edited the engravings that accompany his work, insisting on the great value of images as a memorative medium capable of promoting a true mens artificiata.

[36] Don Paul Abbott, "Diego Valadés and the Origins of Humanistic Rhetoric in the Americas", in Winifred Bryan Horner; Michael Leff (eds.), *Rhetoric and Pedagogy: Its History, Philosophy, and Practice*, Routledge, London, 1995; Diego Valadés, *Rhetorica Christiana*, Julio Pimentel Álvarez (ed.), Universidad Nacional Autónoma de México, Ciudad de México, 2019.

[37] See in particular: Lamin Sanneh, *Whose Religion is Christianity: The Gospel beyond the West*, Eerdmans, Grand Rapids, 2003; *Translating the Message: The Missionary Impact on Culture*, Orbis, Maryknoll, 2009; Romain Bertrand, *L'Histoire à parts égales: récits d'une rencontre Orient-Occident (XVIe-XVIIe siècle)*, Seuil, Paris, 2011; Giuseppe Marcocci, Wietse de Boer, Aliocha Maldavsky, Ilaria Pavan (eds.) *Space and Conversions in Global Perspective*, Brill, Leiden, 2015; Thomas Banchoff, José Casanova (eds.), *The Jesuits and Globalization: Historical Legacies and Contemporary Challenges*, Georgetown University Press, Washington, 2016; Alison Forrestal, Seán Alexander Smith (eds.), *The Frontiers of Mission: Perspective on Early Modern Missionary Catholicism*, Brill, Leiden, 2016; Ronnie Po-Chia Hsia, *A Companion to the Early Modern Catholic Global Missions*, Brill, Leiden, 2018.

[38] Cf., Simon Ditchfield, "Of Dancing Cardinals and Mestizo Madonnas: Reconfiguring the History of Early Modern Roman Catholicism in the Early Modern Period," *Journal of Early Modern History* 8:3 (2004): 386–408; "De-centering the Catholic Reformation: Papacy and Peoples in the Early Modern World," *Archiv für Reformationsgeschichte* 101 (2010): 186–208; "The 'Making' of Roman Catholicism as a 'World Religion'", op. cit.

[39] *World Christian Trends across 22 Centuries* (Global Diagram 4) downloadable from the website of the Center for the Study of Global Christianity at Gordon Conwell Theological Seminary: *http://www. gordonconwell.edu/ ockenga/research/documents/gd04.pdf*. Cf. for greater contextual detail: Todd M. Johnson and Brian J. Grim, *The World's Religions in Figures: An Introduction to International Religious Demography*, Blackwell, Oxford and Malden, 2013.

[40] Simon Ditchfield, "The 'Making' of Roman Catholicism as a 'World Religion'", op. cit, p. 197.

[41] Although this view has sometimes had the merit of questioning 'Western' historical and political paradigms, it risks presenting an overly linear and deterministic view of historical processes. Paradoxically, even with the intention of giving back a voice 'to the vanquished', the danger is to reduce them to mere passive subjects of processes in which they would have played no role. On the contrary, recent studies on missionary history, early globalisation and colonialism show a more composite scenario full of grey areas. In this regard, see James Belich, John Darwin, Margret Frenz, Chris Wickham (eds.), *The Prospect of Global History*, Oxford University Press, Oxford, 2016.

[42] Ibid., p. 198.

Lightning in a Wine Cask: Vernacular Meteorology and Terminology in the *Goodly Gallerye* of William Fulke

Kristin Raffa

Abstract: Lightning and thunderbolts have been sources of wonder since classical antiquity. Interpretations of these aerial and destructive phenomena had roots in the Homeric tradition and further evolved in the meteorological writings of Aristotle and others. In Aristotelian and early encyclopedic writings, lightning and thunderbolts were explained as different manifestations of the dry exhalation or wind. Writers categorized thunderbolts based on their subtlety, speed, and effects. In the sixteenth century, William Fulke viewed thunderbolts similarly to his antique predecessors but interpreted wondrous aspects and categorizations in light of the scientific and religious convictions of Elizabethan England. His English meteorological text, *Goodly Gallerye*, demonstrates an attempt to standardize terminology in the vernacular while also maintaining continuity in descriptions and interpretations of lightning and thunderbolts. This continuity can also be seen in subsequent writers on lightning and thunderbolts who used chymical theories of meteorology.

Keywords: Lightning, thunderbolts, vernacular meteorology, terminology, chymistry, William Fulke.

1. Introduction

Aristotle's treatment of lightning and thunderbolts in his *Meteorology* became part of a long tradition in antiquity to explain the causes of these phenomena in relation to each other and as products of the dry exhalation. As relatively common but remarkable experiences, lightning and thunderbolts appeared in poetry and a variety of other creative works and often provoked wonder.[1] Accounts of strange, violent, or wondrous effects often accompanied descriptions of lightning and thunderbolts even in works that otherwise emphasized causal explanations. Some of the most prominent examples of this persist in Pliny the Elder's *Natural History* and Seneca's *Natural Questions*. These writings explained that lightning could, among other effects, melt coins in a purse without charring the bag, or that the penetrative power of lightning could poison and coagulate wine in a jar without shattering the container.[2] A list of strange effects accompanying descriptions of the causes of lightning and thunderbolts became mostly standard and remained consistent in meteorological works even as Aristotelian explanations on the causes of windy meteors evolved through commentaries and other writings.

The Latin encyclopedic tradition and scholastic commentaries of the Middle Ages demonstrate continuity with the period of antiquity in modes of discussing lightning and thunderbolts. Like Aristotle, many considered lightning and thunderbolts to be distinct from each other.[3] In his *Natural Questions*, Seneca differentiated between lightning and thunderbolts by designating the former as a harmless flash in the sky and the latter as tending to be more destructive due to its striking something.[4] The material, speed, and subtlety of a thunderbolt determined what effects it would have when striking an object. Based on this, writers identified distinct kinds of thunderbolts that were identifiable according to the effects they had when striking an object. Isidore of Seville put forth a tripartite view of thunderbolts in his encyclopedic work *Etymologies* and distinguished between them according to the exceedingly fine and penetrative power of lightning.[5] Adelard of Bath similarly characterized thunderbolts in a tripartite scheme according to their effects.[6] In his commentary on Aristotle's *Meteorology*, Albertus Magnus addressed others' views and offered his own, ultimately describing thunderbolts and accompanying effects similarly to his Greek and Latin predecessors.[7] Many writers maintained a tripartite organization of thunderbolts, but few were in complete agreement about what these thunderbolts did or what their exact cause was. Differences in theory and method surely contributed to these differences, but an intermixing of Greek and Latin terms through translations and commentaries is perhaps another contributing cause.[8]

Andrew Dickson White in his nineteenth-century series considered ancient writers on meteorology to be inadequate for developing serious theories but thought they showed "at least the germs of a science."[9] In his view, the rise of Christianity hampered scientific growth in this area because writers heeded scripture in their works. White explored theories of thunder and lightning as steeped in religious contexts with undertones of superstitious ideas and offered the idea that effects of lightning striking coin purses, wine vessels, sword sheaths, and a variety of other objects were used in the Middle Ages as part of Christian moral lessons.[10] In a more recent work that addresses the standard strange effects of lightning strikes, S. K. Heninger examined meteorological theories in relation to great works of English literature. His main touchpoint for meteorological theories is the Puritan divine William Fulke (1538-1589), who, in addition to numerous theological writings, authored a few works on topics relating to natural philosophy. Heninger draws attention to Fulke's adherence to ancient classifications of lightning and the terms Fulke uses to describe them.[11] The tradition of lightning effects accompanying explanations of lightning

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causes maintained interest beyond superstitious tales and works of literature. Fulke's use of these terms involved careful attention to Greek and Latin works in choosing how to present this information in the English vernacular. As a whole, his work on meteorology sought to subvert superstitious theories while promoting his religious ideals.

A wider accessibility of texts through printing contributed to a growth of vernacular texts in the Reformation era. In sixteenth-century London, Fulke published the *Goodly Gallerye* (1563), one of the earliest writings on meteorology in English. Fulke's explanations of meteors in general and types of lightning in particular maintained many of the methods and characteristics born in classical antiquity, but they were also coupled with responses to ongoing debates and controversies in England. To combat the popish superstition of his Catholic predecessors, Fulke's works on natural philosophy emphasized natural causation and focused on giving a clear explanation of philosophical concepts to the common folk. In the *Goodly Gallerye*, Fulke wedded Greek and Latin traditions of meteorology for a scientifically lay audience in English. In so doing, he committed to somewhat new terminology and made decisions about how words and concepts should be understood in the English vernacular.

2. Lightning and Thunderbolts in Ancient and Medieval Traditions

As part of an inquiry into the natural world, Aristotle's *Meteorology* seeks to explain the causes of sublunary natural phenomena. Books I-III of the *Meteorology* cover the causes of phenomena such as comets, clouds, rainbows, haloes, wind, and earthquakes, while Book IV, previously thought to be spurious, covers the generation of metals and topics related to matter theory.[12] Aristotle saw meteors as having material and efficient causes. The primary material cause of meteors is the dual exhalation: one hot and dry, the other cold and moist. The motion of the heavens and heat from the sun drawing up the exhalations constituted the main modes of efficient causation. Aristotle did not offer formal or final causes of meteors. This general coverage and scope of topics formed a tradition that flourished in medieval universities and persisted up through the early modern period.

In the Aristotelian tradition, thunder, lightning, whirlwinds, firewinds, and thunderbolts were all thought to have the same material cause of the dry exhalation (ξηρᾶς ἀναθυμίασις), differing only in manifestation and degree.[13] Aristotle explains the cause of lightning and thunder in *Mete*. 2.9 and covers the remaining three phenomena in *Mete*. 3.1.[14] Aristotle explains that thunder and lightning are products of ejection that are produced, as opposed to latently existing in clouds. The exhalation, being hot, is forced out of a cloud as it condenses and cools, much like a fruit pit would shoot out from beneath one's fingers when pressed.[15] The percussion of the exhalation against other clouds is heard as thunder (βροντή). When the ejected wind (πνεῦμα) catches on fire, it is called lightning (ἀστραπή). Thunder and lightning are characterized according to their subtlety and rarity. When the wind is more compact and denser, it causes a hurricane (ἐκνεφίας). When the winds in a cloud run into each other they are caused to move in a circular fashion as an "unripe hurricane" or whirlwind (τυφῶν), which is a sort of hurricane that is trapped in a cloud. When whirlwinds are drawn out of the cloud and become finer in texture and thus catch fire, they are called firewinds (πρηστήρ). If the firewind is of great quantity and squeezed from the cloud, it is called a thunderbolt (κεραυνός).

Frederick Bakker has shown that this structure of explaining like phenomena together in a group was a trend in many antique writings treating topics considered to be meteorological.[16] In most writings, lightning and thunderbolts are considered as separate phenomena. Aristotle differentiated between lightning and thunderbolts according to their causes. Aristotle put forth only one cause for these phenomena, but many others like Epicurean philosophers offered multiple possible causes for one phenomenon.[17] Like Aristotle, writers did not often separate lightning into distinct categories and types, however thunderbolts as a separate and distinct phenomenon was typically categorized into groupings. As it concerned thunderbolts, many writers paid heed to the causes, characteristics, and effects.

The effects of thunderbolts according to Aristotle depend on their speed, subtlety, and resistance of the material of the objects they strike. Aristotle identifies two types of thunderbolts based on their effects. A fine-textured and non-scorching bolt is called gleaming (ἀργῆς). A less fine-textured and scorching bolt is called smoky (ψολόεις). Both of these names are used in Homeric references to Zeus' lightning.[18] Aristotle explains the properties of these types of bolts in terms of subtlety and speed, which can be determined from examining how they interact with objects when struck. For instance, the gleaming bolt, in addition to its fine texture, moves rapidly and thus does not harm objects. The smoky bolt moves more slowly than the gleaming bolt, but it still moves quickly enough to not burn objects, instead only blackening them. Objects that fight back or offer resistance (ἀντιτυπήσαντα) suffer, but objects that do not offer resistance do not suffer. For instance, a bronze spearhead melts when struck by a thunderbolt, but its wooden handle is unharmed. The reason for this is that the wind is able to percolate through the wood on account of its texture (διὰ μανότητα).[19] Similarly, thunderbolts can pass through garments without burning them, but instead leaving them threadbare.

Pliny's *Natural History* maintained different goals and methods from Aristotle, but the manner of explaining lightning and thunderbolts is very similar. In the second book Pliny discusses the causes of thunder (*tonitrua*), lightning (*fulmina*), heat-lightning (*fulgetra*), hurricanes (*ecnephias*), whirlwinds (*typhon*), and firewinds (*prester*).[20] A thunderbolt (*fulmen*) is a firewind that always had fire in it and did not catch fire after bursting from the cloud.[21] Pliny says that several types of thunderbolts are reported. Dry thunderbolts cause an explosion rather than a fire. Smoky (*fumida*) thunderbolts do not burn, but rather blacken.[22] A third type is called bright (*clarus*), which has a remarkable nature (*mirificae maximе naturae*). This third type can drain wine casks without damaging their lids or leaving a trace. It can melt gold and copper and silver in bags without singeing the bags or melting the wax seal. Pliny's explanation of causes differs

from Aristotle, and Pliny discusses three types of thunderbolts instead of Aristotle's two, however both of them refer to a bright kind and a smoky kind. Aristotle and Pliny are also similar in that they discuss stormy phenomena in relation to each other, but one key difference is Pliny's penchant for the strange and odd wonders, whereby he names effects that thunderbolts have when striking plants and creatures.[23]

In like fashion, in the *Natural Questions* Seneca discusses the cause of lightning flashes (*fulgurationes*), lightning bolts (*fulmina*), and thunder (*tonitrua*).[24] He differentiates lightning flashes from lightning bolts in a number of ways, one distinction being that a lightning flash is a threat (displays fire) whereas a lightning bolt is an attack (emits fire).[25] Seneca explains that there are differing types of interpretation of thunderbolts rather than three distinct types.[26] Like Pliny, Seneca puts forth a tripartite differentiation of thunderbolts, but differs in their descriptions and names. One type of thunderbolt bores because it is subtle, thin, and pure and thus can travel in and out of substances through narrow openings. A second type scatters and breaks materials rather than traveling through them. The third type clings to materials and thus burns them, leaving black traces. Seneca gives a familiar list of effects wrought by thunderbolts. This includes a description of what happens to swords in sheaths, coins, and wine casks when struck, which appears in a few different sections of Seneca's text.[27] A rough equation between the types of thunderbolts offered by Pliny and Seneca could be bright with boring, dry with scattering, and smoky with clinging.

Aristotle, Pliny, and Seneca had differing purposes for including such examples and explanations in their writings. Aristotle discusses thunderbolts and stormy phenomena as different manifestations of the same material in order to demonstrate that wind is indeed the material cause of them.[28] Seneca makes a similar appeal. When differentiating between lightning flashes and thunderbolts, Seneca emphasizes their relationship because they have the same nature.[29] In his discussion of winds, Pliny makes an appeal to the genre of natural history and accounts from travelers, lamenting that many are not sharing this newly acquired knowledge.[30] Pliny's inclination toward the wonderous and strange occurrences of thunderbolts is perhaps influenced by his desire to collect a wide variety of stories and accounts. Seneca and others, like Epicurean philosophers, addressed violent phenomena in relation to fear, offering natural causation as a way to abate fear of death. Many early writers who included these phenomena focused primarily on establishing a clear material causation; final causes or ultimate purposes are not emphasized.

The Aristotelian and early Latin tradition maintained continuity up through the Middle Ages in explanations of thunderbolts most notably in the distinction of types and explanations of their effects, which were determined by subtlety, speed, and material of the object struck. Translations and commentaries between Greek, Latin, Syriac, and Arabic texts influenced how ideas and concepts relating to lightning and thunderbolts were interpreted by later writers. Encyclopedic works like Isidore's *Etymologies* or Bartholomaeus Anglicus' *De rerum natura* offered continuity of the Latin tradition by maintaining a tripartite organization of thunderbolts. The Syriac meteorology, attributed to Theophrastus, puts forth multiple possible causes of thunder, lightning, and thunderbolts rather than grouping thunderbolts into three types, where continuity is maintained in this text through the description of effects that thunderbolts have due to the subtlety, speed, and material.[31] The translation of Aristotle's *Meteorology* by Gerard of Cremona, the text from which some scholastic writers drew, contained a lacuna at the part of the text where thunderbolt effects are discussed.[32] The medieval corpus of meteorological texts was not fully congruous on how types of thunderbolts should be classed or what the precise cause was, but the method of discussing thunderbolts, primarily by subtlety, speed, and effects, was a great continuity between them.

3. Meteorology in the English Vernacular

William Fulke (1538-1589) was well-acquainted with the heritage of texts from the classical and medieval periods. His works demonstrate a command of Latin literature in poetry and natural philosophy. Fulke had humanist leanings that cherished beautifully written prose.[33] Many of the texts Fulke cites in *Goodly Gallerye* (1563) were available as printed works in Latin by this time in the sixteenth century, though Fulke's mastery of other languages and his emphasis on correctly interpreting texts is evident from his other works.[34] In his *Antiprognosticon* (1560), Fulke recounts his reading of Hippocrates' *Airs, Waters, Places* in Latin as well as Greek, in which he found the margin notes of the Latin version misleading and inadequate, thus necessitating a closer look at the text.[35] Fulke's penchant for beautiful prose and clearly rendered translations perhaps influenced his later work on an English translation of the New Testament (1589) as a response to the Douay-Rheims Vulgate translation.[36]

Fulke participated in the movement of making texts available in the English vernacular. His contributions included not just translations, but also the rendering of interpretations and explanations into plain and common language. The Latin version of his *Antiprognosticon* was reprinted in English in the same year with a significant amendment to the original text.[37] This second English edition contained a second part directed at "common folk," in which Fulke describes his writing in this second part of the text as plain and "omyttyng all colours of rhetorke, and all impediments of paynted speache."[38] As opposed to the original Latin version of the text, the English amendment emphasizes the role of God in nature, a theme that is also evident in the *Goodly Gallerye*. From this it may be drawn that Fulke's writings for those not well-versed in philosophy emphasized clarity in explanations, terminology, and the role of God in the natural world.

The *Goodly Gallerye* was not the only work in English that discussed meteorological topics.[39] A printed edition of John Trevisa's English translation of Bartholomaeus Anglicus' *De rerum natura* appeared in 1495.[40] Almanacs with inclusions of meteorological topics were also available, such as Leonard Digges's *A Prognostication of Right Good Effect* (1555).[41] Nevertheless, Fulke's *Goodly Gallerye* seems to have filled an empty niche in English literature on the topic. This text underwent sever-

al reprints since its initial publication in 1563, with versions appearing in 1571, 1602, 1634, 1639, 1640, 1654, 1655, and 1670. Despite undergoing title changes in 1602 and 1640, few substantial changes were made to the text.[42] The 1654 and subsequent editions include a prefatory note to the reader that vouches for its utility:

> And I may (without breach of modesty) affirm, that there is not in our language any book of so small a bulke, contains so much of the Doctrine of the Meteors. We daily behold and view divers meteors, but very few are skill'd in their causes; but those that are not, may be informed.[43]

The writer of this prefatory note explains the appendix of observations that a "person of quality" made to this book which "on perusal hath been found so advantagious."[44] Others made use of Fulke's text. The almanac writer Thomas Hill, against whom Fulke argued in his *Antiprognosticon*, drew upon the *Goodly Gallerye* in his meteorological text *A Contemplation of Mysteries* (1574).[45] Those with an interest in natural philosophy undoubtedly found Fulke's work on meteors useful, but it seems that one of Fulke's main goals in the *Goodly Gallerye* is to dispel superstition by explaining causes of natural and strange phenomena, thus clarifying his Puritan interpretation of natural phenomena.[46] In this way, Fulke's target audience for this text was perhaps those pushed and pulled by vernacular writings promoting superstitious renderings of the natural world, whether through astrology or otherwise.

From the outset, Fulke structures the *Goodly Gallerye* for a scientifically lay audience of those who have "not tasted the principles of philosophy."[47] Fulke's treatment of meteors generally follows an Aristotelian ordering of explanations. He sorts his work into five books. The first book introduces the general topic, terminology, and an explanation of basic frameworks in natural philosophy, corresponding roughly to *Meteorology* 1.1-1.3. Fulke lays the groundwork for understanding meteorology in this first section of the book. Fulke describes the relation of the four elements to one another. Earth and water combine together to make a ball, air wraps around that ball, and fire wraps around the air "as the peeles of an onion are within one another; after the same sort from the highest heaven to the earth that is lowest, one part that is greater compasseth round about another that is lesser."[48] Meteors, then, are generated either in the earth (wells, springs, earthquakes, metals, minerals) or in the air (rain, hail, snow, dew, blazing stars, thunder, lightning). Unlike Aristotle's text and the scholastic commentaries on it, in this first book Fulke does not attempt to situate meteorology in relation to other branches of natural philosophy.[49] However, he borrows some interpretations of Aristotle from commentators, such as the idea of three different regions of air, something that Aristotle does not explicitly mention, but still fits within his theory.

The remainder of the books are divided according to types of meteors, where the second book covers fiery meteors (*Mete*. 1.4-1.7), the third book covers windy meteors (*Mete*. 1.8; 2.4-3.6), the fourth book covers watery meteors (*Mete*. 1.9-2.3), and the fifth book covers earthly meteors (*Mete*. 3.6; 4.1-4.12). A number of other subjects that Aristotle does not mention are covered in Fulke's work. For instance, the discussion of other phenomena such as fire drakes in works like commentaries may have influenced Fulke to include them in his own work. Likewise, Fulke may have discussed Catholic ideas like purgatory being located in the middle region of air in order to dispel popish superstition on such topics by explaining them thoroughly. While this text is neither a commentary nor is it scholastic in nature, Fulke was acquainted with and influenced by medieval scholastic texts on Aristotle's *Meteorology*.

Fulke lays out basic theory and terminology in the first book. Fiery, airy, and watery meteors are imperfect mixtures, while earthly meteors are perfect mixtures. They are caused by vapors and exhalations. Vapors, like breath or steam, are warm and moist and create meteors when the sun draws them up through the middle region of air and they are mixed with cold. Exhalations, like smoke, are hot and dry and thus ascend up through the highest region of air due to their thinness and lightness. Some exhalations are drawn from clammy, fatty, or oily places that cause exhalations and vapors to become viscous and stick together, causing a variety of phenomena when kindled, like dragons, goats, candles, spears, and the *ignis fatuus* seen in graveyards. Fulke alerts the reader that the terms vapor and exhalation "must be well noted because they must be much used." The sphere of air is divided into three regions. The highest region is hot due to its proximity to the sphere of fire, the lowest region is warm because of the reflection of sun beams, and the middle region is cold and trapped between the two warmer regions on either side. This cold and dark region is prone to generate clouds and storms, which has led "doting divines" to believe that this middle region is where purgatory resides. Thunderbolts are airy meteors produced in the middle region of air, defined by their thinness and subtlety despite their cause being a kindled clammy exhalation.

Fulke discusses causation in Aristotelian terms. The material cause of meteors is mostly from earth (exhalation) and water (vapor), but Fulke points out that the mixture of air and fire are also essential for the generation of meteors.[50] Fulke names two efficient causes. The first efficient (principal) cause is God, who works wonders and causes marvelous effects.[51] The second efficient (particular) cause comes in two parts. There is a far off efficient cause (remote) and a next (proximate) cause. The proximate cause is the qualities of heat and cold, which cause different effects in the vapors and exhalations. Fulke briefly discusses astrological causation by allowing for the stars and planets as an efficient cause, but the *Antiprognosticon* makes it clear that planetary influences do not make meteors significant, nor can astrology adequately predict the weather.[52] Fulke fitted within the bounds of traditional Elizabethan science by describing natural events in accordance with natural causes rather than supernatural ones.[53] His integration of theology with his views on natural philosophy seek not to emphasize God as a cause, but rather to dispel the popish superstition of the Middle Ages. One of the ways Fulke achieves this is through his use of second efficient causes and middle ends.

Fulke has little to say about the formal and final causes, which are not explicitly addressed by Aristotle. The formal cause is "so secret that it is known to no man," with Fulke's explanation being that "God's wisdom com-

prehends the essential form of all substances." If meteors do have an essential form, Fulke does not comment on it. The final cause is "so evident that it is plain to all men," which is the glory of God. Much like his discussion of efficient causes, Fulke introduces a second kind of final cause, which he calls "middle ends." These middle ends are the benefits that God's creatures reap, such as the fruitfulness of the earth, purgation of the air, threatening of God's vengeance, punishing of the world, and moving the world to repentance. All of these middle ends serve the chief final purpose, which is the glory of God. Fulke's addition of formal and final causes to the causes of meteors also lends credence to the fact that he was exposed to other Aristotelian texts.

4. Lightning and Thunderbolt Terminology in the *Goodly Gallerye*

Fulke leads the *Goodly Gallerye* with the claim that no writer that he has seen has explained the causes of phenomena that fall under the purview of meteorology. Fulke's acquaintance with and citation of Aristotle and other ancient authorities suggests this is a statement about the inadequacy of past writers to explain causation in an accurate way. The accurate way to account for causes according to Fulke includes God as an efficient and final cause. By this Fulke does not mean to suggest that causes of meteors cannot be understood in a natural way, but rather that his predecessors introduced superstition and doubt into their approach to meteorology, and a new approach is needed. One of the ways Fulke sets forth to remedy this is through his particular attention to terminology and clear explanations.

In the aforementioned claim that no writer has explained causes of meteorological phenomena, Fulke writes that the common definition of such phenomena that writers use "in no wise will serve us." Aristotle used the term "meteoron" to describe these phenomena, but he was "deriving it from doubtfulness." In response to hypothetical opponents who may argue that finding a term for these phenomena is a frivolous task, Fulke counters with an argument that some learned people might not recognize that the style of this book is "attempered to the capacity of the readers" and thus will interpret his plain style as ignorance. This explanation up front thus serves to "pluck the opinion out of their minds." The opening statements of the *Goodly Gallerye* frame Fulke as an authority on the subject of meteors and establishes the importance of precise language and terminology in discussing these things.

Much of Fulke's theory is free of technical jargon, but he emphasizes particular terminology in many cases. He often defines words when they are introduced and signals to the reader when they are particularly important to remember.[54] In his treatment of particular phenomena with many manifestations, Fulke sometimes chooses to invent names for categories of meteorological phenomena. He sorts earthquakes into four groupings but does not assign names to those groups, but he sorts and names groups of springs.[55] Fulke addresses terminology related to lightning using this latter method.

Lightnings are airy impressions and are thus covered in the third book of *Goodly Gallerye*. Fulke categorizes and names four types of lightning so that "under these four all the rest may be comprehended," acknowledging that other writers have also treated distinct types of lightnings.[56] He derives the four names from Latin: *fulgetrum*, *coruscatio*, *fulgur*, and *fulmen*.[57] Like Aristotle and other predecessors, Fulke distinguishes between lightning and thunderbolts. The lightning flashes typically cause fear rather than harm, but when thunderbolts occur, they usually cause harm.[58] The first three names (*fulgetrum*, *coruscatio*, *fulgur*) refer to lightning flashes, while the final category (*fulmen*) refers to thunderbolts. The category of *fulmen* is further divided into three separate types, which Fulke says is borrowed from Aristotle, Pliny, and Seneca.

Fulke explains *fulgretrum* in association with heat, as it is seen in as a flash in the sky that occurs in the warm periods of the year, such as the summer. Often translated as "heat-lightning" in sources like Pliny and Seneca, *fulgetrum* according to Fulke is generated when many thin, light, and hot exhalations are drawn up from the earth into the lowest or middle regions of air. The exhalations rise because of their nature rather than heat from the sun (since this usually occurs during the evening). When the hot exhalations meet with the coolness of the air, the resistance of contraries kindles the exhalations due to motion and beating back. This explanation of the resistance of contraries, for which Fulke does not use the term antiperistasis, is explained in more detail in other points of the text.[59] Most of the time, this lightning flashes in the air and is not harmful. The exception to this is when the exhalations are earthy and gross and so strike the earth, usually causing only small amounts of damage.[60] Fulke closes this section with an "old wives tale" about the frequency of this type of lightning, which may have functioned as a touchstone for some of his readers.

Fulke calls coruscation a visual phenomenon rather than a material one.[61] It is the appearance of fire (glittering) and the appearance of lightning (glimmering) rather than fire or lightning itself. Coruscation according to Fulke is achieved in two ways. One way is through the appearance of a reflection of enflamed clouds that are otherwise not visible due to their location. The second way is through a "double order" of thick clouds, in which lightning or inflammation pierces downward through the clouds like light through a glass. This description seems to match the way Cleidemus, as portrayed in Aristotle, describes lightning as a brightness or flashing (λαμπρός), or as an optical phenomenon rather than a material one.[62] This description also appears to match how Fulke describes burning spears in the second book of fiery meteors.

Derived from the Latin *coruscatio*, "coruscation" was a relatively new word in English at the time of Fulke's writing, with early appearances found in English printed works from the 1490s.[63] Though some of these early uses of coruscation are found in conjunction with descriptions of lightning, it seldom appears in Pliny and Seneca, nor is it Greek in origin. However, its frequent use in later meteorological writings could perhaps be related to humanist interpretations of Greek sources. In his commentary on Aristotle's *Meteorology*, Agostino Nifo says that coruscation is what the Greeks call *astrepe*.[64] Gerard of Cremona

and William of Moerbeke used *coruscatio* in their Latin translations of Aristotle's *Meteorology*, and Albertus Magnus likewise employs it in his thirteenth-century commentary on the text with more careful differentiation of the terms.[65] Thomas Hill's *Contemplation of Mysteries* (1572) compares the terms *fulgetrum* and *fulgur*, but does not employ coruscation to explain lightning. Despite its absence in Hill's popular English meteorological text, Fulke likely influenced how the term coruscation was used in English. His definition of coruscation appears in a 1661 edition of a dictionary, well after the publication of *Goodly Gallerye*.[66]

Fulgur is the word most commonly used by Pliny and Seneca to refer to lightning flashes. According to Fulke, *fulgur* is caused when a violent exhalation breaks out of a cloud, which makes a noise (thunder) as it percusses the sides of the cloud. With that violence in exiting the cloud, the exhalation is set on fire and creates a big flash. Fulke discusses *fulgur* in relation to its timing with thunder, a subject also discussed in Aristotle, Pliny, and Seneca.[67] The fourth and final type of lightning Fulke describes is called *fulmen*. *Fulmen* is the most dangerous, violent, and hurtful kind of lightning. It occurs when a hot exhalation, enclosed in a cloud, breaks out and is set on fire and stricken down toward the earth with a great force. The thunder that accompanies this lightning is sudden, short, and great, like the sound of a gun. Fulke acknowledges that Aristotle, Seneca, and Pliny refer to this type of lightning in three categories and proceeds to describe them.

According to Fulke, the first type is called dry. This type of thunderbolt is most similar to Aristotle's gleaming, Pliny's bright, and Seneca's boring. Dry thunderbolts are distinguished by a lack of burning and a remarkably swift dividing. It is subtle, pure, and can thus pass through the pores of something as long as the pores are big enough. Those things that give place to it (have big enough pores) are not hurt by it, but the things that resist (have too small of pores) are divided and pierced by it. The subtlety of the lightning and the materiality of the objects determines the effects it has: it melts money in purses without harming the purses, it melts a sword without harming the scabbard, and it penetrates wine casks and coagulates the wine for three days.[68] In addition to the typical examples, Fulke adds a few notable others from Pliny, such as the killing of an unborn child with no harm to the mother.[69] He offers the same explanation for these stranger occurrences on the subtlety and material of the thunderbolt and the objects.[70]

Fulke's descriptions of the remaining two kinds are much shorter and less detailed. The second kind is called moist and is most similar to Aristotle's smoky, Pliny's smoky, and Seneca's clinging kind. Because it is very thin, the moist thunderbolt does not burn things to ashes, but rather blasts or scorches trees, corn, and grass and makes them black and smoky, as a moist log would scorch and blacken in a fire. Fulke does not name the third kind, but its description correlates with Pliny's dry kind and Seneca's scattering kind in that it is the most destructive. Fulke describes it as similar to fire and composed of gross and earthly substances, leaving marks where it has been or otherwise consuming and destroying objects.

After his brief discussion on the three types of thunderbolts, Fulke lists more wonderful and marvelous effects of lightning.[71] He names the reason and causes for them, some of which relate to the thinness and subtlety of thunderbolts, but other causes are related to the nature of humans and animals. Many explanations rely on an explanation of pores. Some of these descriptions have physical explanations, such as the case of few pore holes on certain types of trees. But lightning also has more mysterious properties that are felt with pores. Fulke tells of some who "behold" lightning that become blind, have face swelling, or become leprous because of the fiery exhalation being "received" into face and eye pores, suggesting that lightning does not always need to strike for its effects to be felt. Drawing from Seneca, Fulke also explains the poisonous qualities of lightning, which can be evidenced with the striking of wine or poisonous creatures. The cause of this is twofold and depends on materiality and subtlety. First, the matter of lightning becomes infected with brimstone and other poisonous metallic substances, and second, the thinness of the lightning allows it to penetrate into the body.

Fulke discusses thunderbolts in another way outside of the tripartite framework of the common ancient authorities, which is through the description of a thunderstone.[72] Continuing with similarities to gunfire, Fulke notes that a stone often shoots out with the ejected thunder, which is called a thunderbolt (*fulmen*). The stone is generated when the exhalation that generates the thunder is unctuous and contains metallic substances, like brimstone. Heat hardens the exhalation like a brick, which strikes toward the earth, causing varieties of destruction.[73] However, thunderbolts like this kind are not classed into one of the three groupings. Instead, Fulke describes the thunderbolt as a material object with an explanation of its thickness and sharpness in the third book on airy meteors, but also includes a more thorough entry on thunderbolts in the fifth book on perfect earthly mixtures.[74] Fulke's ideas on matter theory manifests most clearly in this last book, which corresponds most directly with Aristotle's fourth book of the *Meteorology*.

Fulke subverts ancient authorities by tacitly engaging with them and explaining the causes for accounts of strange occurrences. Most of his refutations are uncited rebuttals of wondrous explanations found in authorities like Pliny and Seneca, though he occasionally uses a more polemical tone when addressing particular problematic authorities, such as Albertus Magnus and the Epicureans. Fulke establishes himself as an authority to his lay audience in the opening portions of the *Goodly Gallerye*. But in practice, most of Fulke's innovations to meteorology come from older textual sources rather than things he has seen himself. Aside from a few examples, none of which are in the lightning section in the third book of airy meteors, Fulke does not rely on firsthand accounts of observation.[75] His method of debate relies on textual explanations and was influenced by the culture in England at the time.

The impressive number of reprints alludes the popularity of the *Goodly Gallerye*. This text differed from many vernacular meteorological treatises commonly printed that often encompassed almanacs or more of a focus on strange and superstitious occurrences. Fulke's goal of the accessibility of a scientific text to a common audi-

ence was achieved in part due to the types of explanation he used for a general population. Like ancient authorities before him, Fulke made a number of analogies that would have common touchstones so that "the common sort may understand it." Among the analogies, Fulke compares the sound of lightning and thunderbolts to artillery, which is an idea that is also present in Cardano's *De subtilitate*, a text from which Fulke drew.

Similarly to Fulke, in the *De subtilitate*, Cardano describes thunderbolts as the "fire of fires" and emphasizes their subtlety and describes their effects.[76] Fulke used Cardano as an authority, especially in the fifth book on earthy meteors. Like Cardano, Fulke's text is not in the style of a scholastic commentary, but rather a different sort of work on meteorology.[77] The two share many similarities, despite using different underlying frameworks and seeking different goals. Part of what differentiates Fulke from other contemporaneous writers is his continual emphasis on God and natural causation as a way to explain phenomena that were otherwise seen as superstitious. This goal was influenced by the common people for which he wrote, and his method of achieving it was in part due to his humanist leanings in the clarity of language. Perhaps most differently from Cardano, Fulke maintained an overall Aristotelian explanation of meteorology, though at times he hints toward the new chymical philosophy.

5. Conclusion

Lightning and thunderbolts continued to be held as remarkable for their effects on striking (or for avoiding striking) certain materials long after Fulke. In the modern era, newspapers, journals, and magazines have replaced the early-modern meteorological treatises and almanacs for discussing isolated and specific instances of odd lightning strikes. As recent as 1927, the American Meteorological Society published a piece discussing the Forest Service's employment of the "searchlight of science" on popular forestry lore to discover which types of trees are likely to be struck by lightning in a thunderstorm.[78] Differences in types of foliage struck by lightning have long been noticed in natural histories, but the modes of explanation for such phenomena have adapted to new meteorological theories for what is considered "scientific" for the time. Even with new frameworks, some of the problems to solve are quite familiar. A nineteenth-century magazine accounted for, among other strange experiences, an instance in 1836 of a man being struck by lightning while wearing a purse with gold coins inside.[79] The explanation for why the coins melted and left a strange impression is neither elusive nor wondrous, as the writer assures us that differing electricity intensities can account for the melting of these coins, and the rough texture of garments can account for impressions made through them. Adequate explanations of lightning phenomena demand explanatory frameworks depending on time, place, and audience. The situation for Fulke was no different in this respect.

Discussions of thunder and lightning after Fulke lent themselves particularly well to developing chymical theories of meteorology and emphases on manifestations of matter.[80] Lightning and thunderbolts continued to be explained as part of three groupings and differentiated by subtlety, speed, and effects, but there was some variation in how these descriptions were implemented in writings.[81] There is significant continuity in the way that lightning and thunderbolts have been described, even for authors subverting Aristotelian meteorological theories in the centuries after Fulke. For instance, René Descartes maintained a tripartite organization of thunderbolts, though with a different underlying framework from Fulke, which also included an explanation of thunderbolts as physical stones.[82] Ideas in matter theory and chemical philosophy proffered by people like Jean Fernel and Georgius Agricola manifest in small ways in Fulke's writings and were likely the result of influence by others like Cardano. In the seventeenth century, John Mayow explained the causes for the common lightning effects, like the melting of a sword in a sheath, using chymical theories of nitro-aerial particles.[83] He uses *fulmen* and *fulmine* interchangeably as words for thunderbolt and lightning, respectively.

The continuous ways that lightning and thunderbolts have been discussed in ancient and early-modern meteorological treatises contain more than superficial similarities or a passive retelling of details. Authors maintained different goals relating to individual worldviews and frameworks of nature that shaped the ways that authors chose to interpret causes of strange phenomena and effects. Part of the way Fulke presented his views depended on his goals of informing a scientifically lay audience on the principles of philosophy and dispelling superstition. His mode of achieving such goals used careful renderings of Greek and Latin terms and concepts into the English vernacular, keeping with his humanist proclivities for beautifully written prose. Fulke participated in the long tradition of viewing lightning and thunderbolts according to their materiality, speed, and subtlety with a precision that lent itself well to discussions of meteorological phenomena in a chymical framework.

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Notes

[1] S. K. Heninger, *A Handbook of Renaissance Meteorology: With Particular Reference to Elizabethan and Jacobean Literature* (Durham, N.C.: Duke University Press, 1960), 72; Lorraine Daston and Katharine Park, *Wonders and the Order of Nature: 1150-1750* (New York: Zone Books, 1998).

[2] Pliny, *Natural History*, 2.52; Seneca, *Natural Questions*, 2.52.

[3] For more on the distinct groupings of phenomena in Aristotle, see: Malcolm Wilson, *Structure and Method in Aristotle's Meteorologica: A More Disorderly Nature* (Cambridge: Cambridge University Press, 2013), 77.

[4] Seneca, *Natural Questions*, 2.16.1.

[5] Isidore of Seville, *Etymologies*, 13.9.

[6] Adelard of Bath, *Questions on Natural Science*, 65-67.

[7] Albertus Magnus, *Meteora*, 3.3.

[8] Craig Martin, "Scientific Terminology and the Effects of Humanism: Renaissance Translations of Meteorologica IV and the Commentary Tradition," in *Science Translated: Latin and Vernacular Translations of Scientific Treatises in Medieval Europe* (Leuven: Leuven University Press, 2008), 147–72.

[9] Andrew Dickson White, *A History of the Warfare of Science with Theology in Christendom*, vol. 1 (New York: D. Appleton and Company, 1896), 323.
[10] White, 1:338.
[11] Heninger, *Handbook of Renaissance Meteorology*, 75–76.
[12] For explanations of the basic concepts of Aristotle's meteorological theories, methods, and types of phenomena he covers, see: Craig Martin, *Renaissance Meteorology: Pomponazzi to Descartes* (Baltimore: John Hopkins University Press, 2011), 5–14; Craig Martin, "Meteorology in Renaissance Science," in *Encyclopedia of Renaissance Philosophy*, ed. Marco Sgarbi (New York: Springer, 2022), 2178–85; Liba Taub, *Ancient Meteorology* (London: Routledge, 2003), 77–115. For more on the debates surrounding the authenticity and authorship of *Mete. IV*, see: Craig Martin, "Pores, Parts, and Powers in Sixteenth-Century Commentaries on Meteorologica IV," in *Atoms, Corpuscles and Minima in the Renaissance*, ed. Christoph Lüthy and Elena Nicoli (Leiden: Brill, 2023).
[13] In *Mete*. 2.9.369a27 Aristotle calls the material of these phenomena dry exhalation (ξηρᾶς ἀναθυμίασις), whereas in *Mete*. 3.1.370b5 it is simply called wind (πνεῦμα). *Mete*. 3.1.371a3-6 states "all these phenomena are wind, and wind is dry and warm exhalation" (trans. H. D. P. Lee), and in *Mete*. 3.1.371a1-2 Aristotle says that "it is evident... that smoke (καπνός) is wind and that smoke burns" (trans. H. D. P. Lee). Whatever Aristotle's precise material cause, it seems to be a rare and subtle material with the capacity to catch fire.
[14] Wilson, *Structure and Method*, 227–33.
[15] Aristotle, *Meteorologica*, 3.1.369a25. Aristotle uses a similar explanation in *Mete*. 1.4 on the creation of shooting stars.
[16] Frederik Bakker, *Epicurean Meteorology: Sources, Method, Scope, and Organization* (Leiden: Brill, 2016), 76–78; 127–60.
[17] Bakker, 8–75.
[18] Wilson calls ψολόεις a traditional name (*Structure and Method*, 60), though it appears to be poetic and not related to Aristotle's typical word for smoke (καπνός) that he uses when describing the hot and dry exhalation (*Mete*. 1.4.341b21) or visual appearances with smoke.
[19] To the best of my understanding, this phrase is ambiguous as to whether the wind percolates through the wood on account of the texture of the wind or the texture of the wood. Because some interpretations see μανότητα as porousness, my best reading of this passage is that this is referring to the texture of the wood. Aristotle does not use the word πόρος in this passage.
[20] These words appear in a few different passages in the second book of the *Natural History*: thunder (*tonitrua*) 2.43; lightning (*fulmina*) 2.43; heat-lightning (*fulgetra*) 2.43; hurricanes, which H. Rackham translates as cloudburst (*ecnephias*) 2.49; whirlwinds, which Rackham translates as typhoon (*typhon*) 2.49; firewinds or fiery whirlwinds (*prester*) 2.49-2.50; whirlwinds as a subset of cloudbursts (*turbinem*) 2.50.
[21] Pliny, *Natural History*, 2.50.
[22] Rackham equates this with ψολόεις from *Mete*. 3.1.371a21.
[23] Pliny remarks that thunderbolts can drain casks without damaging their lids or leaving other traces (2.52); melt gold and copper in bags without singeing the bags or melting the wax seal (2.52); a pregnant woman will survive a lightning strike while her unborn child is killed (2.52); things struck by lightning fall in the opposite direction as the flash (2.55); all living creatures burned by lightning are killed (2.55); lightning does not penetrate more than five feet below the ground (2.56); lightning does not strike a laurel bush (2.56); lightning strikes neither the sea-calf nor the eagle (2.56). Pliny also discusses some people being struck by lightning, such as Marcia whose unborn child was killed while she survived, and Marcus Herennius, who was struck on a calm-weather day. Pliny goes on to say that some Tuscans think gods send thunderbolts (where Jupiter hurls three kinds), and some of these bolts are discussed in having planetary causes (2.53). Pliny cites historical records of thunderbolts being caused by prayers (2.54). He talks about thunderbolts in relation to prophecy (2.53, 2.54); discusses which one comes first, thunder or thunderbolts (2.55); elaborates more about augury; and enumerates more things that it can and cannot strike (2.56).
[24] Seneca, *Natural Questions* 2.12.
[25] Seneca, *Natural Questions* 2.12. He also differentiates the two in 2.16, 2.21, and 2.57.
[26] Seneca, *Natural Questions* 2.40.
[27] *Natural Questions* 2.31 lists the melting of swords in sheaths, coins in boxes, and wine in a cask (in addition to a number of other effects). *Natural Questions* 2.52 and 2.53 repeats some of these examples.
[28] Aristotle, *Meteorologica,* 3.1.371a30-31. Aristotle gives other evidence as well, such as ocular evidence with the burning of the temple of Ephesus, which H. D. P. Lee identifies as having occurred in 356 BC.
[29] Seneca, *Natural Questions*, 2.21: "I do not drag out this point at length just to play with words, but to prove that these phenomena are related and are of the same category and nature" (trans. Thomas H. Corcoran).
[30] Pliny, *Natural History*, 2.45.
[31] Bakker (*Epicurean Meteorology*, 70) doubts Theophrastus as the true author of this text and points to the debate over this authorship. On effects, see: Hans Daiber, "The Meteorology of Theophrastus in Syriac and Arabic Translation," in *Theophrastus: His Psychological, Doxographical, and Scientific Writings*, ed. William W. Fortenbaugh and Dimitri Gutas (London: Routledge, 1992), 265–66; see also Hidemi Takahashi, *Aristotelian Meteorology in Syriac* (Leiden: Brill, 2004) for Syriac meteorology, which maintains similar descriptions.
[32] Pieter L. Schoonheim, ed., *Aristotle's Meteorology in the Arabico-Latin Tradition: A Critical Edition of the Texts, with Introduction and Indices* (Leiden: Brill, 2000).
[33] Richard Bauckham, "Science and Religion in the Writings of Dr. William Fulke," *The British Journal for the History of Science* 8, no. 1 (1975): 17–31.
[34] Printing made available many works in different genres, such as works explaining wondrous or strange experiences of weather. See: Arianna Borrelli, "The Weatherglass and Its Observers in the Early Seventeenth Century," in *Philosophies of Technology: Francis Bacon and Its Contemporaries*, ed. Claus Zittel et al., vol. 1 (Leiden: Brill, 2008), 67–130; Heninger, *Handbook of Renaissance Meteorology*, 23–29; Vladimir Jankovic, *Reading the Skies: A Cultural History of English Weather, 1650-1820* (Chicago: University of Chicago Press, 2001), 33–44. Borrelli ("Weatherglass," 11-12) argues that works such as Girolamo Cardano's *De Subtilitate* were influenced by travel. Borrelli ("Weatherglass," 11-13) discusses the availability and impact of vernacular works on meteors, including William Fulke.
[35] William Fulke, *Antiprognosticon*: "...but when I looked nerer to hym selfe, I found no man so frendly to me."
[36] Fulke also published a defense of the English translation of the scriptures against Gregory Martin.
[37] Fulke did not translate the work, but he did author the addendum. See Bauckham, "Science and Religion," for controversy over the authorship of the addendum.
[38] William Fulke, *Antiprognosticon*: "Herafter foloweth a short treatise, as well for the utter subversion of this fained art, as also for the better understandyng of the comon people."
[39] Heninger, *Handbook of Renaissance Meteorology*, 16–20.
[40] Other editions were printed in 1535 and 1582 (with additions by Stephen Batman). For debate about editions of Trevisa's translations, see: A. S. G. Edwards, "The Text of John Trevisa's Translation of Bartholomaeus Anglicus' De Proprietatibus Rerum," *Text* 15 (2003): 83–96.
[41] Multiple editions, appearing as early as 1555. This text discusses lightning in similar ways to previous traditions. A few historians argue that Fulke was probably acquainted with this text, though Fulke does not cite it. On the absence of Digges and Dee in Fulke's writings, see: Sanford Larkey, "Astrology and Politics in the First Years of Elizabeth's Reign," *Bulletin of the Institute of the History of Medicine* 3, no. 3 (1935): 171–86.
[42] For the printing history and catalogue of all changes to the title pages, see: William Fulke, *A Goodly Gallery: William Fulke's Book of Meteors (1563)*, ed. Theodore Hornberger (Philadelphia, 1979), 10–17. A note to the reader was added before the table of contents beginning in 1654, also with some additional materials pertaining to Fulke's fifth book on metals and stones added in subsequent printings.
[43] William Fulke, *Meteors* (London 1654), a2r-a2v.
[44] Fulke, *Meteors* (London 1654), a2r-a2v.
[45] For more of Hill's publishing history, see: Francis R. Johnson, "Thomas Hill: An Elizabethan Huxley," *Huntington Library Quarterly* 7, no. 4 (1944): 329–51.
[46] See also: Rienk Vermij, "A Science of Signs: Aristotelian Meteorology in Reformation Germany," *Early Science and Medicine* 15, no. 6 (2010): 648–74.
[47] Fulke, Meteors (London 1654), 10.
[48] Fulke, *Meteors* (London 1654), 11.
[49] In other words, Fulke does not place this book after a discussion of things in Aristotle's *Physics*, *On the Heavens*, and *On Generation and Corruption*; nor does he promise that subsequent works will discuss perfectly mixed substances with substantial forms, like minerals or animals.
[50] He cites a reason for this, first invoking Aristotle for the vapor and exhalation, then the subtlety of air and fire as a reason why they are not the primary material cause. Fulke invokes the Philosopher (Aristotle) for this, as he says that vapor is a watery thing that is not water, and exhalations are earthly in nature but are not earth. Meteors must be drawn from

water and earth as opposed to fire and air because the latter (fire and air) is too subtle and too thin. All exhalations are made by making a grosser body more thin. Elemental fire is so subtle and thin and cannot be made thinner. If air was made thinner, it would turn into fire. If the fire were made thicker, it would be air. If the air were made thicker, it would become water.

[51] Fulke cites Psalm 148:8 for this.

[52] Fulke, *Meteors* (London 1670), 7. The far off cause is the same as the cause of all other natural effects: "the sun with the other planets and stars, and the very heaven itself in which they are moved." Compare with Fulke, *Antiprognosticon* (London 1560): "Seying the cause of the wynde is not forsene by the starres, no more can the wether that is partly caused by it, nor yet the dearthe or plentie whiche chaunceth by occasion of the weather, bee by astrologie foreshewed" (D7r); "By this definition [Aristotle's explanation of the cause of wind], all power of signifying starres is cleane excluded" (D6v).

[53] Paul H. Kocher, *Science and Religion in Elizabethan England* (Los Angeles: Anderson and Ritchie, 1953), 153–65; Bauckham, "Science and Religion in the Writings of Dr. William Fulke."

[54] As in the case of vapor and exhalation.

[55] Fulke, *Meteors* (London 1670), 121-125.

[56] Fulke, *Meteors* (London 1670), 55.

[57] In the 1634 version of this text "fulmen" is listed instead as "flumen." This appears to be a misprint seen only in this edition and only in this portion of the text.

[58] Here Fulke uses a similar distinction to Seneca.

[59] It is unclear if Fulke is purposefully avoiding this Aristotelian term.

[60] The texture of the exhalations can also cause different colors depending on the time of day that they are seen.

[61] Fulke names *coruscatio* in the initial list of types of lightning, but uses the English "coruscation" in all other instances.

[62] Aristotle, *Meteorologica*, 2.9.370a19.

[63] The word coruscation appears with reference to lightning in William Caxton's 1490 printing of the *Eneydos*, as well as in the English translation by John Trevisa of Bartholomaeus Anglicus' *De Proprietatibus rerum* (1495), also in reference to lightning.

[64] Agostino Nifo, *In libris Aristotelis Meteorologicis commentaria* (Venice 1547) 92v: "Aristoteles premittit intentionem, et dicit pro post haec dicamus de corruscatione, que grece astrepes dicatur, et tonitruo, quod grece brontes appellatur" (book 3, section 2.173). Aristotle uses astrepe (ἀστραπή) for lightning and keraunos (κεραυνός) for thunderbolt.

[65] On differences of terminology in between Greek and Latin works, see: Martin, "Scientific Terminology."

[66] *Glossographia: Or a dictionary interpreting all such hard words* (London 1661), L6v-L7r "A flash of lightning, or a kind of seeming sparkling fire, which appears in Mines by night. 'Tis (saith an Author) a glistering of fire rather then fire indeed, and a glimmering of lightning, rather then lightning itself." Compare with an earlier, similar definition from *The New World of English Words: Or, a General Dictionary* (London 1658), K2r: "Lightning, a flashing or glimmering of light."

[67] Fulke notes that *fulgur* may also appear without thunder.

[68] These examples appear in many sources, but their manner of presentation is most similar to Seneca's.

[69] Other examples include the burning of a hand.

[70] Fulke, *Meteors* (London 1670), 61: "Because the matter is very subtle and thin and burning and will pass through whatever does not give it free passage."

[71] With respect to striking people, Fulke describes the causes and effects of lightning striking sleeping and awake persons, pregnant mothers, and recites the account from Pliny about the virgin who was struck by lightning on the day of Cicero's birth. On plants and creatures, he explains the sea calf, eagles, and trees.

[72] Thunderstones are not part of the three-fold view of thunderbolts, but they are not a new invention; for example, Pliny writes about them in *Natural History*.

[73] It can strike down steeples, high buildings of stone and of wood, pass through them, and set them on fire. It can cleave trees and set them on fire.

[74] Fulke writes that the thunderbolt is sharp pointed (small) at one end and thick at the other end. This is caused by the heavier (moist) parts going to the bottom.

[75] Fulke gives an account of lightning striking a steeple in the section on thunder, and Fulke records an observation of thunderstones in the fifth book on earthy meteors.

[76] Heninger (*Handbook of Renaissance Meteorology*, 81) identifies Pierre de La Primaudaye as calling lightning "much hotter then all other fire," which is an idea he perhaps obtained from Cardano.

[77] Hornberger (*Fulke's Book of Meteors*, 17) suggests Fulke and Cardano wrote in similar styles.

[78] "What Trees Draw Lightning," *Bulletin of the American Meteorological Society* 8 (1927): 85–86.

[79] *Athenaeum*, no. 1535 (March 28, 1857), 409.

[80] Paola Bertucci, "Enlightening Towers: Public Opinion, Local Authorities, and the Reformation of Meteorology in Eighteenth Century Italy," *Transaction of the American Philosophical Society* 99, no. 5 (2009): 25–44; Martin, *Renaissance Meteorology*, 80–105.

[81] As a small sampling from the next two centuries, Thomas Willsford *Nature's Secrets* (London 1658), unlike Fulke, recounts the common litany of lightning effects without separating them into three groups; Franz Xaver Mannhardt's *Elementa Ignis* (1734) divides the lightning into three types in a separate section of the text, very similarly to Fulke.

[82] René Descartes, *Les Météores* (1637), seventh discourse.

[83] John Mayow, *Tractatus Quinque Medico-Physici* (1674), book 13.

Paving the Way of Ideas: Pierre Gassendi's Epistemology and Its Reception up to Locke

Simone Bresci

Abstract: This paper aims to outline some features of Pierre Gassendi's epistemology and its reception in John Locke. To do so, I will also analyze a few potential intermediaries between Gassendi and Locke, that is, the so-called Port-Royal Logic and Gilles de Launay's *Essais logiques*. Then, I will address Locke's manuscript drafts of his well-known *Essay*, showing the extent to which he endorses Gassendi's objections to Descartes. According to the present interpretation, Gassendi's epistemology is mainly a polemical weapon for Locke. Accordingly, the present tentative inquiry aims to place Locke's 'New Way of Ideas' in a wider context of anti-Cartesian claims. Ironically, the framework in which both Gassendi and Locke articulated these anti-Cartesian claims is entirely Cartesian, resulting from his epistemological shift towards ideas.

Keywords: Pierre Gassendi; René Descartes; Antoine Arnauld; Port-Royal Logic; Gilles de Launay; John Locke; Logic; Epistemology; New Way of Ideas.

1. Introduction

Engaging with the reception of Pierre Gassendi's epistemology first requires addressing the *vexata quaestio* of its influence on John Locke.[1] The origins of this controversy can be traced back to the well-known passage almost at the beginning of Leibniz's *Les Nouveaux Essais sur l'entendement humain* (written in 1704), where the character impersonating Locke argues that

> [Locke] is pretty much in agreement with Gassendi's system, which is fundamentally that of Democritus: he supports void and atoms, he believes that matter can think, that there are no innate ideas, that our mind is a *tabula rasa*, and that we do not think all the time; and he seems inclined to agree with most of Gassendi's objections against Descartes.[2]

I will return to this passage in the Conclusion, as I believe it deserves proper attention.

As a preliminary step, I tackle the issue of the legitimacy of an investigation into the reception of Gassendi's epistemology in Locke, as the scholarship on the subject demands. Locke scholar J. R. Milton, in what is perhaps the most significant contribution on the subject, is very dismissive about Gassendi's real influence on Locke, especially in the field of epistemology. He distinguishes between two different ways of investigating such an influence. The first one, the 'internalist' approach, involves a morphological analysis of the similarities between the doctrines of the two authors. Milton dismisses this approach, but he does so too hastily, in my opinion. The second approach, the 'externalist' one he adopts, focuses on the explicit mention of Gassendi in Locke's various writings and notebooks, along with the analysis of Locke's library *et similia*.[3] The downside of this method is that Locke, like most seventeenth-century authors, did not frequently refer to his sources. Milton does not seem to be too aware of this fact. Nevertheless, I acknowledge the results of his research here. In his thorough investigation of Locke's manuscripts, Milton polemically targets the claims of those, beginning with the biographer Richard Aaron (1937), who assert this influence without providing any supporting evidence. As a result, he is inclined to accept as evidence only an explicit mention of Gassendi's name in Locke's writings. Following this track, he convincingly demonstrated that although Locke personally knew François Bernier, the influence of the *Abrégé de la philosophie de M. Gassendi* (1678) on him was likely minimal. Moreover, he convincingly argued against Kroll's suggestion that Thomas Stanley's English translation of Gassendi's *Syntagma philosophiae Epicuri* had no influence on Locke.[4] But, most importantly, he shows that Locke was a reader of both Gassendi's *Syntagma philosophicum* (1658) and the Fifth Objections to Descartes' *Meditationes de prima philosophia* (1641). Surprisingly, he does not dwell at all on the relevance that the diatribe with Descartes might have had for Locke.[5]

Following the 'internalist' approach of exploring the similarities between Gassendi's and Locke's doctrines and drawing on the 'externalist' insights provided by Milton, I will attempt to show that Gassendi's objections to Cartesian epistemology were endorsed by Locke. In order to do this properly, I will first outline Gassendi's main epistemological tenets, primarily expounded in the *Pars logica* of his works. I will then examine the presence of these tenets in the French context of the subsequent decades of the seventeenth century. The so-called Port-Royal Logic (1662) written by Antoine Arnauld and Pierre Nicole and the neglected Gilles de Launay's *Essais logiques* (1673) are significant examples of the Cartesian and Gassendist sides, respectively. Lastly, I will examine the early drafts of Locke's *Essay,* looking for these same Gassendist doctrines. As a result, I endeavor to place Locke's 'New Way of Ideas' in the wider context of anti-Cartesian claims about the nature and origin of ideas. Yet, paradoxically, the framework within which these claims were ar-

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ticulated by both Gassendi and Locke turns out to be entirely Cartesian.[6]

2. Gassendi's Logic, Before and After Descartes (1636-1658)

Gassendi articulates his epistemology in the *Pars logica* of his works. He wrote and published several versions of it, divergent in their form but, for the most part, consistent with each other.[7] The earliest surviving version is the manuscript written in 1636, preserved at the Bibliothèque Inguimbertine in Carpentras, which coincides with books IX-XI of *De vita et doctrina Epicuri*. Here, I will briefly focus on the third and last book of the manuscript (Book XI, *De criteriis veritatis specialiter*), the one in which Gassendi lays down the Epicurean canons.[8] These canons or rules lie at the very core of his epistemology, serving as a guide for the investigation of natural phenomena. These same canons, which he elaborates relying upon the brief account of Epicurean canonics in Diogenes Laërtius' work (DL X 31-34), will be later reproduced with very few changes in the *Animadversiones in decimum librum Diogenis Laertii* (1649) and in the *Philosophiæ Epicuri syntagma* published as an appendix to the former. These same canons have also been reprinted in the *Pars logica* of the posthumous *Syntagma philosophicum* (1658).[9]

However, the latest version of his logic is likely the one that had the greatest influence. It is a sort of standalone treatise, published as the third and final book of *Syntagma*'s logic, titled *Institutio logica in quatuor partes distributa*. This short treatise was reprinted twice in England, in both 1660 and 1668, and the first volume of Bernier's *Abrégé* is simply the French translation of it.[10] As I will show, the reformulation of Epicurean logic in the *Institutio* depends on two factors. The first is to insert Epicurean content within a traditional, scholastic form of logic in order to make it more digestible for the audience of his time. The second, less evident but not less significant, is to focus on ideas or mental content in order to propose an alternative to Descartes' epistemology.

But let us first consider the earlier manuscript version of Gassendi's logic. The starting point of the third book of the 1636 manuscript logic is the conclusion of the previous one. There, Gassendi established that "there is something true that we can know and make judgments about."[11] The first and foremost criterion for establishing truth is sensation. The second one is the intellect, which makes judgments and inferences relying on sensation.[12] The canons he expounds in the following eleventh book deepen this basic tenet. The first canon reads as follows: "Sense is never deceiver, and therefore every sensation, every imagination, or every perceptual appearance is true in itself."[13] Describing it, Gassendi states that every sensation or direct apprehension of a thing (*nuda rei apprehensio*) is true of a so-called 'truth of existence' (*veritas existentiae*), which has no opposing falsehood. This implies that every perception is true insofar as a cause (i.e., a thing) produced it, and so the perception exists as its effect. In perceptions as such, there is nothing false. In contrast, opinions or judgments are true in a much different way, as they can be either true or false. While perception or simple apprehension neither affirms nor denies anything about what it perceives, judgment, in contrast, is subject to error as it affirms or denies the content of apprehension.[14] The latter, consequently, depends on the former, as specified in the second canon: "Every opinion or judgment depends on sense and follows sense; truth and falsehood pertain to it [and not to sense]."[15] As the third and the fourth canons state, a judgment is true when it is supported or not contradicted by the evidence of senses. On the contrary, it is false when it is contradicted or not supported by them.[16] This distinction between the 'truth of the existence' of all sense data and the 'truth of judgment' (*veritas enunciationis*) that depends on the former and in which falsehood and error fall lies at the core of Gassendi's epistemology. On the one hand, this distinction allows Gassendi to argue that any knowledge, i.e., any proposition or judgment about things, is grounded on the evidence of the senses. In other words, what is immediately given to sense perception is the source of evidence and the touchstone through which the truth of any judgment is measured. On the other hand, It allows him to maintain that all sense data upon which knowledge is based is entirely free from falsehood and error, making it epistemologically reliable.

Gassendi's conception of probability, which he indifferently calls *verisimilitudo* and *probabilitas*, is grounded on the evidence and reliability of sensation as well. In the controversy with Descartes, for instance, especially when the veracity of the senses is at stake, the link between sensory evidence and probability clearly emerges. Against Descartes, Gassendi argues that it is absurd to consider all sensations false just because some of them seem to deceive us. Hence, it is absurd to hold that all opinions or judgments, which depend on the senses, must be regarded as false for this very reason. In his view, a false opinion is much further from the truth than a doubtful one, which, insofar as it is close to the sense, is in any case probable.[17] According to Gassendi's probabilism, all knowledge lies within a scale that ranges from maximum certainty or truth, which is directly attested by the senses, to minimum certainty or falsity, which is directly denied by the senses. The inferences that the intellect makes from sense data lie somewhere in between, leaning more towards truth than falsehood. As a result, they are probable. Accordingly, he writes:

> with respect to our knowledge, things are either evident and clear [*manifesta et evidens*], and then we have certain and indubitable knowledge of them, or they are hidden and obscure [*occulta et obscura*], and this makes their knowledge uncertain and doubtful ... or else we call them likely and probable [*verisimilis et probabilis*] when they are closer to certainty than to uncertainty.[18]

In other words, all knowledge is as more probable as it is closer to the evidence of sensation.

The first four canons concern the source of evidence, which is sensation, and the truth of our knowledge, which depends on sensation. Having established this, Gassendi accounts for knowledge as content of the mind. Following Epicurus, he describes these mental contents as preconceptions (πρόληψεως), which literally means 'notions already present in mind'. The first canon on preconceptions reads as follows: "Any anticipation or preconception present in the mind depends on the senses, or by input [*incursione*], or by analogy, or by resemblance, or by com-

position."[19] In other words, any mental content is either directly produced by sensation (by input) or indirectly produced by the mind reworking the content of sensation (by analogy, resemblance and composition). By characterizing 'anticipation or preconception' (*anticipatio, seu praenotio*) in this way, Gassendi establishes the foundation for linking all mental content, even the most abstract and general, to the mental images coming from sense perception.

Moreover, any other mental operation borrows from these preconceptions, as he argues in the second canon on preconceptions: "Anticipation is the very notion of the thing and almost his definition, without which it is not legitimate to seek, to doubt, to have opinions, or to express anything."[20] Opinions or judgments depend on preconceptions, which are the basic constituents of every knowledge. These preconceptions, in turn, depend on the input of the senses. As he writes further on, judgments are nothing but propositions in which the contents of the mind are joined or disjoined. When the conjunction or disjunction of these contents of the mind corresponds to a conjunction or disjunction in things, judgments are true. Conversely, when they do not correspond to the way things are connected, they are false.[21] What informs us about things are, as we have seen, the senses. In sum, in this early version of his logic, Gassendi first describes the source of evidence and the nature of knowledge without mentioning mental contents. Only later these mental contents are described in terms of 'anticipations or preconception' (*anticipationes, seu praenotiones*) produced directly or indirectly by sense-perception.

These preconceptions are never defined, in the 1636 manuscript, as 'ideas'. In my view, this absence is an extremely important clue to understanding the subsequent development of Gassendi's logic. Now, the very same Epicurean logic Gassendi expounds in the manuscript *De vita et doctrina Epicuri* was later published, with very few reworkings, in the *Animadversiones* and in the brief *Syntagma* of Epicurus' philosophy (1649). There, Gassendi merely adds the same aside each time he defines preconception: "[Anticipation or preconception], that is, that idea, or form, and *species*, to which we look at in ourselves."[22] Apart from this aside, his 1649 Epicurean logic remains the same as that in the 1636 manuscript. Only later, in the posthumous *Institutio logica*, will the structure and vocabulary of Gassendi's logic change significantly due to a shift in focus. Gassendi's mature logic hinges on mental content, now defined as 'ideas'. Logic, he states in the preface of the Institutio, is the art of correct thinking (*ars bene cogitandi*). Since thought consists of four distinct actions, Gassendi divides logic into four parts. The first part deals with the art of correctly forming ideas in the mind that correspond to things (*bene imaginari*). The second part deals with the art of making correct judgments, affirming what each thing is and denying what it is not (*bene proponere*). The third deals with the art of making correct inferences or reasoning, properly drawing conclusions from premises (*bene colligere*). The fourth deals with the art of arranging or ordering knowledge in a proper way, from the simplest to the most complex, i.e., from ideas to syllogisms (*bene ordinare*).[23] Ideas are the fundamental constituents of all knowledge, meaning all judgments or propositions. Reasoning draws a proposition as a conclusion from other propositions that serve as premises. Method (i.e. the art of ordering knowledge) is but a concatenation of syllogisms. Accordingly, all knowledge is made up of ideas, conceived as the unities of mental contents. These ideas are now described by Gassendi in the same way as he previously described preconceptions, as their origin is sensation.[24] Therefore, while in his 1636 logic Gassendi expounded the Epicurean canons by keeping those concerning sensation distinct from those concerning preconception, the two are now unified as ideas. There is no separate analysis of sensation and mental contents in the *Institutio*. In contrast, Gassendi focuses from the outset on ideas, explaining how they originate from sensation, how they are then reworked by imagination, and how judgments are but conjunctions or disjunctions of ideas.

Thus, the term 'idea' is totally absent from the 1636 manuscript. In the later Epicurean logic published in 1649, the term was added in a cursory aside of little significance. Then, in the posthumous *Institutio logica* (1658), the main topic is the analysis of ideas, their origin, and how they are the basic constituent of all knowledge. Where does this shift come from? To address this question, it is important to consider what Gassendi was involved in from 1636 to 1649. In 1641 Gassendi wrote a set of objections to René Descartes' *Meditationes de prima philosophia*. A cornerstone of Descartes' epistemology is the analysis of mental contents in terms of ideas, of which he provides a taxonomy according to their origin. In his Third Meditation, he distinguishes between those ideas that are derived from the senses (adventitious ideas), those ideas that are produced by the mind itself (factitious ideas), and finally, those that are present in the mind independently from the input of senses and are not produced by the mind (innate ideas).[25] Against this, Gassendi predictably argues that all ideas are adventitious, meaning they are derived from the senses (*De adventitia omnium idearum origine*).[26] Neither factitious ideas nor innate ideas are anything but reworkings of adventitious ideas. Well, I find it reasonable to assert that the shift we have observed not only occurred after the dispute with Descartes but also as a result of it. Consequently, Gassendi's account of ideas in the *Institutio* is an attempt to provide an alternative to Descartes'. The late formulation of the *Institutio* can be seen as a post-Cartesian logic, in which Epicurean epistemology is revived in the context of a debate over the origin and nature of ideas.

Another aspect that distinguishes the *Institutio* from Gassendi's earlier Epicurean logic is the apparent similarity of its structure to Aristotelian scholastic treatises on logic. For instance, let us compare the *Institutio* with Eustachius à Sancto Paulo's *Summa philosophiae quadripartita* (1620), a popular scholastic textbook in France at the time. According to him, the three operations of the mind are said to be 'simple apprehension' (*simplex apprehensio*), 'judgment or enunciation' (*judicium seu enunciatio*), and 'discourse or argumentation' (*discursus sive argumentatio*). The similarity in terminology is striking. Yet, behind Gassendi's perfunctory adherence to scholastic logic lies a marked resemantization of the terms involved. In brief, one could say that Gassendi adopts a scholastic form while infusing it with Epicurean content. Gassendi arranges his mature logic into canons,

reinterpreting in these canons the theories he had previously presented in his manuscript and published Epicurean logic. Consider, for instance, his account of the formation of universal concepts. There, Gassendi presents an almost direct quotation from Diogenes Laërtius, which expounds the Epicurean doctrine of preconceptions. According to this doctrine, the mind forms preconceptions/ideas by composing, by enlarging and reducing, by transferring and adapting them in proportion to the preconceptions/ideas coming from the senses.[27] In this vein, Gassendi accords epistemological preeminence to singular ideas coming directly from the senses over abstract and more general ones. Singular ideas are the more perfect or complete, the more parts and attributes they represent of the thing that cause them. General ideas are, instead, formed by aggregation and by abstraction from the singular ones. Hence, they are the more perfect or complete the more they represent without extraneous elements that in which the particular ideas convene.[28] Even in his early *Exercitationes paradoxicae adversus Aristoteleos* (1624), Gassendi has raised a series of nominalist counter-examples to the Aristotelian doctrine of universals, which are wholly consistent with his much later claims.[29] Therefore, what at first glance appears to be an adherence to Aristotelian logic should not mislead us. Arguably, Gassendi aims seeks to propagate his Epicurean epistemology under a veil of scholastic vocabulary in the definitive version of his logic, in order to make it more digestible and less controversial to the audience of the time.

Thus, the novelties of Gassendi's *Institutio logica* compared to his earlier Epicurean logic are as follows: first, a shift in focus toward ideas, resulting from the encounter with Cartesian epistemology; second, the scholastic form, which conceals Epicurean content. Now, to better understand the reception of Gassendi's epistemology, I will outline some of the main issues that arose in his criticism of Descartes. Indeed, Gassendi's objections, along with the *Institutio*, appear to be the epistemological writings that most influenced his contemporaries.

3. Gassendi against Descartes (1641-1644)

At the request of Marin Mersenne, in 1641 Gassendi wrote a set of objections published as *Objectiones quintae*, addressing Descartes' *Meditationes de prima philosophia*. Descartes' replies to these objections are particularly harsh, and Gassendi reacted to them with a long series of counter-objections or instances (*instantiae*), which his friend Samuel Sorbière published in 1644, almost against Gassendi's intentions. Here, I will focus mainly on the theory of ideas that Gassendi advocates in this polemical context.

As I have already argued, Gassendi reformulates the Epicurean doctrine of preconceptions as a result of (and in sharp contrast to) Descartes' theory of ideas to propose an alternative to it. This is particularly evident in the objections and instances to the Third Meditation, where Descartes set forth his analysis of ideas. The main objection raised by Gassendi against the Third Meditation is that the fundamental principle upon which Cartesian epistemology rests —namely, 'that everything one can perceive clearly and distinctly is true'— is flawed.[30] The reason he sees this principle as a fallacious criterion of truth is that clarity and distinction are, to him, just indicators of the evidence of the senses. But the senses inform us about the appearance of things, not about their intimate nature. Therefore, we cannot argue from sense data to assert anything about the truth of things themselves. To better explain this fallacy, let us examine the example he brings about the taste of melon. He writes:

> I perceive the taste of the melon clearly and distinctly as pleasant. So, it is true that it appears to me as such, that is, as pleasant. But how could I persuade myself that it is true that such a taste is in the melon itself, I who, when I was a child and in good health, judged differently, that is, perceiving clearly and distinctly another taste in the melon? I see that it also appears differently to different human beings, as well as to different animals. ... So, it seems possible that the truth is repugnant to the truth? Or perhaps, rather, it is not that something is true in itself because it is perceived clearly and distinctly, but, simply, it is true that it is perceived clearly and distinctly as such?[31]

This example reveals much about what ideas are for Gassendi. Our perception of the melon is a mental content, i.e., an idea. All ideas are adventitious, as he argues using Descartes' terms. This means that all ideas have an external, sensible origin and nature. Their sensible nature implies that their content is always sensible as well. Therefore, it follows that every idea has a sensible content, meaning some sensible quality (in this case, the taste of melon). In this fashion, Gassendi asserts that ideas are nothing but images of things (*rerum imagines*).[32] He defines ideas in a similar way some years later, at the very beginning of the *Institutio logica*:

> The images we have in front of us in our mind when we think of something are usually referred to by several names. The names 'idea' or '*species*' are often used, or else 'notion', 'preconception', 'anticipation' or 'anticipated notion' (since it has been acquired previously) or 'concept', or even '*phantasma*', as it has phantasy or the imaginative faculty as its seat [etc.][33]

Now, this characterization of ideas as images is the key point of disagreement between Gassendi's and Descartes' conceptions of ideas. Gassendi exploits the ambiguity of the term 'idea', which appears to exist in Descartes' account. In those same pages of the Third Meditation, Descartes writes: "Some [thoughts] are like images of things, and the term 'idea' applies in a strict sense to them alone."[34] Unsurprisingly, Gassendi quotes this statement in support of his critique.[35] Yet, this is but an argumentative passage of the Meditations, which Descartes himself later dropped. As he writes to Mersenne (July 1641), "By 'idea', I do not just mean the images depicted in the imagination. ... Instead, by the term 'idea' I mean, in general, everything that is in our mind when we conceive something, no matter how we conceive it.[36] Probably, Descartes understood very well that supporting the identification of ideas with images is a viable way to deny innatism. Consequently, he distances himself from such a view, also addressing Gassendi's objection regarding the origin of ideas by stating that the arguments he has raised against him rely on a reduction of ideas to the images depicted in the imagination he has already contested. (… *nomen ideae ad solas imagines in phantasia depictas, contra id quod expresse assumpsi, restringis*).[37]

This concern about the nature of ideas also entails a difference at the level of the cognitive faculties of the mind. More specifically, it involves the Cartesian distinction between intellect and imagination, which Gassendi does not seem inclined to accept. In the Third Meditation, Descartes relies on the distinction between intellect and imagination to account for the difference between innate ideas and adventitious or fictitious ones. He provides several examples to illustrate this distinction, including that of the sun. He argues that we may have two distinct ideas of the sun: one, which comes from the senses, describes the sun only imperfectly; and another, obtained from astronomical calculations, is much more accurate. The latter is derived from innate ideas, while the former is a deceitful adventitious idea arising from sensation.[38] Commenting on this passage, Gassendi argues that both ideas have sensation at their origin, albeit in different ways. The difference between them is only a difference in degree, but not in nature. In the same way, two ideas of the same man, one from ten steps afar and the other from a hundred or a thousand steps afar, are both true and similar to the same thing.[39] Moreover, the epistemological priority Gassendi gives to concrete ideas coming from the senses over the abstract ones reworked by the imagination leads him to argue that "whenever we wish to have a distinct knowledge of the Sun, the mind must return to the figure [*species*] received through sight."[40] Thus, Descartes pretended to distinguish the imaginative faculty from the intellectual faculty by relying on the different nature of their objects, namely ideas. Against him, Gassendi relies on their mere difference in degree to argue that the intellect and imagination are also distinguished only by degree, and not by nature.[41]

What Descartes has failed to prove, according to Gassendi, is that imagination and intellect are two truly distinct faculties and not rather a single faculty performing two functions. Gassendi accounts for these cognitive functions as follows. Firstly, the mind perceives, and thus forms anticipations by the input of the senses (*per incursione*). Secondly, it imagines, that is, it forms anticipations or ideas with these sense data. Thirdly and lastly, it reflects on its perceived and imagined contents. This reflexion is that which is usually called intellection. These three different functions (perception, imagination, and intellection) belong to the same intellective faculty of the soul.[42]

Moreover, their disagreement about the nature of intellect appears in Gassendi's objections to the Fourth Meditation, as Descartes attributes judgment to the will rather than to the intellect. According to Descartes, it is precisely because the (infinite) will has the ability to make judgments beyond the limits of the (finite) intellect's knowledge that error occurs.[43] Gassendi cannot agree with this since judgments are, to him, conjunctions or disjunctions of ideas that produce knowledge, thus pertaining to the intellect. This point gives Gassendi the opportunity to outline the construction of knowledge from its basic constituents (i.e., ideas), which he later elaborated on in the *Institutio*. Three operations pertain to intellect: simple apprehension, i.e., gaining ideas from the senses; judging, i.e., connecting ideas into propositions; and reasoning, i.e., inferring a conclusive proposition from other propositions as premises.[44] Against Descartes, Gassendi argues that "The progression of the intellect from the first operation [i.e., simple apprehension] to the second [i.e., judging], and from the second operation to the third [i.e., reasoning] […] is made by the intellect without any meddling of the will."[45] In other words, judgments and inferences are brought forth in an automatic or involuntary way by the intellect. This point, which is not explicitly addressed in the various versions of Gassendi's logic, emerges here because of the polemical emphasis he places on it in opposition to the Cartesian theory of judgment.

In relation to these anti-Cartesian claims, Gassendi offers a critique against innatism. In his objections, he uses the example of a blind man to argue against Descartes that there are no innate ideas. He so apostrophizes Descartes: "Do you want to understand that none of our ideas is innate in us?"[46] If one could look into the mind of someone born blind to the idea of a color, one would find none, given that every content in the mind is either an image of something perceived or a reworking of some of these images. To better illustrate his account of ideas, he employs the metaphor of the mirror:

> the cause of the existence of the ideas [in the mind] is not [the mind itself], but the things that are represented by these ideas, inasmuch as they emit their images into [the mind], as in a mirror; although from these things [the mind] is able, at times, to draw from them to paint chimeras.[47]

This metaphor also involves the mind's passivity towards ideas, especially towards the simple ideas produced by the senses. While the mind can rework these simple ideas, its activity always deals with data of external origin, and towards which it is passive.[48] As I will argue later, Locke will borrow from the example of the blind man and from the metaphor of the mirror, in his arguments against innatism. Likewise, Locke seems to borrows from Gassendi as he argues against the Cartesian claim that the mind always thinks. To this claim —which depends on the Cartesian view that thought is the essential attribute of mind—[49] Gassendi observed that it is hard to conceive how the mind can think while asleep or in the womb. At that moment, thought is nearly a nothing.[50] Locke will argue the same against Descartes.

4. Port-Royal Logic (1662)

The final version of Gassendi's logic was published posthumously in 1658. Four years later, the first version of the so-called Port-Royal Logic, written by Antoine Arnauld and his collaborators, was published anonimously, as *La Logique ou l'Art de Penser, contenant, outre les regles communes, plusieurs observations nouvelles, propres à former le jugement* (1662). The influence of Gassendi's logic in general and of *Institutio logica* in particular on Port-Royal Logic is quite evident. First of all, while entirely Cartesian in its contents, this work closely resembles the *Institutio* in its form. In the preface, the authors define logic as 'the art of thinking' (*l'art de penser*). This art, just as Gassendi's *ars bene cogitandi*, consists in reflecting on the four operations of the mind: first, conceiving ideas (*concevoir*); second, making judgments (*juger*);

third, reasoning (*raisonner*); fourth, ordering (*ordonner*). Accordingly, the four parts of the Port-Royal Logic are devoted to these four operations.[51] The conceptual framework that Gassendi developed in his mature logic as a result of his debate with Descartes is also present here, as Cartesian Port-Royal logic focuses on ideas. As the authors write, "reflecting on our ideas is perhaps the most important thing to do in logic, because [ideas] are the basis of everything else [meaning, of every other operation of the mind]."[52] Judgments are conjunctions or disjunctions of ideas. Reasoning is to concatenate judgments in the form of syllogism. Method is the correct way of connecting syllogisms. Thus, all knowledge is, according to Gassendi and the Port-Royal Logic, grounded on ideas.

However, a precise alignment in form goes hand in hand with a sharp contrast in content. Furthermore, the authors of Port-Royal authors have Gassendi as their explicit polemical target, as they deal with the nature and origin of ideas. Quoting Descartes almost word for word, the first chapter of the first part (*Des idées selon leur nature et leur origine*) opens with the following anti-Gassendist statement. Since the notion of 'idea' is self-evident,

> all that can be done to avoid misunderstanding is to point out the erroneous meaning that could be given to this term [idea], narrowing it down to that way of conceiving things that occurs with the application of our mind to the images that are imprinted in our brain, and which is called imagination.[53]

In the same vein, they define ideas by emphasizing that they are not merely images. Instead, ideas are mental contents, whatever they may be.[54] This point is so crucial that they go so far as to argue that there is nothing more important (*rien de plus considerable*) than the distinction between mind and body, and thus the separation between incorporeal ideas and corporeal images.[55]

Just as Gassendi formulated his conception of idea in sharp contrast with Descartes, now Arnauld and his collaborators reassess the Cartesian view against Gassendi. As it is explicitly argued, beneath this divergence on the nature of ideas lies a divergence about the powers of the human mind. For Gassendi, ideas are material images originating from the senses and reworked by the imagination, while for Descartes and the Port-Royal authors, ideas are the immaterial content of the mind (at least in part) independent from the senses. Cartesians' concern is to advocate, against Gassendi, the independence of intellection from the images of sensation and imagination, as they argue that our mind "is able to conceive a great number of things without the aid of images" and so to comprehend "the difference between imagination and pure intellection."[56]

The fact that Gassendi is the main polemical target regarding this issue is also confirmed by the extensive paraphrase of the first part of the *Institutio* found a few pages later. After restating the nature of ideas, they now address their origin:

> The fundamental issue [*toute la question*] is to establish whether or not all our ideas come from our senses, and so whether or not we can accept the common maxim: *Nihil est in intellectu quod non prius fuerit in sensu*. This is the opinion of a widely admired philosopher, who begins his logic with this proposition: *Omnis idea orsum ducit a sensibus*. He admits, however, that not all our ideas exist in the mind exactly as they were in the senses, but he claims that at least they are formed from those which passed through the senses. This happens either by composition [...]; or by amplification and diminution [...]; or by accomodation and proportion [etc.][57]

The 'well-known philosopher' (*philosophe qui est estimé dans le monde*) they refer to is Gassendi, as the quotation proves. After expounding this key feature of Gassendi's epistemology, Port-Royal's authors reaffirm Cartesian innatism. They argue that ideas are not at all produced by the sense perception but rather by the mind itself, although it is often aroused (*excitée*) to produce them by something that falls under the senses. To speak properly, no idea is produced by the senses.[58]

Hence, Port-Royal Logic fully endorses a Cartesian conception of ideas. Nevertheless, the goal of this work is to expound a comprehensive logic —something Descartes never aimed to achieve.[59] In order to do so, its authors seem to have borrowed the framework of Gassendi's *Institutio*. Still, at first glance, both Gassendi's and Port-Royal Logic resemble Aristotelian scholastic logic. Comparing these works with a scholastic text-book such as Eustachius', one can see that the terms employed to describe the first three operations of the mind (*simplex apprehensio*; *judicium seu enunciatio*; *discursus sive argumentatio*) are quite overlapping. Furthermore, the addition of a fourth part on method follows a trend initiated by Petrus Ramus.[60] However, as I have already argued in the case of Gassendi, this similarity is just superficial. What has changed is the conceptual background of these works compared to scholastic logic.

Let us look, for instance, at what 'simple apprehension of things' (*rerum simplex apprehensio*) means now. In both Gassendi's *Institutio* and Port-Royal Logic, the basic constituents of every knowledge coming from simple apprehension are ideas, and the point of disagreement between the two lies in the nature of these simple ideas. While simple apprehension is described in Gassendi's and Port-Royal's logic in terms of ideas —that is to say, in terms of mental contents— the meaning of the term in scholastic logic is slightly different. Eustachius, for instance, deals with apprehension of simple terms in the first treatise of his logic (*De terminis dialecticis*).[61] There he distinguishes the mental dimension of these simple terms from their verbal dimension and their written dimension. He describes their mental dimension as "an image of the thing in the mind, representing it."[62] Yet, his analysis proceeds only by considering these terms in their verbal and grammatical aspects. For instance, the distinctions he presents are quite traditionally categorized as univocal, equivocal, and analogous terms.[63] The products of simple apprehension are merely verbal and grammatical terms for Eustachius and scholastic logic in general. The epistemological shift initiated by Descartes, which both Gassendi's *Institutio* and the Port-Royal Logic follow, focuses no longer on the grammatical terms of which propositions are composed, but rather on mental contents or ideas. Locke's *Essay* is also a product of this shift. Similar to Gassendi, Locke will base his epistemology on an anti-Cartesian conception of idea.[64]

5. de Launay's *Essais logiques* (1673)

Besides Gassendi and Port-Royal Logic, another source for Locke must be considered. Examining the catalogue of Locke's personal library may reveal a surprising detail: he owned four copies of a work on logic by a largely unknown Gassendist author, Gilles de Launay. Very little is known about him, including his date of birth and death. In the volume edited by John Harrison and Peter Laslett on Locke's library, it is recorded:

> [Gilles de Launay:]
> *La dialectique* … 12°, Paris, 1673.
> *Essai de logique*. 8°, Paris, 1678.
> *Essais logiques*. 12°, Paris, 1657.
> *Essais logiques*. 12°, Paris, 1663.[65]

As far as I could find, only the first work reported here is, without doubt, a work by Gilles de Launay: the first one reported. Its complete title is *La Dialectique du sieur de Launay, contenant L'Art de Raisonner juste sur toute sorte de matieres avec Les Maximes necessaires pour se détromper des erreurs, & se desabuser des chicanes & des fausses subtilités des Sophistes de l'Ecole.* It was published for the first time in 1673, in Paris (*Achevé d'imprimer pour la premiere fois le 23. Fevrier 1673*).[66] However, in both the *Extrait du privilège du Roy* and within the volume, the work is referred to as *Essais logiques*. Milton convincingly argued that the second book on the list was not authored by de Launay. Instead, it was probably a book with that very title (*Essai de logique*, published in 1678) by physicist and botanist Edme Mariotte, as correctly reported elsewhere in the list of books owned by Locke.[67] Regarding the other two books on the list, it can be conjectured that Locke may have owned two additional copies of de Launay's *Dialectique*, reported as *Essais logiques*, and that the person who compiled the list reported incorrect dates. In any case, one point should be emphasized: Locke certainly owned many other books by Gilles de Launay. Almost all of them, actually. He owned a copy of his *Introduction à la philosophie* (Paris, 1675) and a copy of his *Essais physiques* (reported as *Physique universelle*). Both are nothing but a paraphrase of sections of Gassendi's *Syntagma*.[68]

Setting aside Locke's library for the moment, let us briefly analyze the extent to which de Launay endorses Gassendi's epistemology in his work on logic. Although resuming Gassendi's text less than the other works I have just mentioned, *Les Essais logiques* are a sort of paraphrase of the *Pars logica* of Gassendi's *Syntagma*. De Launay also reframes the first two books of *Syntagma*'s logic, which were drafted much earlier, in 1636, in light of the shift on ideas from the late *Institutio*. In the first dissertation (*De la logique en général*), he starts by paraphrasing the proemial chapter on the definition of logic.[69] In the third chapter, he likewise follows the distinction given by Gassendi at the very beginning of his first book of *Pars logica*.[70] However, in the second chapter, as he discusses the proper object of logic, he no longer follows the second book of *Syntagma*'s logic, *De logicae fine*. There, Gassendi argues that the object of knowledge is truth. De Launay revises this definition in light of the insights from the *Institutio*. The proper object of logic is the intellect and its operations, which logic aims to regulate (*bien régler*). [71] Broadly speaking, the object of knowledge is certainly truth. But, to speak more properly,

> The well-regulated four operations of the intellect are the formal and truthful object of logic; as well as the essential difference according to which we can distinguish it from all the other parts of philosophy.[72]

It goes without saying that these four operations are the ones Gassendi has already outlined in his later logic: conceiving, judging, reasoning, and ordering (*concevoir*, *juger*, *raisonner*, *ordonner*).[73] These operations of the intellect are the main subject of de Launay's work, accounted in detail from the second to the seventh and final Dissertation. There, he essentially replicates Gassendi's *Institutio*, further emphasizing adherence to the standard form of scholastic logic.[74] Following Gassendi, he holds that acquiring and ordering the knowledge of natural phenomena through the four operations of the intellect is what physics is all about. The main task of logic is, for de Launay just as for Gassendi, to give some rules (*règles* or *maximes*) for the correct use of these mental operations.[75] By providing these rules, logic has "at its direct aim the correctness [*rectitude*] of these mental operations, and indirectly to avoid errors and to seek after truth."[76]

The first mental operation seems to be the most important one, in de Launay's view. The plain sight of things (*simple veue des choses*) is the ground upon which all knowledge is built, and this plain sight is described as conceiving ideas or images of things produced by the senses.[77] As he argues, this same action can be referred to as the 'simple apprehension of things' (*apprehension simple de l'objet*). While this terminology is unusual in French, it is quite common in Latin.[78] The reference to Gassendi's terminology is even more pronounced here. In fact, de Launay explicitly argues that ideas or mental contents are merely images of things, following Gassendi in opposition to Descartes. He carries this identification between ideas and images so far that he describes how the intellect works with them by drawing an analogy to a painter: the mind (*esprit*) organizes the images it possesses of things from the simplest to the most complex, much like a painter does, imitating the order of things in nature. [79] Still following Gassendi against Descartes, de Launay openly reaffirms the identification of intellection with imagination. It is worth noting that he resorts here to a typically Cartesian assumption —that is, that everything we can conceive, we conceive through ideas— precisely to reaffirm the Gassendist claim regarding the sensible origin and nature of ideas. He writes:

> we cannot conceive of anything that is outside us, except by means of ideas that are within us, that represent external objects. [...] This reasoning seems to me quite convincing to condemn the error of those philosophers [i.e., the followers of Descartes] who believe that our mind knows an infinite number of things without having the need to form images of them, as if they claimed that it represented these things, without forming of them any representation or idea. I do not know how the Cartesians can get out of this labyrinth when they maintain that the mind conceives immaterial things without forming any images of them.[80]

To conceive any kind of thing means nothing more than to have a mental content or an idea of that thing. However, having an idea is merely possessing some sort of image that represents it. Thus, everything we conceive through intellect is simply something we have conceived by imagination. Clearly, the underlying premise of this argument is that ideas or mental contents are just images, that is, representations of things perceived by the senses.

As we have seen, the fundamental assumption of Gassendi's sensism —*Nihil est in intellectu quod non prius fuerit in sensu*— was critically addressed by Port-Royal Logic, explicitly referring to Gassendi. Now, de Launay reassesses it against the Cartesians. An important maxim regarding ideas, he argues, is that as long as the soul is joined to the body, it is able to know things only through sensations. In other words, every mental content stems directly or indirectly from sensation. This maxim "is particularly important because it has been recently challenged by Cartesians."[81]

The polemical context in which this work is situated is quite clear. Just as Gassendi developed an anti-, and post-, Cartesian conception of ideas in his late logic, and the authors of Port-Royal authors dealt with it to reaffirm the Cartesian theory of ideas as the foundation of their epistemology, so does de Launay, but in the opposite direction. That is, reassessing Gassendi's view against Descartes'. During these same years, Locke does almost the same thing as de Launay, as I will show in a moment. Therefore, his interest in his work is certainly not accidental.

6. Locke's 1671 Drafts for his *Essay Concerning Humane Understanding* (1690)

In order to investigate the relevance of Gassendi's epistemology to Locke's, I will now preliminarily examine the 'external evidence' of this influence. To do so, let us look at Locke's library, keeping in mind that owning a specific book does not necessarily imply its relevance for the owner, just as the absence of a book does not rule out such relevance. However, one fact should be noted: the only work by Gassendi that Locke owns is the intellectual biography of Gassendi's patron, Fabri de Peiresc (*Viri illustris Nicolai Claudii Fabricii de Peiresc vita*, 1641).[82] This work contains some interesting details about Gassendi's natural philosophy, but it offers very little epistemological discussion. Locke also owned François Bernier's *Abrégé de la philosophie de M. Gassendi*, along with his *Doutes sur quelques-uns des principaux chapitres de son Abrégé* [etc.].[83] Moreover, Locke met Bernier in person during his stay in France. However, Milton convincingly argued that Bernier's philosophical influence on Locke was minimal, if any.[84] Locke also owned two copies of the Port-Royal Logic, originally published in 1662, in two editions both published in 1674.[85] As I have already argued, Locke owned at least one copy of Gilles de Launay's *Dialectique* or *Essais logiques* published in 1673.[86] Lastly, and most importantly, Locke both owned and was very familiar with Gassendi's *Objectiones quintae* to Descartes' *Meditationes* (1641).[87] Although there is no evidence that he was also familiar with Gassendi's *Disquisitio metaphysica* (1644) that stemmed from these objections, this point should not be underestimated. Despite its polemical nature, Gassendi presents several of his epistemological claims there. From Locke's perspective, the fact that these claims were made in a polemical, anti-Cartesian context arguably makes them even more intriguing.

Locke wrote what are known as Drafts A and B of his *Essay Concerning Humane Understanding* in 1671-1672, prior to his trip to France. Draft A (entitled *Sic cogitavit de intellecto humano Jo*[*hn*] *Locke anno 1671*), in particular, reveals a striking similarity to Gassendi's logic, as I will demonstrate. Therefore, we must rule out the possibility that the indirect sources are de Launay's work and/or Port-Royal Logic, of which he only has later editions acquired in France. However, the fact that he later purchased several copies of de Launay's *Essais logiques* may, in any case, suggest his interest in Gassendi's logic. According to his notebooks, we know that, at the time, Locke had read Gassendi's objections to Descartes and (at least part of) *Syntagma philosophicum,* especially the book on void and space. It is not so unlikely that he was acquainted with Gassendi's *Institutio* as well, contained in the same volume.[88]

With this established, let us move forward with an 'internalist' or 'morphological' analysis of these 1671 drafts, in comparison to Gassendi's doctrines. Locke begins Draft A as follows:

> all knowledg is founded on and ultimately derives its self from sense, or something analogous to it & may be cald sensation which is donne by our senses conversant about particular objects which give us the simple Ideas or Images of things & thus we come to have Ideas of heat & light, hard & soft which are noe thing but the reviveing again in our mindes those imaginations which those objects when they affected our senses caused in us [etc.][89]

Not by chance, Locke begins the first version of his essay on human understanding with a statement reminiscent of Gassendi regarding the origin and nature of ideas. I have already argued that this represents a key point of disagreement between the Cartesians and the Gassendists, in those same years. In agreement with Gassendi and against Descartes, Locke asserts that ideas originate in the senses and are nothing but the images of the things from which they are produced. In other words, for him, 'idea' and 'image' are quite synonymous, at least in this initial draft. Additionally, similar to Gassendi and de Launay, Locke refers to the process of acquiring simple ideas of things through sensation 'apprehension';[90] and also refers to these ideas or images as 'simple apprehensions'.[91] From a collection of several simple ideas, understanding (or better, imagination) brings forth general and abstract ideas, such as the idea of substance. Locke states that these general ideas "are grounded upon the repeated exercise of senses."[92]

From the assertion that all ideas or images of things come from the senses, it follows that a blind man cannot have ideas of colors, nor can a deaf man have ideas of sounds. Thus, reiterating what Gassendi argued against Descartes, he writes:

> all the words in the world […] will not give a blinde man any Idea of black or white or bl[ue][,] those simple ideas being to be conveyd to the minde noe other way but by the senses. [N]or can

all the words in the world […] produce in a mans minde one new simple Idea unless it be of the sound its self.[93]

It is worth noting that Locke repeats the exact same example as Gassendi here, mentioning in the same order first the blind man, and then the deaf man deprived of sensible ideas.[94] It is well known that Locke aligns with Gassendi in opposing Cartesian innatism, to the extent that he dedicates an entire book of the *Essay* to this subject. It is no surprise, then, that he reiterates Gassendi's example of the blind and deaf men, which is suitable to support the sensible origin of all ideas against innatism.[95]

Furthermore, Locke not only shares Gassendi's *pars destruens* against Cartesianism (i.e., innatism), but also his *part construens*, as he provides a nearly identical account of how the mind reworks all the other ideas it possesses from simple ideas. He writes that, beyond simple ideas, "all the knowledg we have […] is noe thing else but the compareing uniteing compounding enlargeing & otherwise diversifying these simple Ideas one with an other."[96] According to Gassendi, the mind forms its ideas in the same way, namely by composing (*compositio*), by enlarging or reducing (*ampliatio vel imminutio*), by transferring or adapting (*traslatio et accomodatio*) ideas produced by the senses.[97] The terminological similarity is striking. While the mind is active in reworking its own compound ideas from simple ones, it is instead passive towards the simple ideas that originate from the senses. As Gassendi did, Locke illustrates the passivity of the mind with the example of the mirror:

the understanding can noe more refuse to have these [ideas] or alter them when in it or make new ones to its self & receive new ones into it any other way then by the senses […] then a mirror can refuse alter or change or produce in its self any other images or Ideas then the object set before it doe therein produce[98]

Therefore, the mind has only simple ideas derived from the senses and compound ideas formed by combining those simple ones. All knowledge, he writes, consists of ideas "simple or compounded".[99] Still aligned with Gassendi and opposing Descartes, Locke argues that evidence or clarity and distinction are proper to simple ideas, while compound ideas are evident only in a derivative way.[100] In other words, what comes from the senses, i.e., simple ideas, provides the evidence that serves as a touchstone for the evidence of every knowledge. Moreover, if the mind has no knowledge beyond simple ideas gained through the senses and those compounded by the imagination, it is evident that Locke aligns with Gassendi and opposes Descartes in denying the existence of any pure intellection independent of the imagination.

All knowledge, whose ideas are the basic constituents, is structured in propositions or judgments. This seems, at first glance, to bring Locke's epistemology back into the fold of Aristotelian scholastic logic. However, in Locke, as in Gassendi, scholastic logic is resemantized, as judgments are now just conjunctions or disjunctions of ideas, the truth of which depends on what the senses inform us of. In this respect too, Locke appears to follow Gassendi in distinguishing what the latter calls 'truth of existence' (*veritas existentiae*) of every simple idea from the 'truth of judgment' (*veritas enunciationis*) in which exclusively lies falsehood.[101] Locke describes judgment or proposition as follows:

When the minde is furnishd with the simple Ideas of things brought in by the senses [...] [it] joyne two of these Ideas [...] togeather or separate them one from another by way of affirmation or negation, which when it comes to be expressed in words is cald proposition & in this lies all truth & falshood[102]

In sum, falsehood and error, according to Locke as well as Gassendi, belong to judgments that join or disjoin ideas, not to ideas themselves. Furthermore, both agree in attributing the faculty of judgment to the intellect rather than the will, against Descartes. Locke summarizes as follows the different functions of understanding, a term which, in this draft, seems equivalent to 'intellect'. First of all, "the understanding is capable of receiving, retaining & reviveing […] a certain number of simple Ideas, gathered only by experiment [*scil*. experience] & observation."[103] In addition, "[i]t hath the power to astract", that is, to "unite, combine, enlarge, compare &c. these simple Ideas together & thereof make comple ones".[104] Furthermore, it has the power to make judgments or propositions, viz. to "knowing truth & falshood which is to be found only in uniting or separating [ideas] or in affirmation of negation which are verbal propositions".[105]

So far, the similarities between this early draft of Locke's major work and Gassendi's critique of Descartes, along with his account of knowledge, seem undeniable to me. But there is another point I want to stress about the similarity between the two: their probabilism. As we have observed, Gassendi claims that any knowledge deemed 'probable or truth-like' (*probabilis seu verisimilis*) is such insofar as it aligns with the evidence of sensation. In terms that overlap with Gassendi's, Locke defines the degrees of probability in knowledge as follows:

though most of those propositions we think […] are not evident & certain, & we cannot have undoubted knowledg of their truth yet some of them border soe near upon certainty, that we make noe doubt at all of their truth […] But there being degrees of Probability from the very neigbourhood of certainty & evidence quite downe to improbability & unlikelynesse even to the confines of impossibility. [etc.][106]

Hence, Locke's development of his theory of opinion and probable knowledge, which goes far beyond the role played in Gassendi's epistemology, seems to stem from the latter's view of probable knowledge as an approximation to the evidence of sensation.

Locke's Draft A has quite strong terminological similarities with Gassendi's epistemology, especially with the polemic against Descartes. The so-called Draft B — *De Intellecto Humano, 1671. An Essay concerning the Understanding, Knowledge, Opinion & Assent*— [107] brings Locke into different directions, at least from a terminological point of view. This second manuscript, which closely resembles the published *Essay*, shows significantly less terminological (more than conceptual, though that is another story) similarity to Gassendi. I will provide just one example of this terminological shift that makes Locke's connection to Gassendi's theory a little more difficult to discern: the definition of idea he now presents. In Draft A, the term 'idea' is used as a synonym

for 'image' of the external thing that produces it. Now, in a formulation that will be taken literally in the definitive *Essay*, he writes:

> in this following discourse I shall use the word Idea for whatsoever is the object of the understanding when a man thinks & by it expresse all that is meant by Notion[,] phantasme, species, or what ever else the minde can be imploid about in thinkeing.[108]

At first glance, the shift from 'idea' as 'image' to 'idea' as 'mental content' or "whatsoever is the object of the understanding when a man thinks" seems to bring Locke closer to Descartes than to Gassendi. The point of contention between the two was precisely whether or not to identify ideas with the images of things. Descartes, against this identification, argued that "by the term 'idea' I mean in general everything which is in our mind when we conceive something, no matter how we conceive it."[109] Well, Locke's terminological shift in no way implies a departure from Gassendi's sensist theory. Locke firmly holds the sensible origin and nature of simple ideas as the foundation of all his epistemology, and this will remain the same in the *Essay*. Likewise, all the other tenets present in Draft A that I have analyzed will also persist unchanged, without exception. The fact that, here, Locke more generically defines ideas as mental contents is due to the characterization he intends to give his work, which he appears to decide more resolutely now, in Draft B: an investigation of the limits and capacities of human knowledge. This is done in a way that does no more take into account physical considerations about how this knowledge is formed. Accordingly, he argues:

> I shall not at present meddle with the physicall consideration of the mind or trouble myself to examine […] wherein the essence of it consists or by what motion of our spirits, or what alteration of our bodys we come to have any Idea in our understanding & whether these Ideas are material or immaterial[110]

This certainly marks a departure from Gassendi, for whom the physiology of perception was pivotal in shaping his epistemology. Although Locke does not entirely disregard physical and physiological considerations in the *Essay*, contrary to what he programmatically states, and even though these considerations are quite similar to Gassendi's. As I will show in the conclusion, significant influences on Locke's understanding of Gassendi's physics and physiology included, among others, his contemporaries Robert Boyle and Thomas Willis.

In any case, even if the similarities between Locke's Draft A and Gassendi's epistemology become less pronounced in Locke's later reworkings, the influence remains since there is no significant difference in Locke's tenets between this 1671 draft and the final version of the Essay, published in 1690. Additionally, Locke seems to leverage Gassendi's epistemology as a polemical tool, drawing on the *Objectiones quintae* against Descartes.

Besides the various Gassendist views that Locke clearly advocates in Draft A, another example of their anti-Cartesian use can be found in the *Essay*. It involves Descartes' assertion that, as long as it exists, the mind thinks.[111] Against this claim, Gassendi objected:

> Those who cannot understand how you can think in the drowsiness of lethargy, or even in the womb, will not be persuaded [that the mind always thinks]. [...] I would just like you to remember how obscure, how tenuous, almost a nothing [*pene nulla*] your thought could have been at that moment [i.e. in the womb].[112]

Now in the paragraph 'The Soul thinks not always', Locke argues that the Cartesian assumption that the mind always thinks as thought is its essence is not at all self-evident, and it needs to be proved.[113] Significantly, Locke offers the same two counter-examples given by Gassendi: sleep and the fetus in the womb.[114] For Locke, the mind begins to think when it begins to perceive, that is, to have sensations. And the fetus has but a few sensations. We may suppose, he writes, that "a foetus in the mother's womb, differs not much from the state of a vegetable [and that it] passes the greatest part of its time without perception or thought."[115] Once again, Locke can find arguments that align with his own epistemology in Gassendi, Descartes' antagonist.

7. Conclusion

Therefore, both internal and external evidence concur to prove that Locke likely draws on Gassendi's epistemology. As the internal or morphological comparison shows, in Draft A (1671) of the *Essay,* Locke maintains views that were both conceptually and terminologically similar to Gassendi's. As for the external evidence, Milton has shown that Locke took notes both from Gassendi's *Syntagma* and from *Objectiones quintae*.[116] Moreover, even though the editions of de Launay's *Essais logiques* (1673) and Port-Royal Logic (1674) in Locke's library were published after 1671, their presence there remains significant. As for de Launay's work, the fact that he purchased several copies (likely three, as I have suggested) demonstrates his interest in Gassendi's logic during the 1670s. Regarding Port-Royal Logic, he could have read earlier versions during the 1660s. In any case, it is evident that Locke aligns himself with Gassendi, opposing Arnauld's reaffirmation of Cartesian views, and adopts several arguments from Gassendi's objections to challenge Descartes.

Now, to conclude, let us take a closer look at the passage from Leibniz's *Nouveaux Essais* that I quoted in the introduction. As is well known, this work is a chapter-by-chapter rebuttal of Locke's *Essay.* About ten years younger than Locke, Leibniz is an insider of the context in which Locke lived and worked and also had a deep understanding of Gassendi's *Opera omnia*.[117] Therefore, I will take seriously the passage in which Leibniz stated that Locke "is pretty much in agreement with Gassendi's system."[118] On this basis, I dispute Milton's claim that Gassendi had little influence on Locke. Who, more than one of his contemporaries, could have been aware of the proximate context of Locke's philosophy?

To conclude, I am now entering into more detail on what Leibniz wrote. Firstly, Leibniz seems well aware of the polemical use of Gassendi against Descartes on Locke's behalf, as it is said that the author of the *Essay* "seems inclined to agree with most of Gassendi's objections against Descartes."[119] Secondly, the character im-

personating Locke lists several views endorsed by Locke, which he evidently considers pivotal in Gassendi's *système*: "[1] he supports void and atoms, [2] he believes that matter could think, [3] that there are no innate ideas, [4] that our mind is a *tabula rasa*, [4] and that we do not think all the time."[120] The interconnected theses three and four are more properly epistemological. I have mainly addressed them here, and I also referenced the fifth. As I have argued, Locke endorses Gassendi's account of the sensible origin of ideas. Accordingly, he believes that the mind begins to have ideas, i.e., to think, only when it perceives external things, of which ideas are images. Moreover, in a polemical vein, he borrows from Gassendi's counter-examples against Descartes' innatism, as well as against Descartes' assumption that the mind always thinks; that is, that thought is its essence. For both Gassendi and Locke, thought is not the essence of the mind, but merely one of its operations.

Regarding the first two theses, discussing them at length exceeds the scope of the present contribution. I just point out that, unlike the other theses I have addressed here, they have explicit intermediaries: Robert Boyle for his corpuscular matter theory, and Thomas Willis for the thinking matter issue. The influence of Boyle's physics on Locke is something so well-established that it is not worth reasserting it here.[121] Less obvious, however, is that Locke's well-known hint on thinking matter comes from Gassendi and Willis. As John Wright has convincingly demonstrated, it is likely that the claim that matter arranged in a specific way is capable of thought comes from the neuro-physiological research of Willis, whose 1663-1664 Oxford lectures were copied by Locke in one of his notebooks. In turn, Willis is a follower of Gassendi on this point[122] Several tenets related to Gassendi's physics and physiology are to be found in Locke and his immediate context, especially in authors like Boyle and Willis. However, a more comprehensive study on this topic has yet to be written.

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Notes

[1] On this controversy, see: Aaron 1937 (esp. pp. 31-35); Yolton 1955; Coirault 1957; Duchesneau 1973 (esp. pp. 93-119); Kroll 1984; Michael & Michael 1990; Ayers 1991; Puster 1991; Lennon 1993 (esp. pp. 149-190); Sarasohn 1996 (esp. pp. 168–197); Specht 1997; Milton 2000. It seems that, after Milton's sharp critique, scholars have been no more inclined to discuss this subject in a relevant way.

[2] "En gros, il est assez dans le système de M. Gassendi, qui est, dans le fond, celui de Démocrite. Il est pour le vide et pour les atomes; il croit que la matière pourrait penser, qu'il n'y a point d'idées innées, que notre esprit est tabula rasa, et que nous ne pensons pas toujours; et il paraît d'humeur à approuver la plus grande partie des objections que M. Gassendi a faites à M. Descartes.": *Nouveaux essais sur l'entendement humain* I. 1 (Leibniz 1996, p. 70). Except where otherwise indicated (as in this case), all translations are mine.

[3] Milton 2000, pp. 88-91.

[4] *Ibid*. pp. 98-104.

[5] *Ibid*. pp. 91-92.

[6] At first glance, it might seem that I'm endorsing the general narrative provided by Thomas Lennon (Lennon 1993). However, I believe one should be far, for the most part, more cautious when proposing general narratives like the one that Lennon presented. By claiming that Locke uses Gassendi as a polemical weapon against Descartes, I do not endorse that the opposition between Gassendi and Descartes is paradigmatic and exhaustive of the entire spectrum of positions from the second half of the seventeenth century onward.

[7] For the timeline of Gassendi's so-called Epicurean project, see the still authoritative Rochot 1944. On Gassendi's logic and epistemology, see mainly: Bloch 1971 (esp. pp. 6-151); Messeri 1985; Fisher 2005 (esp. pp. 19-86); LoLordo 2006 (esp. pp. 60-99); Garau 2023; Paganini 2023.

[8] Gassendi 2010, pp. 228-327 (= Ms. Carpentras 1832, ff. 239r-256r).

[9] *Cf.* Gassendi 1649, pp. 120-159; OO III, pp. 4-10; OO I, pp. 52b-56a.

[10] *Cf.* OO I, pp. 91-124; Gassendi 1660; Gassendi 1668; Bernier 1992, vol. I.

[11] "est aliquid verum quod possit diiudicari et sciri": Gassendi 2010, pp. 210-211 (= Ms. Carpentras 1832, f. 236r).

[12] See Gassendi 2010, pp. 198-211 (= Ms. Carpentras 1832, ff. 234r-235v).

[13] "Sensus nunquam fallitur; ac proinde est omnis sensio, omnisque phantasiae, seu apparentiae perceptio vera": Gassendi 2010, pp. 230-231 (= Ms. Carpentras 1832, f. 239r). *Cf.* Gassendi 1649, p. 158; OO I, p. 53a; Ibid. III, p. 5a.

[14] "[…] alia cognitio est simplex quaedam adprehensio, alia vero iudicium. Et simplex quidem adprehensio est cum res nuda cognositur et nihil penitus de ea vel adfirmatur vel negatur […]. Iudicium vero est quoties res ita cognoscitur ut quidpiam de ea adfirmetur vel negetur […]. Iam quod spectat quidem ad iudicium ac opinionem potissimum dictum est supra, ut veritas aut falsitas illi conveniat. Neque hoc Epicurus negat, sed adserit potius […]. Quod spectat vero ad simplicem nudamve rei adprehensionem censet Epicurus nullam falsitatem in eam cadere, esse vero eiusmodi, ut cum veram existendi causam habeat, competat illi veritas quam existentiae diximus, cuique falsitas opponitur nulla.": Gassendi 2010, pp. 230-233 (= Ms. Carpentras 1832, f. 239v).

[15] "Opinio est consequens sensum, sensionique superadiecta, in quam veritas, aut falsitas cadit.": Gassendi 2010, pp. 256-257 (= Ms. Carpentras 1832, f. 243v). *Cf.* Gassendi 1649, p. 158; OO I, p. 53b; *Ibid*. III, p. 6a.

[16] "Opinio illa vera est, cui vel suffragatur, vel non refragatur sensus evidentia."; "Opinio illa falsa est, cui vel refragatur, vel non suffragatur sensus evidentia": Gassendi 2010 pp. 274-275, 284-285 (= Ms. Carpentras 1832, ff. 247r, 249r). *Cf.* Gassendi 1649, p. 158; OO I, p. 54a; *Ibid*. III, p. 7a-b.

[17] "[…] supponis *posse eadem non modo fieri dubia, verumetiam haberi falsa*; at hoc ipsum videtur adhuc tanto magis esse impossibile, quanto magis falsa, quam dubia opinio, in qua est probabilitas, ab ipsa veritate, ac certitudine distat": OO III, p. 280b.

[18] "[…] quatenus ad nostram cognitionem respectum habet, vel ea manifesta et evidens est, et tunc, quia parit in nobis cognitionem sui certam et indubiam […] vel occulta est et obscura, et tunc, quia sui cognitionem facit incertam et dubiam […]. Dicitur autem praeterea verisimilis et probabilis, quando maius quoddam est certitudinis quam incertitudinis argumentum.": Gassendi 2010, pp. 140-141 (= Ms. Carpentras 1832, f. 225r).

[19] "Omnis, quae in mente est anticipatio, seu praenotio, dependet a sensibus; idque vel incursione, vel proportione, vel similitudine, vel compositione.": Gassendi 2010, pp. 294-295 (= Ms. Carpentras 1832, f. 250v). Cf. Gassendi 1649, p. 158; OO I, p. 54b; *Ibid*. III, p. 8a.

[20] "Anticipatio est ipsa rei notio, et quasi definitio, sine qua quidquam quaerere, dubitare, opinari, imo et nominare non licet.": Gassendi 1649, p. 158; OO I, p. 54b; *Ibid*. III, p. 8b. The 1636 manuscript version of this canon is slightly different. It runs as follows: "Nihil quaerere, dubitare, intelligere, opinari, redarguere, edisserere sine praenotione licet.": Gassendi 2010, pp. 302-303 (= Ms. Carpentras 1832, f. 252r).

[21] See the third canon on preconception: Gassendi 1649, p. 158; OO I, p. 55a; *Ibid*. III, p. 8b. The manuscript version is quite different: *cf*. Gassendi 2010, pp. 308-309 (= Ms. Carpentras 1832, f. 253r).

[22] "v.c. idea, seu forma, atque species illa, ad quam respicientes apud nosmetipsos": Gassendi 1649, p. 27; OO I, p. 54b; *Ibid*. III, p. 8b.

[23] OO I, p. 91a-b.

[24] See *ibid*. pp. 92b-93b.

[25] AT VII, pp. 38-39.

[26] OO III, p. 318a.

[27] OO I, p. 93a. *Cf.* DL X, 32.

[28] OO I p. 95a-b.

[29] *Cf*. OO III, pp. 157a-165a. On this, see Bloch 1971, pp. 110-148.

[30] "illud omne verum est, quod valde clare et distincte percipio": OO III, p. 314b. *Cf.* AT VII, p. 35.

[31] "Ego saporem peponis gratum clare distincteque percipio: itaque verum est peponis saporem apparere mihi hujuscemodi. At quod propterea verum sit talem in ipso pepone esse, quomodo mihi persuadeam? qui, puer cum essem ac bene valerem, secus judicavi, nimirum clare distincteque alium in pepone saporem percipiens. Video et multis hominibus secus videri; video et multis animalibus, quae gustu pollent, optimeque valent. An ergo verum vero repugnat? An potius, non ex eo quod aliquid clare distincteque percipitur, id secundum se verum est, sed verum solummodo est, quod clare distincteque tale percipiatur?": OO III, p. 314b.

[32] OO III, p. 316b. See also *ibid*. p. 322a-b.

[33] "Imago porro illa, quae nobis rem quampiam cogitantibus menti obversatur, ac veluti obiicitur, plerisque etiam aliis donari nominibus solet. Dicitur enim etiam idea ac species, et […] notio, praenotio, anticipatio, seu anticipata notio (prout nempe fuit prius acquisita) ac rursus conceptus, itemque phantasma, prout sedem habet in phantasia, facultateve im-

aginatrice. Nobis idea crebrius dicetur, quod et iam vox haec familiaris, tritaque sit.": OO I, p. 92a.
[34] "Quaedam ex his tanquam rerum imagines sunt, quibus solis proprie convenit ideae nomen": AT VII, p. 37.
[35] See OO III, p. 322a-b.
[36] "Car je n'appelle pas simplement du nom d'idée les images qui font dépeintes en la fantaisie; au contraire, je ne les appelle point de ce nom, en tant qu'elles sont dans la fantaisie corporelle; mais l'appelle généralement du nom d'idée tout ce qui est dans nostre esprit, lors que nous concevons une chose, de quelque manière que nous la concevions": AT III, pp. 392-393. In the appendix to the second replies, he so defines ideas: "*Ideae* nomine intelligo cujuslibet cogitationis formam illam, per cujus immediatam perceptionem ipsius ejusdem cogitationis conscius sum; adeo ut nihil possim verbis exprimere, intelligendo id quod dico, quin ex hoc ipso certum sit, in me esse ideam ejus quod verbis illis significatur. Atque ita non solas imagines in phantasia depictas ideas voco; imo ipsas hic nullo modo voco ideas, quatenus sunt in phantasia corporea, hoc est in parte aliqua cerebri depictae, sed tantum quatenus mentem ipsam in illam cerebri partem conversam informant.": *ibid*. VII, pp. 160-161.
[37] OO III, p. 321a (=AT VII, p. 364).
[38] AT VII, p. 39.
[39] OO III, p. 320b (=AT VII, p. 363).
[40] "quoties habere distinctam de Sole cogitationem volumus, oportet mens redeat ad speciem, quam intercedente oculo accepit.": OO III, p. 321a (=AT VII, p. 364).
[41] See e.g. OO III, p. 385b (=AT VII, p. 329).
[42] OO III, p. 307a-b. See also *ibid*. pp. 318a, 367a.
[43] AT VII, p. 58.
[44] OO III, p. 367a.
[45] "Progressus intellectus a prima operatione in secundam, et ab hac in tertiam […] absque ulla actionem voluntatis intermistione": *ibidem*.
[46] «Et capere vis hujusce ideae nihil a natura esse insitum? Illam require ex caeco nato [etc.]»: OO III, p. 320b (=AT VII, p. 284). See also *ibid.* I, p. 92b.
[47] "[…] tu [mens] causa non es realitatis idearum, sed ipsaemet res per ideas repraesentatae, quatenus emittunt imagines sui in te ut in speculum; licet tu ex ipsis occasionem possis aliquando sumere chimaerarum depingendarum.": OO III, p. 332b (=AT VII, p. 291).
[48] See OO III, p. 318a (=AT VII, pp. 279-280).
[49] *Cf*. AT VII, p. 27.
[50] OO III, p. 298a (=AT VII, p. 264).
[51] Arnauld & Nicole 1965, pp. 37-38. On Gassendi and Port-Royal Logic, see Michael 1997.
[52] "les reflexions que l'on peut faire sur nos idées, sont peut-être ce qu'il y a de plus important dans la Logique, parce que c'est le fondament de tout le rest": Arnauld & Nicole 1965, p. 39.
[53] "Mais tout ce qu'on peut faire pour empêcher qu'on ne s'y trompe, est de marquer la fausse intelligence qu'on pourroit donner à ce mot [d'idée], en le restreignant à cette seule façon de concevoir les choses, qui se fait par l'application de notre esprit aux images qui sont paintes dans notre cerveau, & qui s'appelle imagination.": *ibid*. p. 40.
[54] *Ibid*. p. 41.
[55] *Ibid*. p. 30.
[56] "nous concevons un très-grand nombre de choses sans alcune de ces images, […] s'apperçoive la difference qu'il y a entre l'imagination et la pure intellection.": *ibid*. p. 40.
[57] "Toute la question est de savoir si toutes nos idées viennent de nos sens, & si on doit passer pour vraye cette maxime commune: *Nihil est in intellectu quod non prius fuerit in sensu*. C'est le sentiment d'un philosophe qui est estimé dans le monde, & qui commence sa Logique par cette proposition: *Omnis idea orsum ducit a sensibus*. *Toute idée tire son origine des sens*. Il avoue neanmoins que toutes nos idées n'ont pas été dans nos sens, telles qu'elles sont dans notre esprit; mais il prétend qu'elles ont au moins été formées de celles qui ont passé par nos sens, ou par composition, comme lorsque des images séparées de l'or, & d'une montagne, on s'en fait une montagne d'or; ou par ampliation & diminution, comme lorsque de l'image d'un homme d'une grandeur ordinaire on s'en forme un geant ou un pigmée; ou par accomodation & proportion, comme lorsque l'idée d'une maison qu'on a vûe, on s'en forme l'image d'une maison qu'on n'a pas vûe. [etc.]": *ibid*. pp. 43-44. *Cf*. OO I, pp. 92b-93a.
[58] See Arnauld & Nicole 1965, pp. 45-46.
[59] On this, see e.g. Petrescu 2018.
[60] On this, see the classical Ong 1958.
[61] See Eustachius 1620, pp. 15-25.
[62] "Res in qua significandi vis aliqua reperitur, triplex vulgo assignatur, nempe mens, vox, & scriptura. Quare Dialectici non immerito terminum […] distinguunt in mentalem, vocalem, & scriptum. Mentalis est, qui animo duntaxat concipitur, vocalis, qui voce exprimitur, scriptus, qui scriptura pingitur. […] [M]entalis terminus […] nunquam ex hominum instituta, sed a natura, rem cuius est imago, eodem modo repraesentat [etc.]": *ibid*. p. 17.
[63] *Ibid*. pp. 19-20.
[64] For a thorough analysis of this shift, see Schuurman 2004.
[65] Harrison & Laslett 1971, p. 170.
[66] See de Launay 1673, *Extrait du privilege du Roy*, unnumbered page (f. 5r). On de Launay, see Milton 1992 and Lennon 1993 (esp. pp. 66-78).
[67] See Milton 1992, p. 108.
[68] See Harrison & Laslett 1971, pp. 169-170. *Cf*. de Launay 1675 (*Introduction à la philosophie*) and OO I, pp. 1-30 (*De philosophia universe*); de Launay 1667 (*Les Essais Physiques*) and OO I, pp. 135-228 (*Pars Physica*, *Sectio Prima*, Book I: *De universo et mundo, qui complexus est, seu natura rerum*; and Book II: *De loco, et de tempore, seu spatio, et duratione rerum*).
[69] *Cf*. de Launay 1673, pp. 5-10 (*Des noms et des definitions de la Logique*); OO I, pp. 31-34 (*Qui nominetur, definiatur, ac dividatur Logica*).
[70] *Cf*. de Launay 1673, pp. 22-24; OO I, p. 35.
[71] de Launay 1673, p. 11.
[72] "Les quatre operations de l'entendement bien réglees, sont l'objet formel & veritable de la Logique, & la difference essentielle par laquelle nous la distinguerons de toutes les autres parties de la Philosophie": *ibidem*.
[73] "Il y a quatre operations de l'esprit humain, qui lui servent comme des degrez pour monter à la connaissance de toute sorte de veritez. Ces differentes actions de l'ame consistent à concevoir, à juger, à raisonner, & à ordonner. [etc.]": *ibid*. pp. 15-16. *Cf*. OO I, p. 91.
[74] See de Launay 1673, pp. 40-264.
[75] See *ibid*. pp. 17-21.
[76] "La fin prochaine de la Logique, est la rectitude des operations de l'esprit; & la fin derniere est d'éviter l'erreur, & de trouver la verité.": *ibid*. p. 21.
[77] *Ibid*. pp. 14-15, 41.
[78] *Ibid*. p. 42.
[79] *Ibid*. p. 18.
[80] "[…] nous ne pouvons rien concevoir des choses qui sont hors de nous, que par le moyen des idées qui sont en nous, pour servir de copies à representer au dedans les objets exterieurs. […] Ce raisonnement me semble assez convaincant pour condamner l'erreur de ces Philosophes qui croient que nostre ame connoit une infinité de choses sans avoir besoin d'en former les images, comme s'ils soatenoient qu'elle se les representast, sans en former la representation ou l'idée. Je ne sçay pas comment les Cartesiens se peuvent tirer de ce labirinthe, quand ils soustiennent que l'esprit connoist les choses spirituelles sans en former aucun fantôme.": *ibid*. pp. 44-45.
[81] "La quatriéme Maxime qui est très importante, parce qu'elle est contestée par les Cartesiens, consiste à tenir pour asseuré, que tant que l'ame est unie au corps, elle ne connoist aucune chose que par le ministere des sens externes & internes. Ce sont comme les portes de l'ame [etc.]": *ibid*. p. 48.
[82] Harrison & Laslett 1971, p. 140.
[83] *Ibid*. p. 84.
[84] Milton 2000, pp. 98-102.
[85] Harrison & Laslett 1971, p. 75.
[86] *Ibid*. p. 170.
[87] *Ibid*. p. 101.
[88] See e.g. Milton 2018, p. 20.
[89] Draft A, § 1 (Locke 1990, p. 1).
[90] *Ibidem*.
[91] *Ibid*. § 5 (p. 15).
[92] *Ibid*. p. 6. On the formation of abstract and general ideas, see also *ibid*. § 3 (pp. 11-12).
[93] *Ibid*. pp. 6-7.
[94] *Cf*. OO III, p. 320b.
[95] *Ibid*. pp. 320a-321a.
[96] Draft A, § 2 (Locke 1990, p. 8). See also *ibid*. § 27 (p. 42), and § 43 (pp. 74-75).
[97] OO I, p. 93a; *ibid*. III, pp.
[98] Draft A, § 5 (Locke 1990, p. 15). *Cf*. OO III, p. 332b.
[99] Draft A, § 7 (Locke 1990, p. 16).
[100] See *ibid*. §§ 5-7 (pp. 15-18).

[101] See *ibid*. § 8 (pp. 18-20).
[102] *Ibid.* § 9 (p. 20).
[103] *Ibid.* § 27 (p. 42).
[104] *Ibidem*.
[105] *Ibidem*.
[106] *Ibid.* § 32 (p. 61).
[107] Locke 1990, pp. 85-270.
[108] Draft B, § 3 (p. 103). See *Essay* I, i, 8 (Locke 1975, p. 47).
[109] AT III, pp. 392-393; *ibid*. VII, pp. 160-161.
[110] Draft B, § 2 (p. 102). See *Essay* I, i, 2 (Locke 1975, p. 43).
[111] See e.g. AT VII, p. 27.
[112] "verum ii non persuadebuntur, qui non capient quo modo possis aut per soporem lethargicum, aut in utero etiam, cogitare. […] Insinuo duntaxat, ut memineris, quam obscura, quam tenuis, quam pene nulla esse potuerit temporibus illis tua cogitatio.": OO III, p. 298a (=AT VII, p. 264).
[113] *Essay* II, i, 10 (Locke 1975, pp. 108-109).
[114] *Ibid.* II, i, 11-21 (Locke 1975, pp. 109-117).
[115] *Ibid.* II, i, 21 (Locke 1975, p. 117).
[116] Milton 2000, pp. 91-92. See *infra* p. 52.
[117] On Gassendi's impact on Leibniz, see e.g. Moll 1997, Fichant 1997, and Robinet 1997.
[118] Leibniz 1996, p. 70. See *infra* p. 52.
[119] *Ibidem*.
[120] *Ibidem*.
[121] See e.g. Anstey 2011. For a larger picture, see Clericuzio 2018 and Id. 2023.
[122] Wright 1991. For Locke's transcription of these lectures, see Dewhurst 1980.