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Article

The Archimedean Revolution of Nicolaus Copernicus

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Abstract:
The year 2023 marks the 550th anniversary of the birth of the Polish scholar Nicolaus Copernicus. Usually deemed one of the most emblematic examples of the *scientific revolution* and the theory of paradigm shift in the history of science, the heliocentric theory proposed by Copernicus in 1543 has fed the minds of philosophers and historians for centuries. Recently, increasing attention has been put on the recognition of the sources that might have influenced Copernicus's creativity. The outcomes showed that the claims on paradigm shift are pretty shaky, because Copernicus was deliberately in dialogue with Ancient Greek and Arabic authors, and his *On the Revolutions of the Celestial Spheres* deliberately emulates Ptolemy's *Almagest*. In this sense, the essence of the scientific revolution is more an attempt to recreate the debate with ancient authors then a breaking with their paradigms. This study takes a closer examination of Copernicus's early draft on heliocentrism, the *Commentariolus* (1510-1515 ca.) and it argues that the birth of the heliocentric theory was first conceived as an attempt to write an Archimedes-like treatise, while the efforts to emulate Ptolemy come at a later stage. On this account, the early Copernicus can be considered an Archimedean. This calls for further historiographical reflections on the scientific revolution.

Keywords: Copernicus; *Commentariolus*; *On the Revolutions of the Celestial Spheres*; Archimedes; Scientific Revolution

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For Nicolaus Copernicus's 550th birthday anniversary

Introduction

Marking the 550th anniversary of the birth of the Polish scholar Nicolaus Copernicus, the year 2023 calls for further study of Copernicus's work. This paper takes the opportunity to pay homage to this immense figure by proposing a new interpretation of how to read the birth of the heliocentric theory.

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It is well established that Copernicus's major work, *On the Revolutions of the Celestial Spheres* (henceforth *De Rev*) shows that Copernicus strives to emulate his main model, i.e., Ptolemy's *Almagest* (most recently: Netz 2022a; Netz 2022b; Ragep 2022). In the *vulgata*, the proposal of the heliocentric theory corresponds with the publication of *De Rev*, in 1543, but a closer look at Copernicus's production reveals a more sophisticated scenario, which is worth exploring further. In fact, if the heliocentric theory proposed by Copernicus is unanimously considered a major breakthrough in the history of science and, more generally, culture, still the nature and the process that triggered the creativity of Copernicus has been puzzling scholars for ages and continues to do so (most recently, among others: Goldstein 2002; Goddu 2010; Westman 2011; Omodeo 2014; Vesel 2014, Gingerich 2016).

Copernicus's *De Rev* undoubtedly marked a momentous change in the history of science and culture such that Copernicus is usually mentioned as one of the main figures of what is commonly known in historiography as *scientific revolution*. Notably, philosophers Alexandre Koyré and Thomas Kuhn deemed him a watershed figure between the science of the ancients and modern science, the first who broke from the medieval Aristotelian-Ptolemaic paradigm about the cosmos (Koyré 1957; Kuhn 1962). But the birth of Copernican theory is not just a punctuation in a page of history, because it is a process of creativity, which started way before 1543, and which is attested by an unpublished text, authored by Copernicus himself, circulating before the publication of *De Rev*, the so-called *Commentariolus*, that is "brief draft" (ca. 1510-15). Moreover, given the link between Copernicus and the historiography of science, recent reflections on the scientific revolution deserve attention. For instance, Reviel Netz (2022a; 2022b) has convincingly argued that Copernicus's production is to be understood as the outcome of a sixteenth-century scholar in dialogue with the ancients, and his novelty should be reconsidered in light of this stylistic fact. It is known that *De Rev* was written on the genre-model of Ptolemy's *Almagest* and benefitted from astronomical models proposed by Islamic astronomers (whether or not it was an "independent" discovery—a still open debate—this question is beyond the scope of the present article). At any rate, *De Rev* is not the point where the Copernican heliocentrism begins. Therefore, what is the stylistic model, if any, for the first Copernican draft of the heliocentric theory? This article will give an answer to this, as yet unanswered question.

Moreover, Netz (2002b) has convincingly argued that Archimedes and his rediscovery in fifteenth- and sixteenth-century Italy were essential in paving the way to the scientific revolution, and that the latter is essentially a recreation of the dialogue with ancient Greek mathematicians and their debates on scientific and philosophical matters.

This article argues that it is reasonable to read Copernicus's first formulation of the heliocentric theory as an attempt to reproduce an Archimedean treatise: Copernicus can be considered in dialogue with the ancients on astronomical matters even before the publication of *De Rev*. Although there is no evidence of Copernicus reading the works of Archimedes, the genre of the *Commentariolus* shows that his creation was well due to an attempt to write an Archimedean-style treatise on mathematical sciences. Therefore, it is expedient to see the rediscovery of Archimedean works as the ideal intellectual environment for the creativity of the early Copernicus and for the search of a model to emulate during the writing process of the first draft on heliocentrism.

A Link between Copernicus and Archimedes: Preliminary Working Questions

The inspiration for this study on Copernicus is due to a reading of a provocative essay on Archimedes and his place in world history, authored by Reviel Netz. It is worth quoting one of Netz's passages:

> What needs to be stressed for Copernicus himself is, first, that he spent the great bulk of his creative energies on studying and emulating Ptolemy; second, that his own understanding of his heliocentrism was not as the casting out of antiquity in favour of modernity but, rather, as the revival of an ancient debate; and, finally, that he was right. By saying that he was right, I do not mean the fact that there were indeed a few heliocentric authors in antiquity, which is largely besides the point. I mean that Copernicus sensed, correctly, that by presenting his own astronomy as a superior alternative to past astronomies, he was reviving, rather than abandoning, the agonistic practices of ancient science. This is why it is important to note that Koyré and Kuhn were wrong to think of the Aristotelian paradigm as ancient; and why it is important to note that Copernicus was a man of the renaissance. (Netz 2022b, 318)

It is well established that Copernicus presents his dialogue with past masters of astronomy in *De Rev*, and I agree with seeing Copernicus as reviving the agonistic practice of ancient science. Such an agonism is carried out by choosing models and writing treatises in order to emulate them. Copernicus did this for *De Rev*, which is a long mathematical-astronomical treatise shaped along the structure and the geometrical models of Ptolemy's *Almagest* and the innovative models of Islamic astronomers (among others, Ragep 2007; 2010; 2022). Furthermore, the agonistic spirit was played through erudition, which was not an autoreferential attitude but a fruitful way of communication between Renaissance peers, pursued in order to demonstrate their scholarly talents in sixteenth-century Europe (Omodeo 2014). As Netz points out, "It is not a joke to observe that Copernicus could have been remembered as no more than the translator of Theophylact. The fact that he cared about that is indeed telling for the actual culture – and suggestive for the potential alternatives" (Netz 2022b, 324).

In this state of the art, it is worth asking what is the stylistic model for Copernicus when writing the *Commentariolus*? Could he refer to an Archimedean model, although he does not mention him explicitly? To whom else? Given the relevance of *Commentariolus* to the birth of the heliocentric theory, thus the scientific revolution, these are important questions. Recently, Netz (2022a; 2022b) has shaped a new view of Copernicus in the historiography of the scientific revolution: it starts by singling out the relevance of Archimedes's work as outstanding for the history of mathematical sciences and global history more generally. According to Netz, Ptolemy represents the culmination of the achievement of the generation of Archimedes. Later on, figures within the European Renaissance, thanks to the spreading of scientific works through print as well as the manuscripts coming from Byzantium, re-read Archimedes and continued a tradition based on debates, agonism, and non-conformism with the authorities of the Middle Ages. In this sense, the revolution of Copernicus is a re-creation of that agonistic spirit, the outcome of a combination of the Islamic criticism of Ptolemy's mathematics and the rediscovery of the *Almagest* in Europe. For Copernicus, to be modern means to become ancient. Therefore, can Copernicus be considered, in this intellectual framework, an Archimedean?

Let us take a closer look at the *Commentariolus*.

Copernicus's *Commentariolus*: A Brief Overview

The first written occurrence of the Copernican heliocentric theory is provided in a brief treatise entitled *Draft on the hypothesis on celestial motions established by Nicolaus Copernicus* [*Nicolai Copernici De Hypothesibus Motuum Caelestium A Se Constitutis Commentariolus*], better known as *Commentariolus*, likely composed between 1510 and 1515 (Swerdlow 1973; Rosen 1971; Folkerts, Kirschner and Kühne 2019). The *Commentariolus* has attracted the attention of twentieth-century historians of astronomy. But its relevance to astronomical inquiry was recognized immediately after Copernicus's death. In fact, among others, Joachim

Rheticus, Duncan Liddel, and Tycho Brahe had in their hands a copy of the *Commentariolus* (Dobrzycki and Szczucki 1989). Particularly noteworthy is the Aberdeen edition, because it contains the pages of *Commentariolus* and *De revolutionibus* in parallel, according to the criterion of affinity of the proposed theme, demonstrating that the generation immediately following Copernicus considered the two works as complementary and not mutually excluding (Dobrzycki 1973).

The *Commentariolus* is the first witness to Copernicus's dialogue with ancient scholars dealing with astronomy. It begins indeed by recalling past masters of astronomical science and their theories. Let us read the Copernican text in the following.

> I understand that our predecessors assumed a large number of celestial spheres principally in order to account for the apparent motion of the planets through uniform motion, for it seemed highly unreasonable that a heavenly body should not always move uniformly in a perfectly circular figure. They had discovered that by the arrangement and combination of uniform motions in different ways, it could be brought about that any body would appear to move to any position.
>
> Calippus and Eudoxus, attempting to carry this out by means of concentric circles, could not by the use of these give an account of everything in the planetary motion, that is, not only those motions that appear in connection with the revolutions of the planets, but also that the planets appear to us at times to ascend and at times to descend in altitude, which concentric circles in no way permit. And for this reason, a preferable theory, in which the majority of experts finally concurred, seemed to be that it is done by means of eccentrics and epicycles.
>
> Nevertheless, the theories concerning these matters that have been put forth far and wide by Ptolemy and most others, although they correspond numerically [with the apparent motions], also seemed quite doubtful, for these theories were inadequate unless they also envisioned certain *equant* circles, on account of which it appeared that the planet never moves with uniform velocity either in its *deferent* sphere or with respect to its proper center. Therefore, a theory of this kind seemed neither perfect enough nor sufficiently in accordance with reason. (Translation Swerdlow 1973, 433–434)

It is straightforward to see Copernicus's will to dialogue with the ancient masters. Moreover, the heliocentric theory is introduced through a list of seven axioms. Let us read them in full.

> Therefore, when I noticed these [difficulties], I often pondered whether perhaps a more reasonable model composed of circles could be found from which every apparent irregularity would follow while everything in itself moved uniformly, just as the principle of perfect motion requires. After I had attacked this exceedingly difficult and nearly insoluble problem, it at last occurred to me how it could be done with fewer and far more suitable devices than had formerly been put forth if some postulates, called axioms, are granted to us, which follow in this order:
>
> First Postulate – There is no one center of all the celestial spheres (*orbium*) or spheres (*sphaerarum*).
>
> Second Postulate – The center of the earth is not the center of the universe, but only the center towards which heavy things move and the center of the lunar sphere.
>
> Third Postulate – All spheres surround the sun as though it were in the middle of all of them, and therefore the center of the universe is near the sun.

> Fourth Postulate – The ratio of the distance between the sun and earth to the height of the sphere of the fixed stars is so much smaller than the ratio of the semidiameter of the earth to the distance of the sun that the distance between the sun and earth is imperceptible compared to the great height of the sphere of the fixed stars.
>
> Fifth Postulate – Whatever motion appears in the sphere of the fixed stars belongs not to it but to the earth. Thus, the entire earth along with the nearby elements rotates with a daily motion on its fixed poles while the sphere of the fixed stars remains immovable and the outermost heaven.
>
> Sixth Postulate – Whatever motions appear to us to belong to the sun are not due to [motion] of the sun but [to the motion] of the earth and our sphere with which we revolve around the sun just as any other planet. And thus, the earth is carried by more than one motion.
>
> Seventh Postulate – The retrograde and direct motion that appears in the planets belongs not to them but to the [motion] of the earth. Thus, the motion of the earth by itself accounts for a considerable number of apparently irregular motions in the heavens. (Translation Swerdlow 1973, 435–436)

Concerning these axioms, the eminent historian of science Noel Swerdlow argued that they are "incorrectly called axioms since they are hardly self-evident, take the place of the general description of the universe in the opening chapters of the *Almagest*, the *Epitome*, and later, *De revolutionibus*. [...] There is no reason to doubt that he also believes these postulates to be true" (Swerdlow 1973, 437). Against Swerdlow, scholars agreed that Copernicus was not referring to axioms as self-evident truths (Goddu 2010; Bardi 2023). Moreover, the notion of self-evidence is not the only feature that mathematicians attach to axioms, which are indeed more versatile and can be employed in many ways in mathematical practice (Schlimm 2013; Bardi 2023). To be sure, Copernicus considered his assumptions to be true, because he was certainly not an "instrumentalist". However, to interpret the Copernican assumptions as attached to the notion of self-evidence is a choice which refers to a notion of mathematical principles which distinguishes postulates and axioms. Such a distinction originated in the debates on Euclid's *Elements* (De Risi 2016). So, if Copernicus was not referring to that debate, where did he find the term "axioms" (*axiomata*) in the literature he had at his disposal? What sources could have influenced him?

Let us recall Copernicus's words:

> [...] it at last occurred to me how it could be done with fewer and far more suitable devices than had formerly been put forth if *some postulates, called axioms*, are granted to us, which follow in this order. (Swerdlow 1973, 435, emphasis added)

The original Latin text reads *petitiones quas axiomata vocant*, where *petitio* conveys a variety of meanings: requirement, statement, assumption, axiom, postulate.

Swerdlow was undoubtedly referring to a precisely connotated meaning of axioms and postulates, where axiom is exclusively connected to *self-evidence*. This distinction is not modern; it traces back to the debates on Euclid's *Elements*, more precisely to the Greek philosopher Geminus (first century BCE), as attested in Proclus's *Commentary on the First Book of Euclid's Elements*. According to Geminus-Proclus, the postulates of Euclid's *Elements* can be divided into two groups, reflecting their different nature: constructions are required in postulates 1–3, while postulates 4–5 state properties of particular geometric objects. As for the axioms (or common notions), they were generally conceived as assumptions conveying self-evident truths, hence requiring no proofs. Yet, not every author of mathematics assumed principles in the same manner as Euclid did. For example, Archimedes used axioms as true statements to describe the physical world, e.g., Archimedes's *On the Sphere and the Cylinder* opens with axioms (Netz 2004, 34–36). More below.

Edward Rosen pointed out, with the right reasons, that Copernicus was not taking part in any Hilbertian program (Rosen 1976). Later on, André Goddu (2010) undertook detailed research on the making of Copernican cosmology and his possible sources, detected his logical and philosophical backgrounds, and surmised a plausible method of reasoning in a Socratic-dialectic process (as detectable in Plato's *Parmenides*) used by Copernicus in setting out his axioms. Goddu claimed that axioms are to be intended in the sense of common notions, assumptions to be taken for granted, where no self-evidence is needed (Goddu 2010, 243).

At any rate, there is no occurrence of the word *petitio* as a synonym for *axioma* in the Euclidean tradition (De Risi 2016). It is therefore likely that Copernicus knew that axioms were known and evident to everybody, which could explain why he names his principles such. Second, the word *axioma* in Latin was extremely rare around 1515, when Copernicus composed the *Commentariolus*. Indeed, the only occurrence is in Giorgio Valla's *De expetendis et fugiendis rebus* (Valla 1501, Book 10, ch. 110, fol. oiii verso), an encyclopedic work of sciences and arts.[2] Valla was a humanist who was keen on transliterating Greek words into the Latin alphabet (De Risi 2016, 643; Goddu 2010, 229–236).

In sum, it is safe and historically accurate to read Copernicus's assumptions as axioms, and it is noteworthy that Archimedes is among the possible models Copernicus could be referring to in the way in which he is using his axioms. Given Archimedes as a possible model, a closer look at sources will make the scenario clear (next section).

After the exposition of the axioms, further chapters from the *Commentariolus* deal with the other topics in the following order: the arrangement of the heavenly spheres; the motions of the earth (i.e., the motions apparently attributed to the sun); the convenience in assuming the uniformity of motions from the fixed stars rather than from the equinoxes; the motions of the moon and the five planets of ancient astronomy, i.e., Saturn, Jupiter, Mars, Venus, and Mercury. By Copernicus's will, lemmas, theorems, proofs and diagrams are absent. All of them were destined, again according to the author's explicit statement, for a more extensive work, namely *De Rev*.

> Now that these postulates have been set down, I shall attempt briefly to show how carefully the uniformity of the motions may be preserved. I have decided, however, for the sake of brevity to leave the mathematical demonstrations out of this treatise as they are intended for a larger book. Nevertheless, the lengths of the semidiameters of the spheres will be set down here in the explanation of their circles, from which anyone not ignorant of mathematics will easily understand how very precisely such an arrangement of circles agrees with computations and observations.
>
> In the same way, in case anyone believes that we have asserted the movement of the earth for no good reason along with the Pythagoreans, he will also receive considerable evidence [for this] in the explanation of the circles. And in fact, [the evidence] by which natural philosophers attempt so very hard to confirm the immobility of the earth depends for the most part upon appearances. All [their evidence] falls apart here in the first place since we overthrow the immobility of the earth also by means of an appearance. (Translation Swerdlow 1973, 438–439)

[2] I wish to thank André Goddu for helping me consult this source and locate the page in the rare book.

Looking for a Stylistic Model for the *Commentariolus*

Undoubtedly, Copernicus treats the ancient astronomers as his contemporaries and aims at debating with them. This is clear from the brief introduction we read in the previous section and from the way he uses axioms. The axiomatic approach is indeed fundamental in our attempt to look for a stylistic model which Copernicus could refer to or emulate. Actually, he could well refer to the Greek tradition of mathematical sciences, which was keen on using such an axiomatic approach. For instance, several Greek works of mathematical sciences often adopted six or seven unproved assumptions to open treatises, for instance Archimedes's *On the Equilibrium of Planes* (Heath 2002, 189–190). It is likely that Copernicus arranged his treatises on seven principles in order to refer to that tradition, which could well have served as a model for him. Archimedes's *On the Equilibrium of Planes* was circulating in Italy thanks to the Latin translation of William of Moerbecke, and that work opens with the word *petimus* (the verb linked to *petitio*, meaning "we require," "we state some principles"), which is followed by exactly seven principles (Clagett 1976, 116). Moreover, *Elementa Jordani* (*Elements of mechanics* by Jordan of Nemore) provides seven initial unproved assumptions (Clagett and Moody 1952, 154–155).

Goddu (2010) argued that the axioms are likely the outcome of a process of Socratic questioning, indebted to Plato's *Parmenides*. However, there are five opening questions in Scholastic style in Blasius of Parma's (14^{th} c.) *Questiones super tractatum de ponderibus* (Clagett and Moody 1952, 232), therefore Copernicus, being educated in Italy, could have structured his treatise in a similar manner. Instead, he chose to put axioms directly in the form of statements. Since Copernicus chose to put his assumption in declarative mode, he is more Archimedean than Scholastic in his style. However, he would have been fully Archimedean had he provided proofs in the chapter following the assumptions.

Notably, the only surviving work by Aristarchus of Samos, *On Sizez and Distances*, opens with six axioms. Let us read them in full.

> 1. That the Moon receives its light from the sun.
>
> 2. That the earth is in the relation of a point and center to the sphere in which the moon moves.
>
> 3. That, when the moon appears to us halved, the great circle which divides the dark and the bright portion of the moon is in the direction of our eye.
>
> 4. That, when the moon appears to us halved, its distance from the sun is then less than a quadrant by one-thirtieth of a quadrant.
>
> 5. That the breadth of the (earth's) shadow is (that) of two moons.
>
> 6. That the moon subtends one-fifteenth part of a sign of the zodiac.
>
> (Translation Heath 1913, 353)

Aristarchus's theory was criticized in Archimedes's *The Sand-Reckoner* (ca. 216 BCE) for having set up mathematically impossible proportions, but Aristarchus was the first astronomer who demonstrated that a sound astronomical theory could be established out of a few observational data combined with purely mathematical arguments, thus putting the emphasis on mathematical structure rather than empirical numerical data (Neugebauer 1975, 634–642). In other words, Aristarchus provided rigorous and logical geometrical proofs in a similar fashion to Euclid and Archimedes. *On Sizes and Distances* marks the first attempt to determine astronomical distances and dimensions by mathematical deductions based on a set of assumptions.[3]

That Copernicus adopted an Archimedean model to propose once again a heliocentric theory, which Archimedes had criticized as mathematically unsustainable, would be fascinating, but unfortunately, it is just speculative, for it is unprovable by the sources at our disposal. Copernicus did not read the *Sand-Reckoner*, but mentioned Aristarchus in a passage of a draft of *De Rev*. However, that passage was not included in the final publication (Goldstein 2002, 232). However, a scholar like Copernicus would have certainly been perfectly at ease with such erudite references, and these were the kind of stylistic traits that he and his peers were using when confronting their ancient predecessors in their writings.

At any rate, Archimedes was one of the authors who sparked enthusiasm among those Europeans rediscovering Greek scientific works. One of the first written evidences of this process is in fifteenth-century astronomer Regiomontanus's lecture at Padua University in 1464 (Regiomontanus 1537), (Schmeidler 1972, 43-53), (Swerdlow 1993), (Byrne 2006), (Malpangotto 2008, 133-46), (Goulding 2010, 8-10), (Omodeo 2021). On that occasion, Regiomontanus spoke highly of the Syracusan scholar: "The discoveries of Archimedes will produce no less admiration than joyfulness to us readers as to future human beings even after thousand generations" (Malpangotto 2008, 142, my translation).[4]

Triggered by the smart rhetorical skills of Petrarch,[5] the rediscovery of Archimedes was indeed one of the main features of humanism and its success in the generations preceding and following Copernicus (Høyrup 1992, 1996, and 2017). Just to mention a few facts of Archimedes's rediscovery in the lifetime of Copernicus, William of Moerbecke's and Jacopo da San Cassiano Cremonensis's translation of Archimedean works were circulating in sixteenth-century Italy (D'Alessandro and Napolitani 2012) and Girolamo Cardano in 1535 praised Archimedes as a man of highest genius in his *Encomium geometriae* at the Academia Platina in Milan (Høyrup 2017, 14). Moreover, the first printed edition of Archimedes's works was printed in Basel in 1544, just one year after *De Revolutionibus* (Venatorius 1544), and not to mention those most influential Italian Archimedean scholars like Francesco Maurolico, Guidobaldo del Monte, Federico Commandino and Bernardino Baldi (Høyrup 2017). Giorgio Valla himself is among those who acquired the manuscript used by Moerbecke and he not accidentally mentions Archimedes (mathematics or life episodes) in *De expetendis* (Høyrup 2017, 11). During his sojourn in Italy, Copernicus might well have encountered Archimedes by reading Valla.

Conclusion

Usually deemed one of the most emblematic examples of the *scientific revolution* and the theory of paradigm shift in the history of science, the heliocentric theory proposed by Nicolaus Copernicus in 1543 has fed the minds of philosophers and historians for decades. Recently, greater attention has been put on the recognition of the sources that might have influenced Copernicus's creativity. The outcomes showed that the claims on paradigm shift and similar are pretty shaky, because Copernicus was deliberately in dialogue with Ancient

[3] The question of why heliocentrism was not further developed among the Greeks is still open. It is likely that a mathematics adequate for sustaining heliocentrism as a physical hypothesis was not developed at that time. First, heliocentrism was undoubtedly developed before the geometrical models, proofs, and calculations of Apollonius of Perga, Hipparchus, and Ptolemy, whose works were all based upon a geocentric orientation. Second, Aristotle's doctrine of natural places held its influence for long time, making the central position of the Earth in the universe harder to confute.

[4] *Inventa Archimedis post mille secula venturis hominibus non minorem inducent admirationem quam legentibus nobis iucunditatem* (Malpangotto 2008, 142).

[5] Petrarch wrote short biographies of Archimedes (Quoted in Clagett 1978, 1336-1341).

Greek (and Arabic) authors, and his *On the Revolutions of the Celestial Spheres* emulates Ptolemy's *Almagest*. In this sense, the essence of the scientific revolution is more an attempt to recreate the debate with ancient authors than breaking with their paradigms. This study has contributed to this scholarship by taking a closer examination of Copernicus's *Commentariolus* and has reached several conclusions. First, the birth of the heliocentric theory was first conceived as an attempt to write an Archimedes-like treatise, and the struggle to emulate Ptolemy and integrate the innovations of the Arabs comes at a later stage. Second, the style of the *Commentariolus* is Archimedean because the way in which Copernicus takes his axioms (as true statements to describe the physical world) and deals with astronomy in brief chapters resembles Archimedean treatises on mathematical sciences circulating through Latin translation in sixteenth-century Italy, where Copernicus had his education. Third, if we want to take a broad historiographical picture following Netz (2022a; 2022b), Ptolemy is the culmination of the achievements of the generation of Archimedes in Greek mathematical sciences, Copernicus is the one who managed to re-read Ptolemy and reform it through Ptolemy's own devices. Therefore, in a framework of intellectual history, the Copernican heliocentric theory, in its first conception, is Archimedean. In this sense, against previous theses that take Copernicus's work as a reaction to an astrological crisis (Westman), pure rediscovery of the Greeks (Koyré, Popper), paradigm shift (Kuhn), or a culmination of Islamic astronomy (Ragep), the first occurrence of the Copernican theory might be better understood as an attempt to write an Archimedes-like treatise. Copernicus's process of creativity can be seen as an attempt to emulate Archimedes, which evolves into an emulation of Ptolemy, integrating the *Almagest* with the innovations of the Arabs. In this sense, the Copernican revolution is Archimedean.

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