

The Making of Copernican Cosmology:

Mathematical Practices and Political Economy in Comparative Perspective

This workshop takes Copernicus's synthesis of cosmological, practical-mathematical, economic and medical interests as an occasion to reflect on the social settings of mathematical and economic practices in the Middle Ages and Early Modernity, and their cross-cultural transfer. Copernicus was not only the author of the most relevant astronomical works of the Renaissance (*De revolutionibus* 1543), but also wrote and worked on practical fields ranging from monetary policy to land surveying and medicine. This prism of interests, far from being a unique case, continued and transformed well established scientific practices.

The meeting will bring together the competences of various scholars on medieval and early modern science who will explore more in detail the economic and cultural dimensions of the mathematical practices of the past. We will particularly delve into several cases that indicate a wide range of examples of possible practices: 1) the geometrical tools that were deployed for the modeling of the cosmos and the practical goals of the related mathematical practices; 2) the political use of mathematics for the state in fields such as economy, calendar making and public health; 3) surveying of land and resources. By investigating the shared and differing approaches to the epistemic position of mathematical practices, we hope to motivate further research into how social frameworks affect reshaping of cosmological views.

Organizers:

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Titles and Abstracts

(in order of presentation)

Petitiones quas axiomata vocant: A Note on Copernicus' Epistemology of Mathematics

Alberto Bardi (Tsinghua University, Beijing)

Seven unproved assumptions are provided in the introduction of the brief Copernican treatise entitled *Nicolaus Copernicus' draft on the models of celestial motions established by himself*, better known as *Commentariolus* (ca. 1515). Briefly, they deal with the renowned Copernican hypothesis of considering the Earth in motion and the Sun, not affected by motion, near the center of the universe. Although Copernicus has decided to omit the proofs for the sake of brevity (proofs will appear later in *De Revolutionibus*), the deductions in the *Commentariolus* are supposed to be drawn from the initial seven assumptions. Copernicus refers to them with the Latin word *petitiones* and apparently understand them as an equivalent of *axiomata* (axioms) (Lat. [...] *petitiones quas axiomata vocant*). The nature and the logic of those assumptions have triggered debates among scholars. Notably, Swerdlow claimed that Copernicus has called them incorrectly as axioms and has made more assumptions than were necessary, pointing out problems of internal logic and axiomatic rigor. Rosen, in reply to Swerdlow's interpretation, defended Copernicus' choices and charged Swerdlow of anachronism. Later on, Goddu, Vesel, Lerner, Segonds, and others provided further interpretations of Copernicus' assumptions. This paper examines Copernicus' seven assumptions and provides a new interpretation.

The Relations between Oresme's Astronomy and his Monetary Theory

Philippe Debroise (Université Paris Diderot, Paris)
Murtaza Chopra (Hebrew University)

For the historian Jacques Le Goff, the creation of European universities launched the existence of a new character, the «intellectual». Mixing scientific achievements and political engagement, Nicole Oresme would surely be a good example of this novelty. On one side, he made himself famous until today for his geometrization of natural motion and any intensive phenomena, his doctrine of ratios of ratios anticipating logarithms, his strong argumentation in favor of the hypothesis of a diurnal terrestrial motion. On the other side, he wrote a celebrated treaty on money in the middle of the Parisian turmoil during the 1350s to defend stability of currency, and actively participated to a campaign of translation of Aristotelian treatises at the request of the King, and commented extensively the *Politics* of Aristotle. But can we establish a relation between those two kinds of activities, theoretical and political, contemplative and active?

We will argue that indeed one cannot be well understood without the other. Our talk will be divided in two main parts, one theoretical, the other historical. We will argue that Oresme's scientific and political views are motivated by a same concern, the clearness of judgment in a world essentially made of variations.

Citing Copernicus in early modern works with astrological content: Catholic cases

Tayra Lanuza-Navarro (Università Ca' Foscari, Venice)

Abstract: TBA

Natural Philosophy and Astronomy in the Arabic Tradition and Copernicus

Paul Hullmeine (BadW, Munich)

Ptolemy starts his *Almagest* with the well-known epistemic distinction between mathematics and natural philosophy. While the mathematical sciences including astronomy offer certain knowledge and decisive proofs, physics provides us only with conjectural knowledge because it deals with ever-changing objects and qualities. This concept is crucial in order to understand both of Ptolemy's most cosmological treatises, namely the *Almagest* as well as the *Planetary Hypotheses*, because it enables Ptolemy to arrive at a cosmological system that is in his view 'most probable', although not all aspects of it can be demonstrated solely by mathematics. After a summary of important examples from Ptolemy's works, this talk will investigate how this epistemic relation was debated from Ptolemy up to the Copernican tradition. For example, we see an awareness of the conjectural status of some of Ptolemy's own doctrines already in Late Antiquity, most notably Proclus. In a next step, the talk will briefly summarize different positions on the relation between Ptolemaic astronomy and physics in the medieval Arabic tradition, before it proceeds with the reception of Copernicus' claim on heliocentrism. In this way, the presentation will compare the arguments on the physical status of astronomical hypotheses both in the context of Ptolemaic as well as Copernican astronomy.

Pre-Copernican Islamic and Latin Approaches to the Immobility of the Earth: Connections and Controversies

Razieh S. Mousavi (MPIWG, Berlin)

Most studies on the question of the stillness of the Earth at the center of the universe in pre-modern astronomy have focused on philosophical and theological foundations of negation arguments without attempting to provide a coherent history of formation and development of these debates. The present paper reviews a series of intellectual and public accounts of the stationary Earth in pre-modern Islamic and Latin traditions and shows how the synthesis of cultural and experimental elements shaped the discussions and attitudes toward immobility of the Earth from a cosmological perspective.

The Politics of Invariance in the mathematics of Copernicus

Pietro D. Omodeo (Università Ca' Foscari, Venice)

Senthil Babu (French Institute of Pondicherry)

Nicolaus Copernicus has often been taken as a model of purely speculative science, sometimes in connection with theological and Platonic views on harmony and cosmological perfection. A. Koyré and T. Kuhn emphasized the significance of the 'Copernican Revolution' as a revolution of thought, even a *spiritual* one. In this essay, we take a different stance and argue for the practical and political relevance of Copernicus's science. We do this by closely looking at the practical sources of his scientific endeavor and his economical thought, and show how the latter reverberates throughout his approach, including mathematical astronomy. We begin with a reassessment of the practical dimension of his astronomical research in connection with the problem of the calendar reform. Although this theme has already been addressed in the secondary literature, we think that this has been done in an unsatisfactory manner, as we ought to move beyond its typically biographical treatment and the anecdotic understanding of this issue. We claim that problems of practice did not only constitute an extrinsic motivation to Copernicus's astronomy but determined his research agenda, the main astronomical problems to be dealt with, and the manner his work was presented (including his heliocentric theory), notably by his pupil, G.J. Rheticus. We then engage with an analysis of Copernicus's writings on money. In them, he addressed crucial problems, such as the function of monetary standards and inflation, with the eye of an administrator and politician who was concerned about the societal tensions of the time. We briefly consider the broad historical context which connects Copernicus's Prussia and Poland to the rise of Capitalist economic relations in connection with paramount changes in European and global society. They ranged from Iberian colonialism to the introduction of massive quantities of gold and precious resources from the Americas, the disruption of the lives of the weaker classes as well as widespread and organized peasant revolts. We further argue that the political epistemology underlying Copernicus's economic treatises was physico-mathematical in the early-modern sense of both terms, because it aimed to determine the so-called *propter quid*, that is, the *causes* and *effects* of the *quia*, that is, mathematically quantifiable (economic) phenomena. But it was also a medical epistemology. In line with his education and practice as a physician, Copernicus inferred the causes (ultimately, a wrong monetary politics) of societal unbalances from 'symptoms' of disorder (e.g., the mounting prices of bread) in order to prescribe a *political* cure (the necessity of monetary standards that make transactions speculations impossible). We conclude with a general consideration of the practical and political import of mathematical abstraction in Copernicus's work in general.

Copernicus's *Monetae cudendae Ratio* and the Scholarly State-of-the-Art

Jonathan Regier (Università Ca' Foscari, Venice)

The purpose of this talk is to examine Copernicus's *Monetae cudendae ratio* according to the most recent scholarship on the history of medieval and early modern coinage practices. I would then like to connect these observations to questions of economic and

political agency, that is, I would like to ask what debasement practices and corrective prescriptions tell us about how elites saw the limits and capacities of their power.

The understanding of matter in Copernicus' reports on coinage in the context of his time

Helge Wendt (MPIWG, Berlin)

Is gold identical to gold, silver identical to silver, and copper identical to copper? From the perspective of material history, this assumption must be negated. However, in Copernicus' reports on the coinage of 1517 and 1522, one can get the impression of an uncritical assessment of these materials. The presentation proposes to approach Copernicus' understanding of the purity and mixture of metals for minting by comparing the forms other authors presented these materials. This comparison is also intended to contribute to addressing the complexity of practical knowledge in the early modern period

Copernican Cosmology and the Expanding Empire of Late-Medieval Measurement

Michael Shank (University of Wisconsin-Madison)

This paper adopts a synthetic approach to frame Copernicus's work in terms of a late-medieval interest in measurement, understood generically. Stimulated by 12th-century translations from the Arabic, these developments were already evident in the 13th-century excitement about the mathematical sciences. In the 14th- and 15th-century universities, however, the concern for measurement took over new approaches to old problems (e.g., the quantification of medicinal qualities is generalized to quantitative considerations in natural philosophy such as the latitude of forms and the science of motion, among others).

Key elements in this trend toward quantification shaped the curricula in which Copernicus's predecessors and contemporaries were trained and spilled out beyond the universities. These developments appear in the "mechanical quantification" of astronomical clocks, the growing emphasis on data (including observations, weather reports, and complaints about inaccuracies in tables and uncertainties in basic parameters). In areas that overlap with Copernicus's work, they surface in the rebirth of mathematical geography and the mapping of new regions, disputes about the size and speed of the cosmos, reforms of the calendar, and coinage. In the aggregate, the density of these efforts to measure and their range constitute a distinctive slice of late-medieval culture.