Did Copernicus steal ideas from Islamic astronomers?

November 2023

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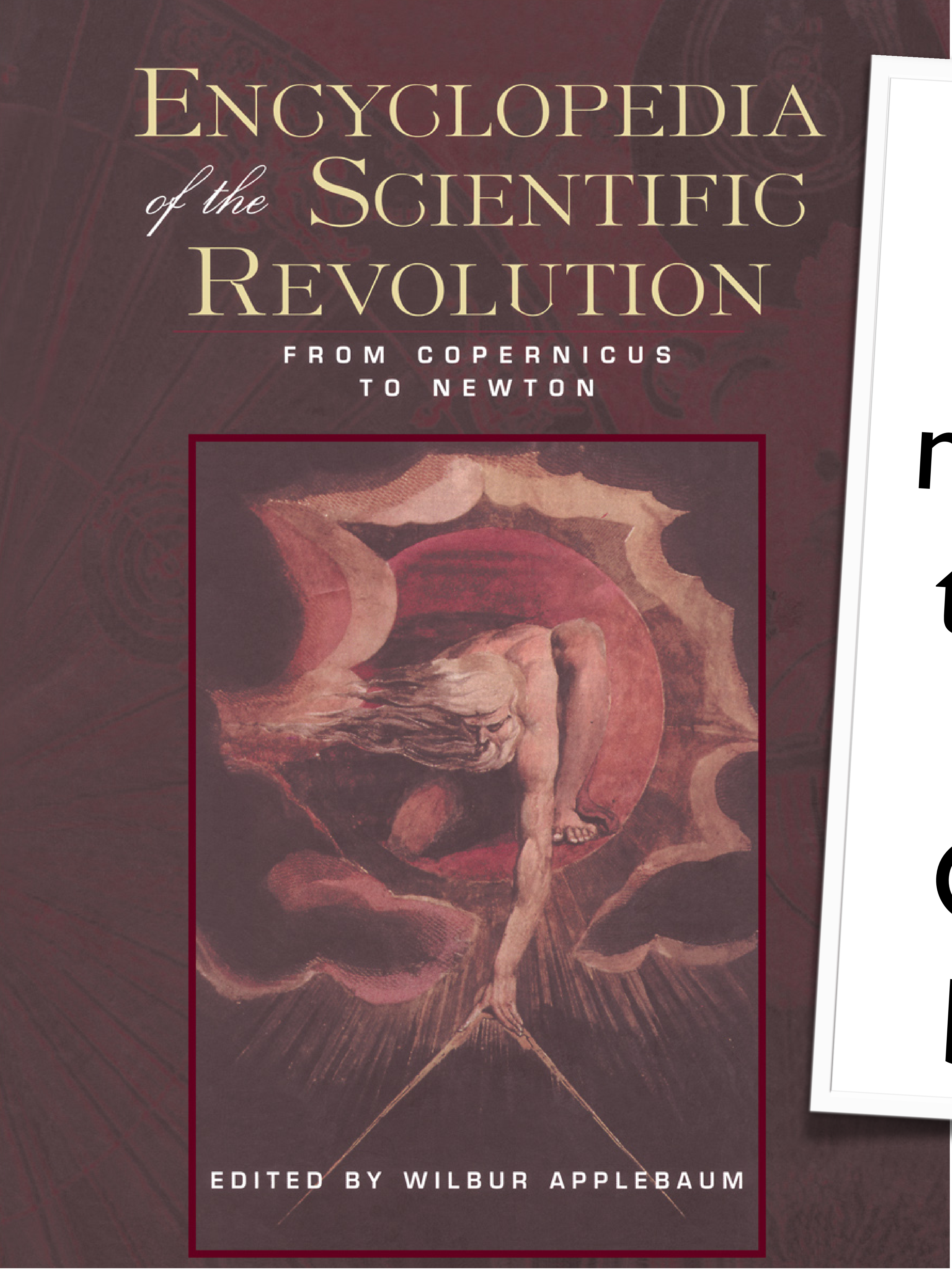
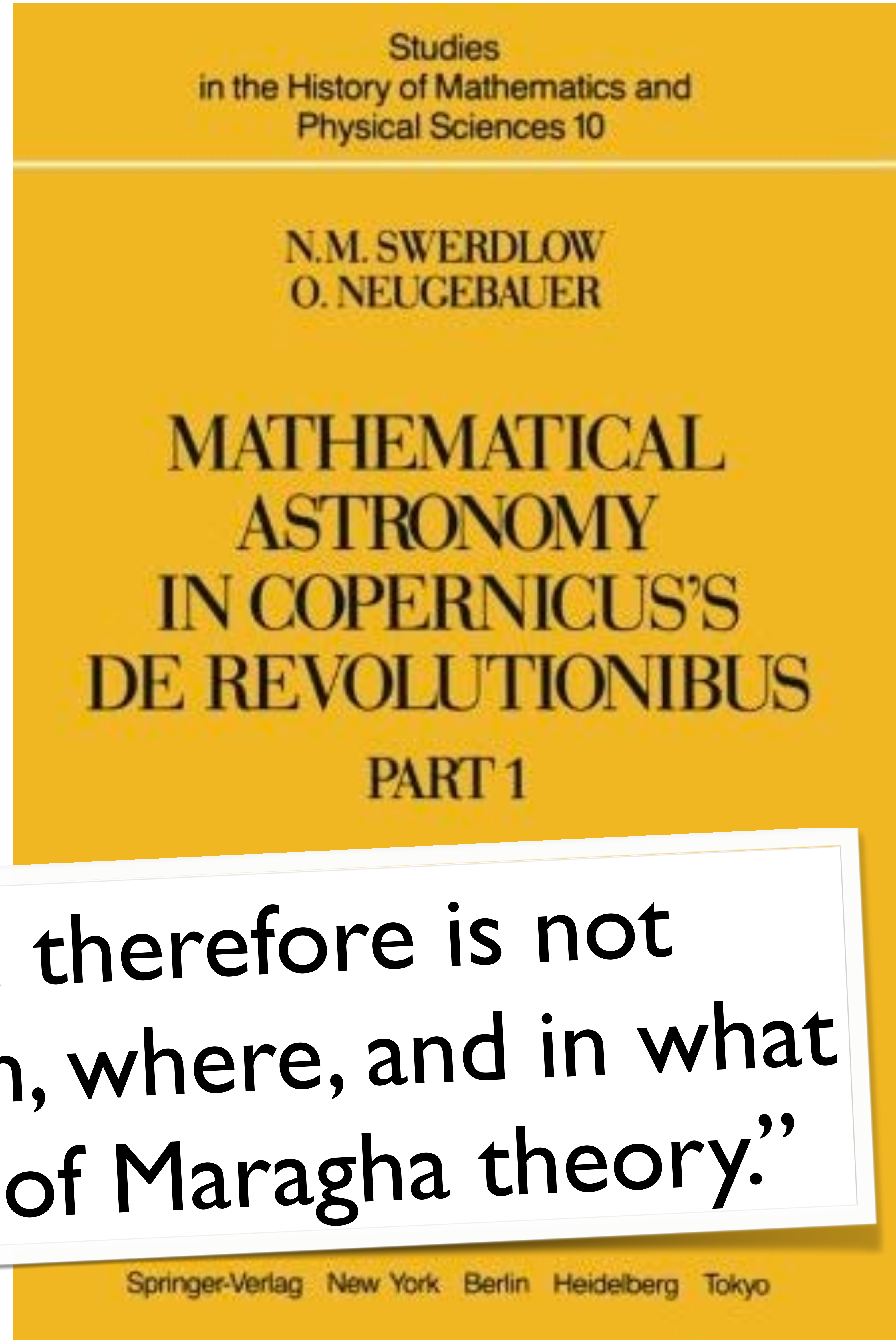
Ptolemy
Alexandria
2nd century

Maragha School, Iran
13th–14th centuries

Copernicus
Poland
16th century



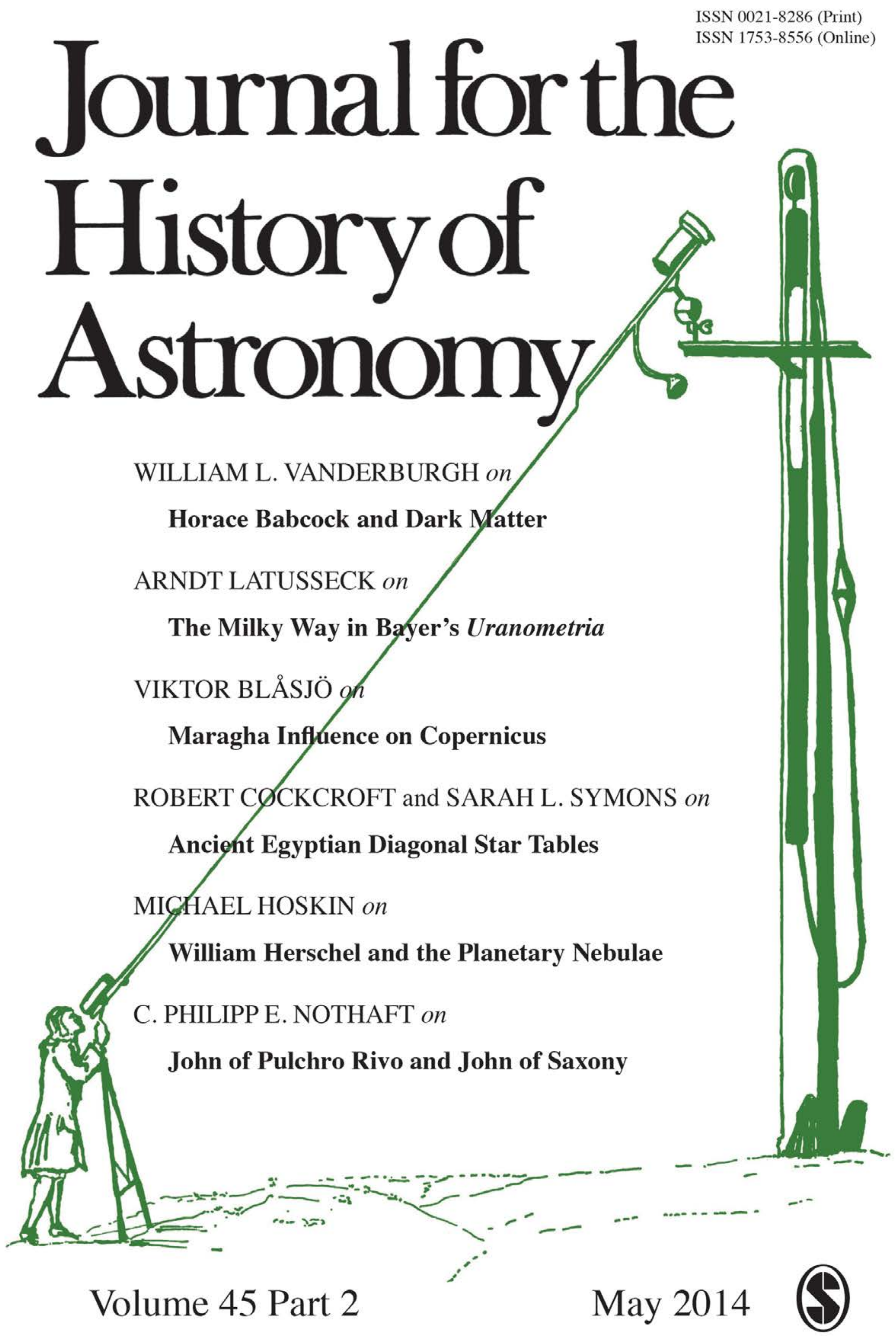
"The relation between the models is so close that independent discovery by Copernicus is all but impossible."



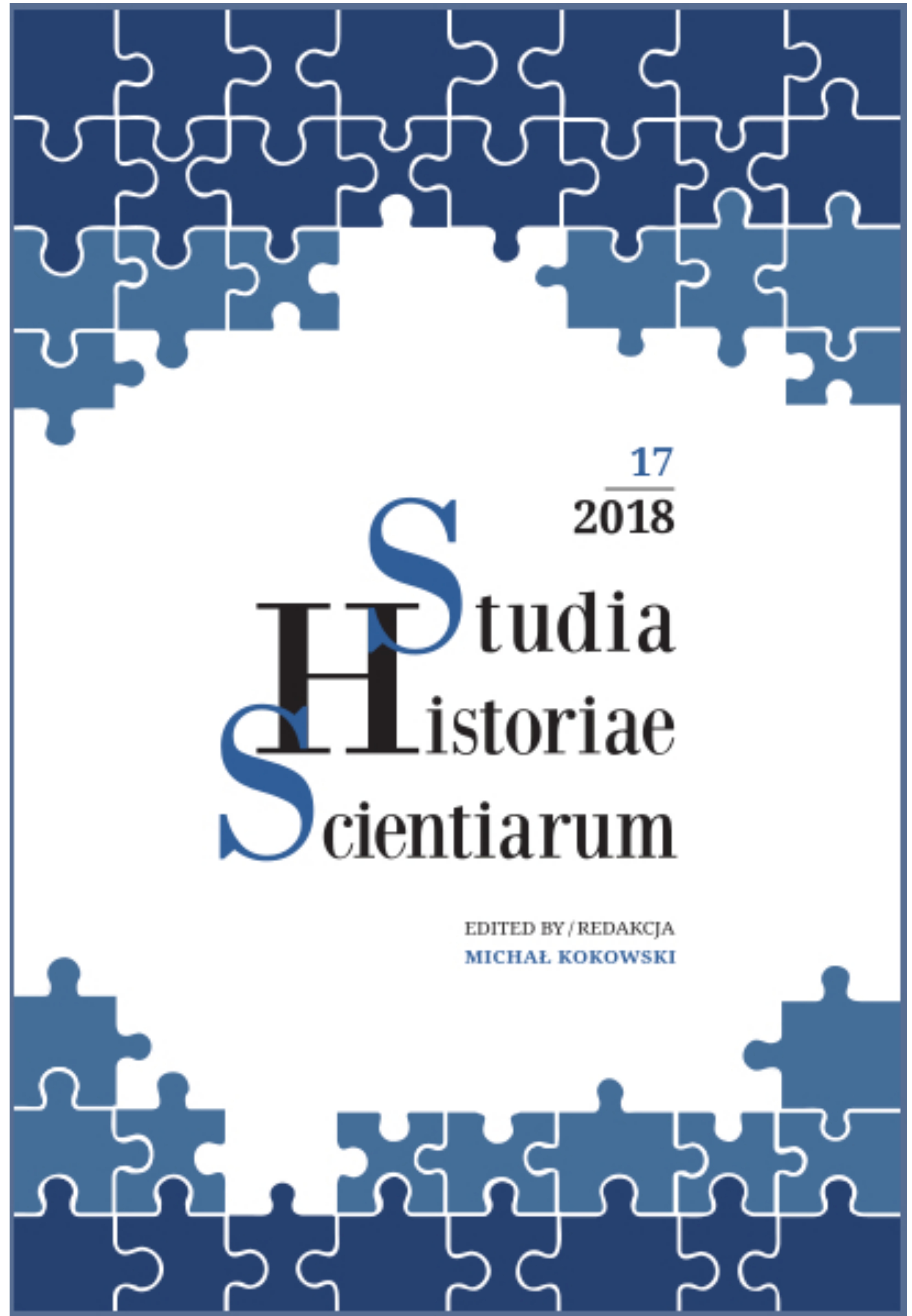
"The question therefore is not whether, but when, where, and in what form he learned of Maragha theory."

A CRITIQUE OF THE ARGUMENTS FOR MARAGHA INFLUENCE ON COPERNICUS

VIKTOR BLÅSJÖ, Utrecht University



A rebuttal of recent arguments for Maragha influence on Copernicus



ISR INTERDISCIPLINARY SCIENCE REVIEWS

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Mathematics, the mathematical sciences, and historical contingency: Some thoughts on reading Netz

F. Jamil Ragep

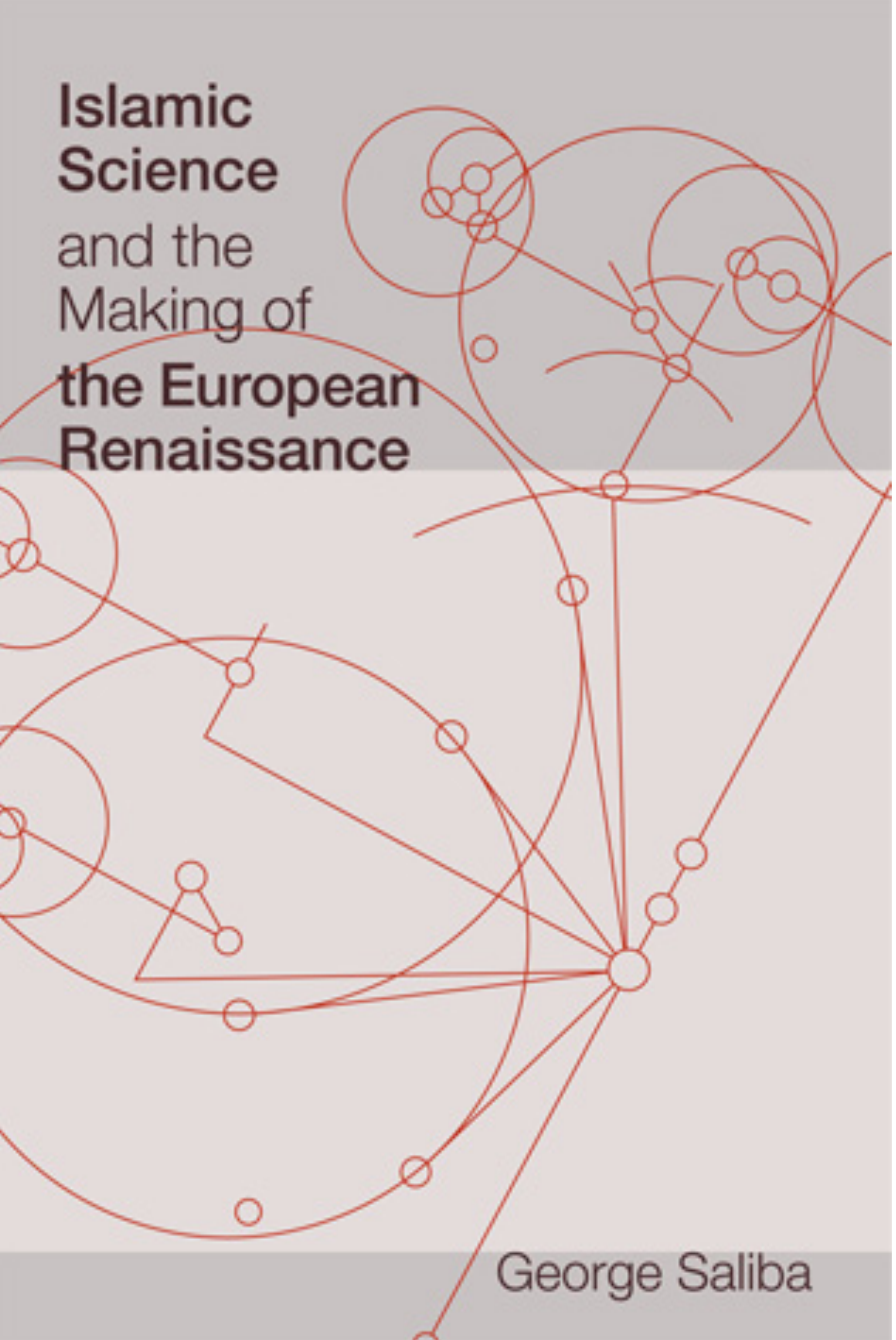
Institute of Islamic Studies, McGill University, Montreal, Canada

For the most part, historians of science have accepted the influence of Islamic astronomy on Copernicus.[14]

= me

[14] Despite some recent, rather insubstantial claims to the contrary, the Islamic background to Copernicus is fairly well established; see Ragep (2007) and, more recently, Nikfahm-Khubravan and Ragep (2019).

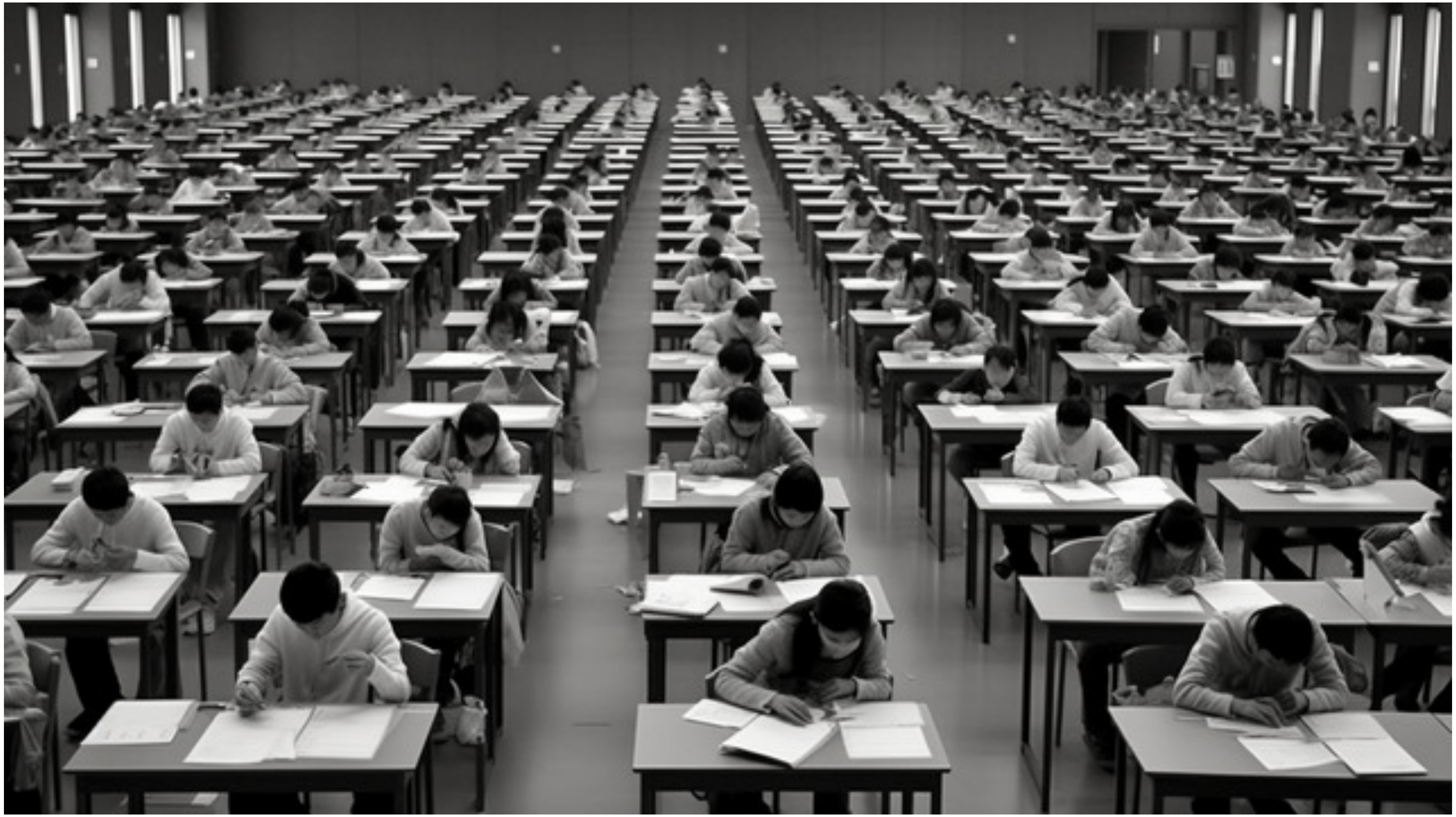
lunar model



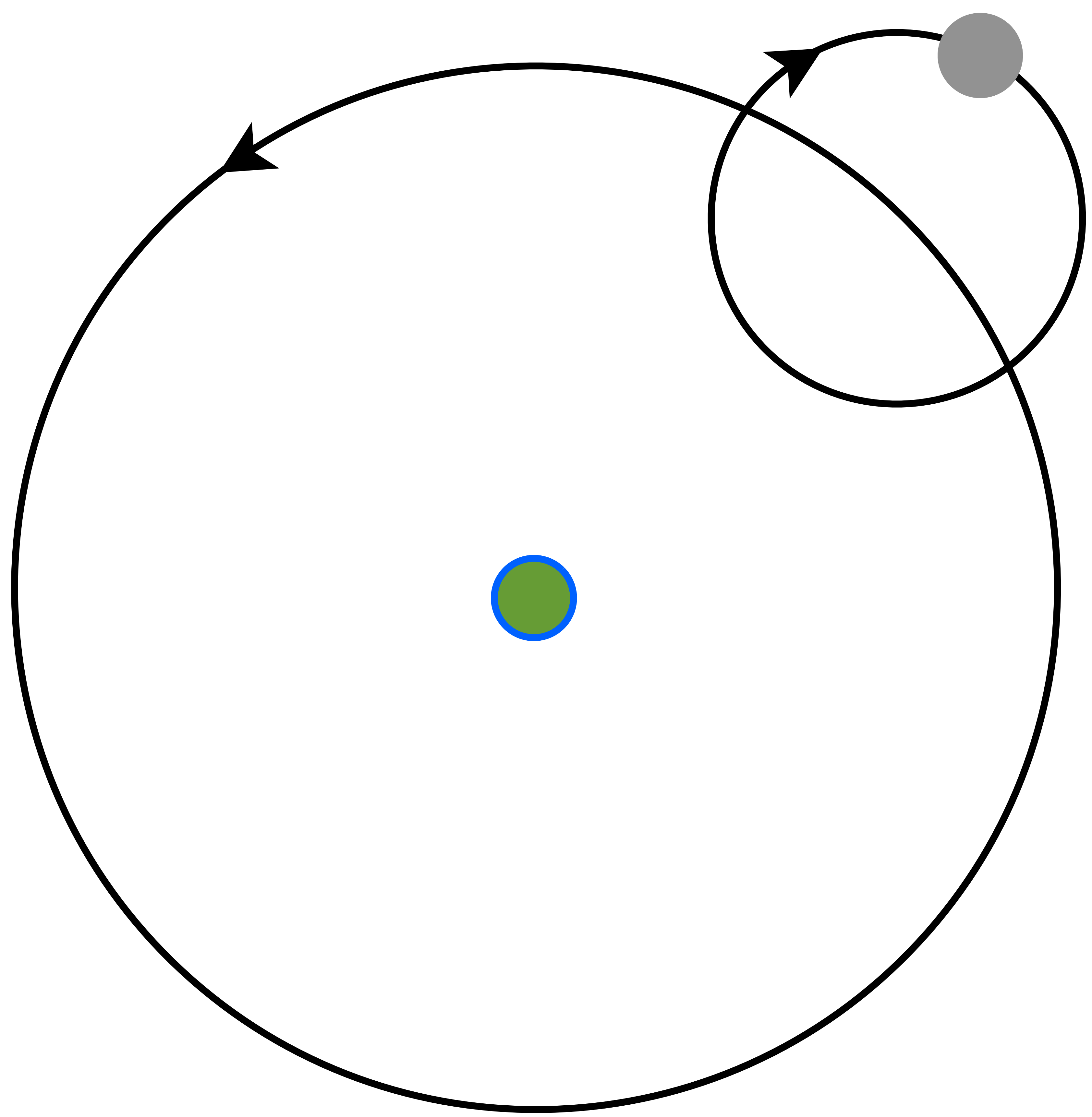
George Saliba: *Islamic Science and the Making of the European Renaissance*
Cambridge: The MIT Press, 2007, HC, 315 pp, ISBN: 978-0-262-19557-7

“Ibn al-Shatir’s lunar model was indeed identical, in every respect, to that of Copernicus.”

Trying to solve the same problem with the same tools leads to similar outcomes.



simple moon model doesn't work



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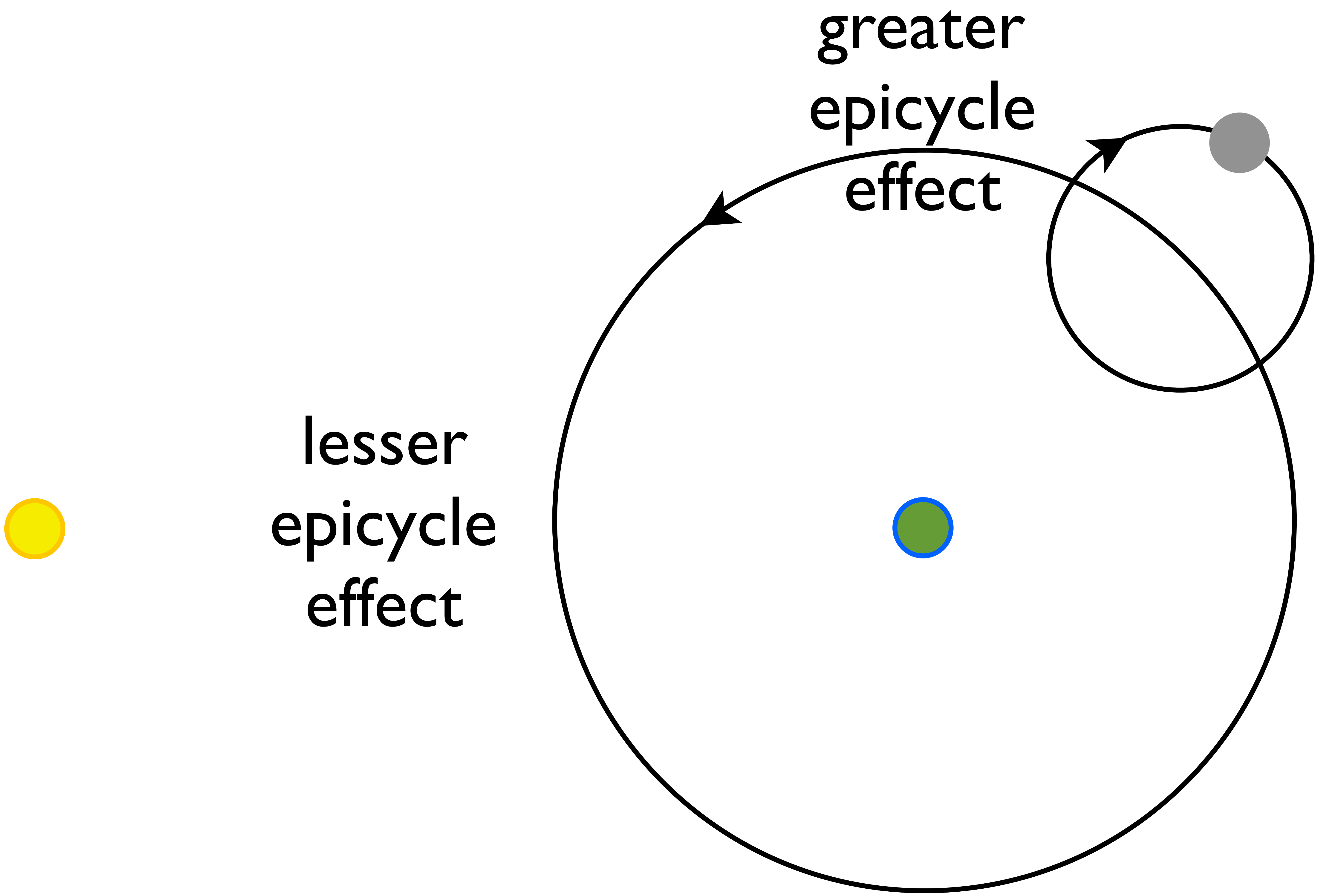
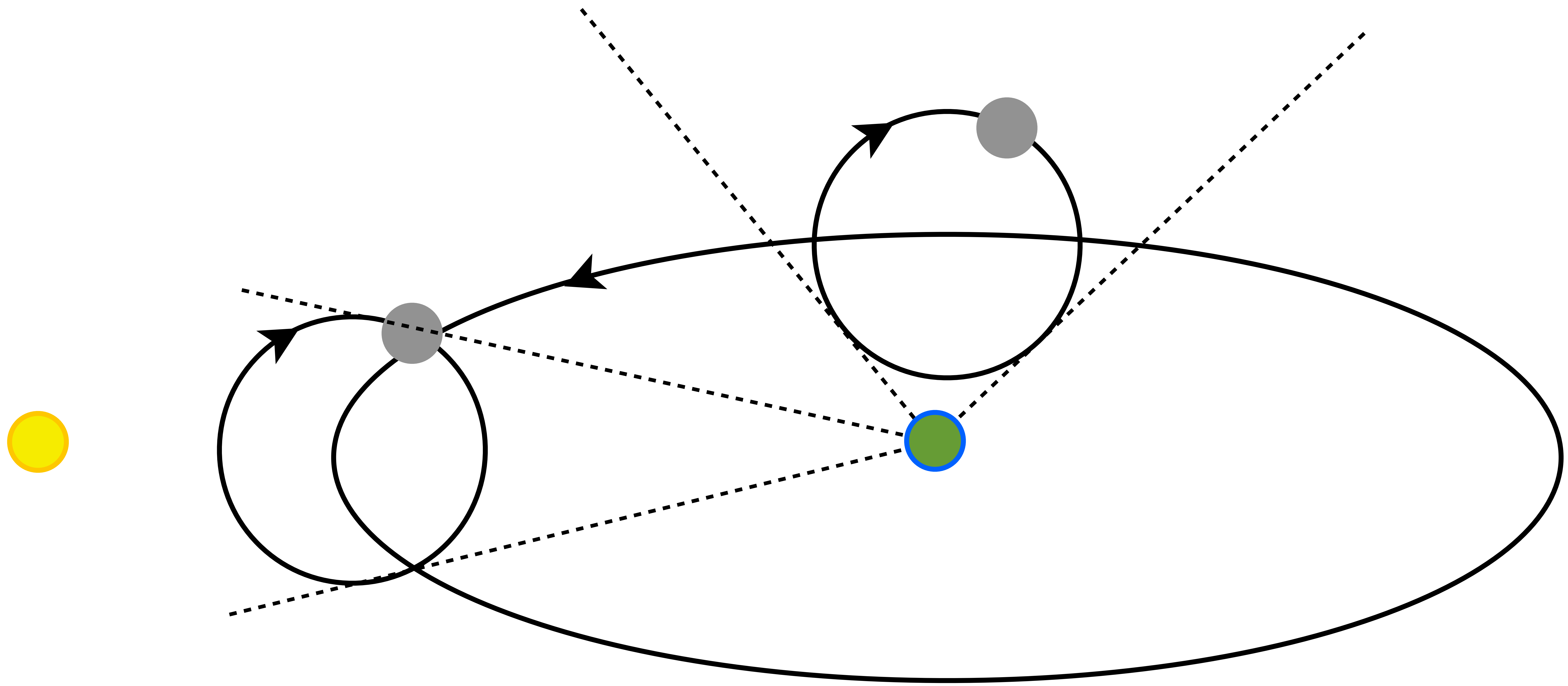
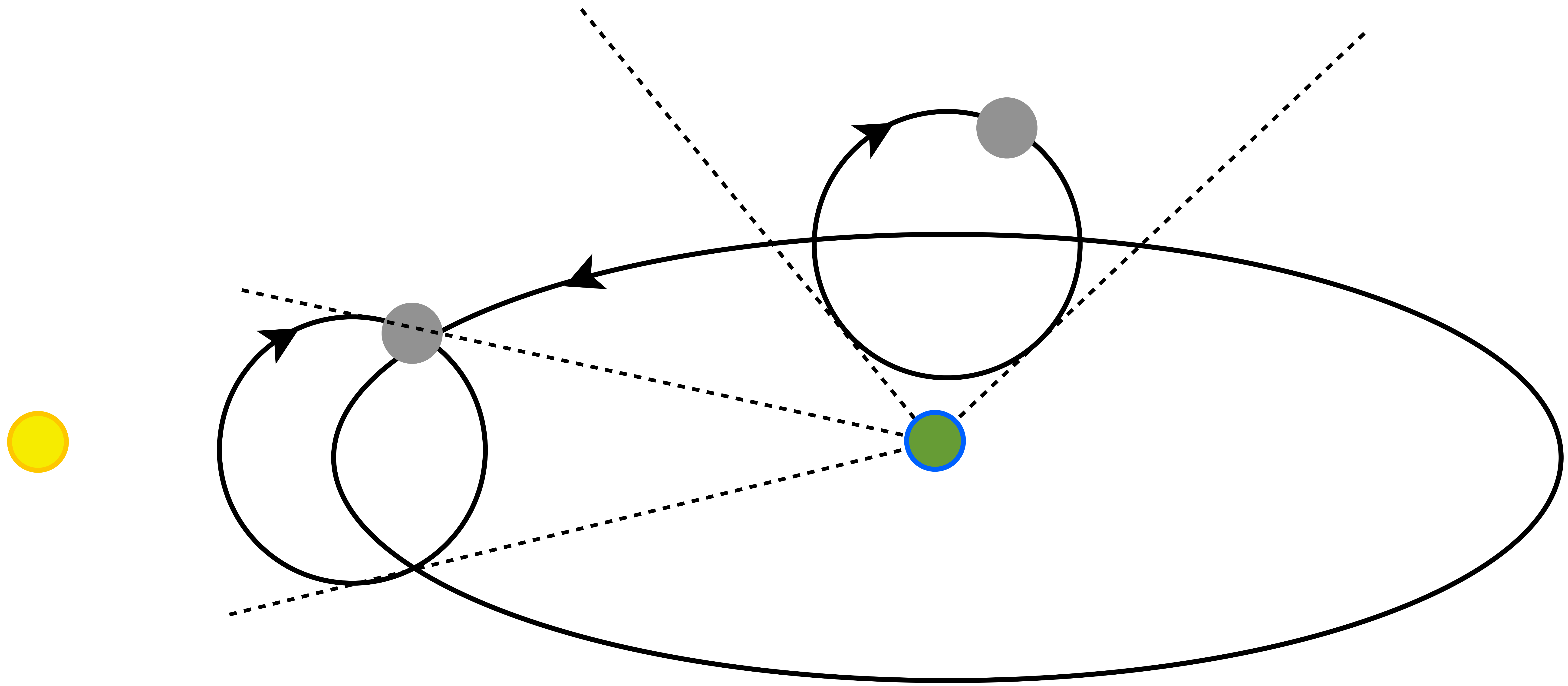


Ptolemy's solution: bring epicycle alternately closer and further away



Problem for Ptolemy:
distance to moon varies unrealistically



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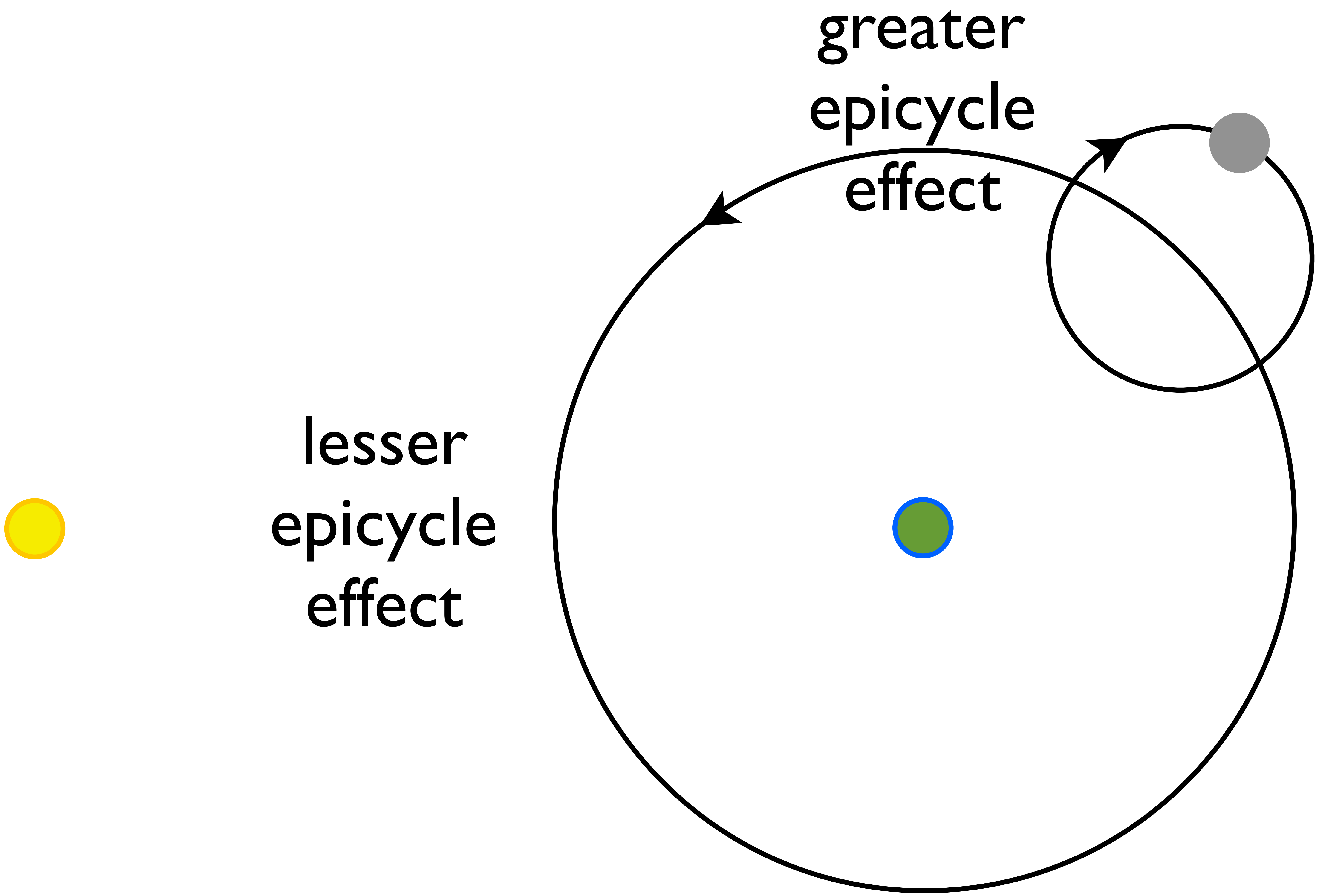
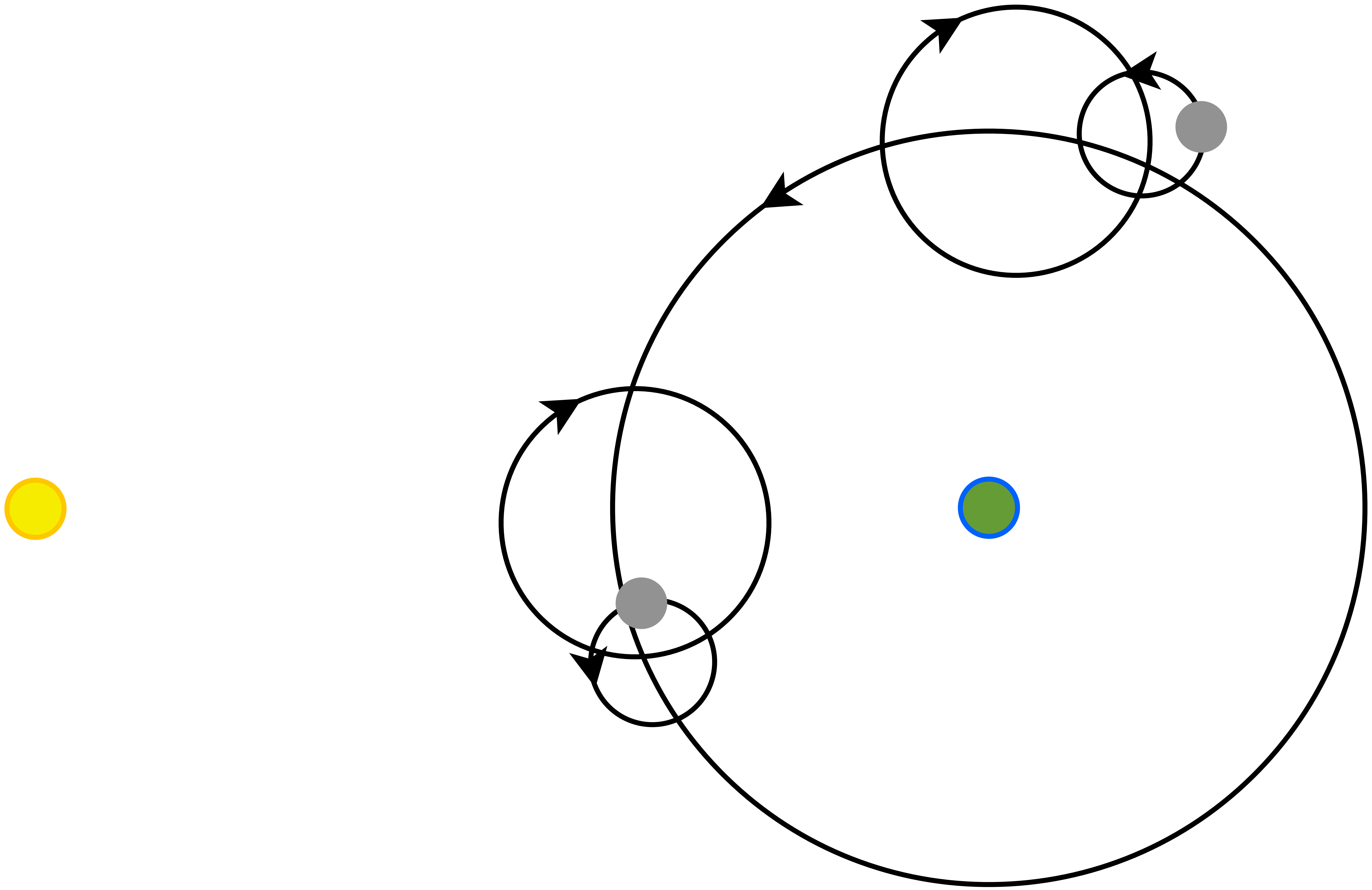
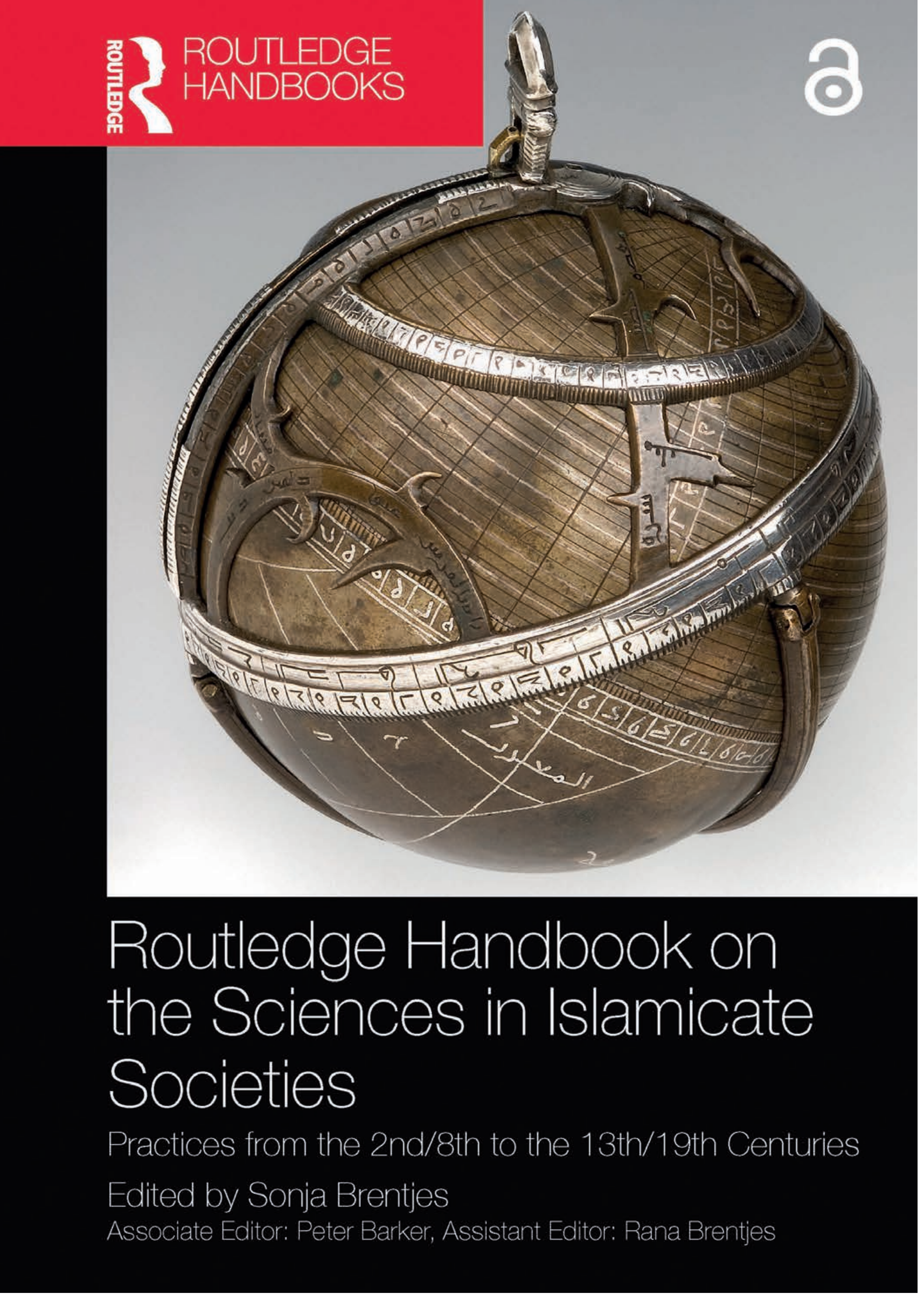


Without greatly varying the radius.

Copernicus's and Ibn al-Shatir's solution: One more epicycle



"consensus"



II.6
PLANETARY THEORY

Amir Mohammad Gamini

The connections between Copernicus, Ibn al-Shāṭir and earlier members of the Marāgha school have been intensely studied = me by historians of astronomy since their discovery in the 1950s. Despite some recent controversy, the main consensus is that Copernicus obtained information from works of al-Ṭūsī, al-ʿUrḍī, and Ibn al-Shāṭir, probably during his education in Italy, and incorporated their ideas in his own astronomical work (Swerdlow and Neugebauer 1984; Nikfahm-Khubravan and Ragep 2019). A central problem concerns the transmission of

Arabic Sciences and Philosophy, 29 (2019): 1-59
doi:10.1017/S0957423918000085

THE MERCURY MODELS OF IBN AL-ŠĀṬIR AND COPERNICUS

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Noel Swerdlow, throughout his career, has insisted that the similarities between Copernicus' models and those of his Islamic predecessors "is so close that independent invention by Copernicus is all but impossible[7]". But for Mercury (as well as for Venus) this creates something of an unacknowledged conundrum for Swerdlow. Since Ibn al-Šāṭir's Mercury model and Copernicus' in *De revolutionibus* are *virtually* the same, one must then explain why the *Commentariolus* model (from some 30 years earlier) is different, not to say flawed, if, as Swerdlow has maintained, Copernicus did have Ibn al-Šāṭir's one and only Mercury model when composing the *Commentariolus*. Swerdlow has provided a complex scenario, most recently repeated in an article, that culminates with the *Commentariolus* model[8]. But it has seemed odd to us that Copernicus substituted a flawed model when, according to Swerdlow, he had a much better one immediately at hand. We are also uncomfortable with the numerous ad hoc assumptions Swerdlow needs to make in order for Copernicus to reach, over a 30-year period, essentially what he had all along. Thus part of the purpose of this paper is to suggest an alternative account that we believe provides a more straightforward explanation[9]. Inasmuch as Swerdlow has already offered a critique of some of the central points in this paper, we will need to respond to his criticisms[10].

Transmission believers now diametrically disagree with each other.

Article

JHA

N.M. Swerdlow
California Institute of Technology, USA

Copernicus's Derivation of the Heliocentric Theory from Regiomontanus's Eccentric Models of the Second Inequality of the Superior and Inferior Planets

Journal for the History of Astronomy
2017, Vol. 48(1) 33–61

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DOI: 10.1177/0021828617691203
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SAGE

fatal to Professor Ragep's assumption

Professor Ragep has trouble with numbers and computations throughout his paper.

This is more than I can believe, and I wonder whether the reader or even Professor Ragep can believe it either.

Because Copernicus does not use Ibn al-Šāṭir's parameters, and in fact makes some ill-advised choices, we think it much more likely that he had diagrams but not Ibn al-Šāṭir's text.

Article

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And if, as Professor Ragep believes, Copernicus adapted the heliocentric form of the models for Venus and Mercury directly from Ibn ash-Shāṭir, with figures no less as he believes, which is not certain, one must ask why he did not get it right in the first place, which would be obvious in the figures.

I doubt whether he had figures.

Marketing department terminology trick to try to make people think there is a connection to heliocentrism.

When we say Ibn al-Šāṭir's models have a "heliocentric bias", we mean that Ibn al-Šāṭir has made the Earth the center of mean motion (α). This gives his system a certain "bias" that makes the transformation from a geocentric to heliocentric system much easier.

Ibn al-Šāṭir's models were easier to transform into the heliocentric models of the *Commentariolus* and *De rev.* than the other possibilities available to Copernicus.

Article

JHA

N.M. Swerdlow
California Institute of Technology, USA

Copernicus's Derivation of the Heliocentric Theory from Regiomontanus's Eccentric Models of the Second Inequality of the Superior and Inferior Planets

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So the fact that the earth is at the centre of the sphere in Ibn ash-Shāṭir's model, Professor Ragep's "quasi-homocentricity" and "heliocentric bias," has *no* significance for the very transformation he shows since Ptolemy's model would do just as well, for the transformation affects *only* the second inequality. The same would be true of the model in *De revolutionibus* in which the larger epicycle is replaced by an equal eccentricity on the apsidal line, and all that Professor Ragep writes at such length about why it cannot be done with Ptolemy's model, or any model with eccentricities on the apsidal line, about "centering on the Earth," "quasi-homocentricity," and "heliocentric bias," as well as his objection to a "bifurcated" derivation, is beside the point, in fact simply wrong.

Mercury model

THE DERIVATION AND FIRST DRAFT OF COPERNICUS'S PLANETARY THEORY A TRANSLATION OF THE COMMENTARIOLUS WITH COMMENTARY

NOEL M. SWERDLOW

Assistant Professor of History, The University of Chicago

PROCEEDINGS OF THE AMERICAN PHILOSOPHICAL SOCIETY, VOL. 117, NO. 6, DECEMBER 1973

Copernicus's description

is utter nonsense as a description of the apparent motion of Mercury.

he copied it without fully understanding what it was really about. Since it is Ibn ash-Shāṭir's model, this is further evidence, and perhaps the best evidence, that Copernicus was in fact copying without full understanding from some other source, and this source would be an as yet unknown transmission to the west of Ibn ash-Shāṭir's planetary theory.

George Saliba: *Islamic Science and the Making of the European Renaissance*
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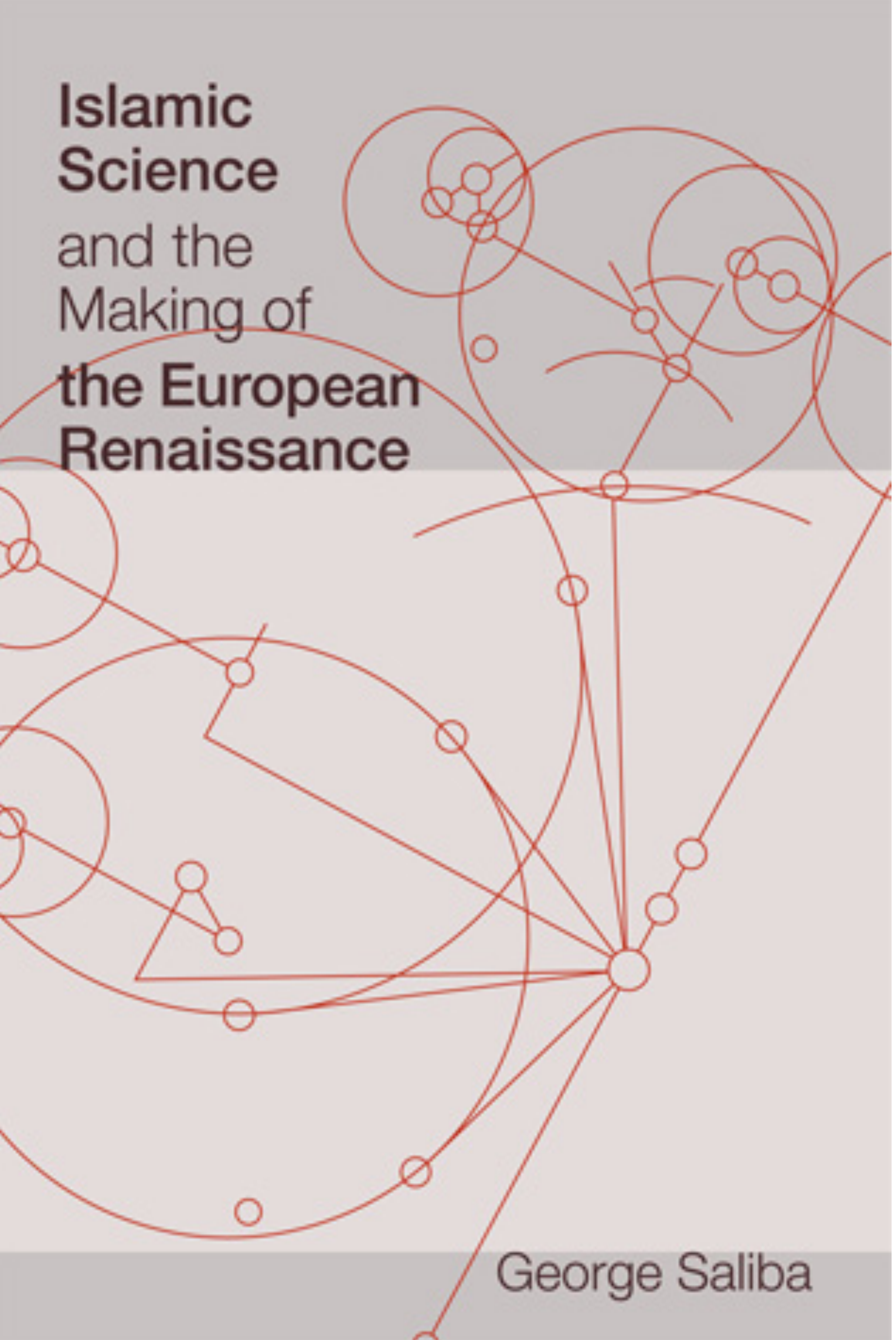

“[Swerdlow’s Mercury argument] elevates the discussion of the similarities to a whole new level.”

Ibn al-Shatir

Article Talk

From Wikipedia, the free encyclopedia

ʿAbu al-Ḥasan Alāʾ al-Dīn bin Alī bin Ibrāhīm bin Muhammad bin al-Matam al-Ansari[1] known as **Ibn al-Shatir** or **Ibn ash-Shatir** (Arabic: ابن الشاطر; 1304–1375) was an Arab astronomer, mathematician and engineer. He worked as *muwaqqit* (موقت, religious timekeeper) in the Umayyad Mosque in Damascus and constructed a sundial for its minaret in 1371/72.

Possible influence on Nicolaus Copernicus [edit]

Copernicus's Mercury model was flawed in the fact that he was not able to properly understand the model first created by Ibn al-Shatir.

THE DERIVATION AND FIRST DRAFT OF COPERNICUS'S PLANETARY THEORY A TRANSLATION OF THE COMMENTARIOLUS WITH COMMENTARY

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Assistant Professor of History, The University of Chicago

PROCEEDINGS OF THE AMERICAN PHILOSOPHICAL SOCIETY, VOL. 117, NO. 6, DECEMBER 1973

Copernicus's description

accurate

is ~~utter nonsense~~ as a description of the apparent motion of Mercury.

he copied it without fully understanding what it was really about. Since it is Ibn ash-Shāṭir's model, this is further evidence, and ~~perhaps the best evidence~~, that Copernicus was in fact copying without full understanding from some other source, and this source would be an as yet unknown transmission to the west of Ibn ash-Shāṭir's planetary theory.

no evidence at all

Swerdlow's reply on his Mercury argument:

"You got me there. I should not have said that."

Re: Questions concerning the relation of Copernicus's models to Maragha models

Viktor Blåsjö	Dear Professor Swerdlow, I was very happy to receive your thorough comments o...	14/06/2014
Noel Swerdlow	I have made some comments on what you have written. I am also sending this, a...	17/06/2014
Viktor Blåsjö	Thank you for your prompt reply and your serious attention to this matter. Pl...	17/06/2014
Hogendijk, J.P. (Jan)	Dear Noel I am just writing to confirm receipt of your email. As I wrote to y...	18/06/2014
Noel Swerdlow	Here are yet more comment on what you have written, which I have placed follo...	18/06/2014

Viktor Blåsjö <viktor.blasjo@gmail.com> 20/06/2014

to Noel

Blåsjö does point to an illuminating mistake in Swerdlow's understanding of the Mercury model that will figure in our own analysis.

But as Blåsjö has recently shown, and as we will discuss below, Swerdlow based his assessment on a misunderstanding of what Copernicus was saying regarding the behavior of the Mercury model.

Ragep agrees that I disproved what Swerdlow called "perhaps the best evidence."

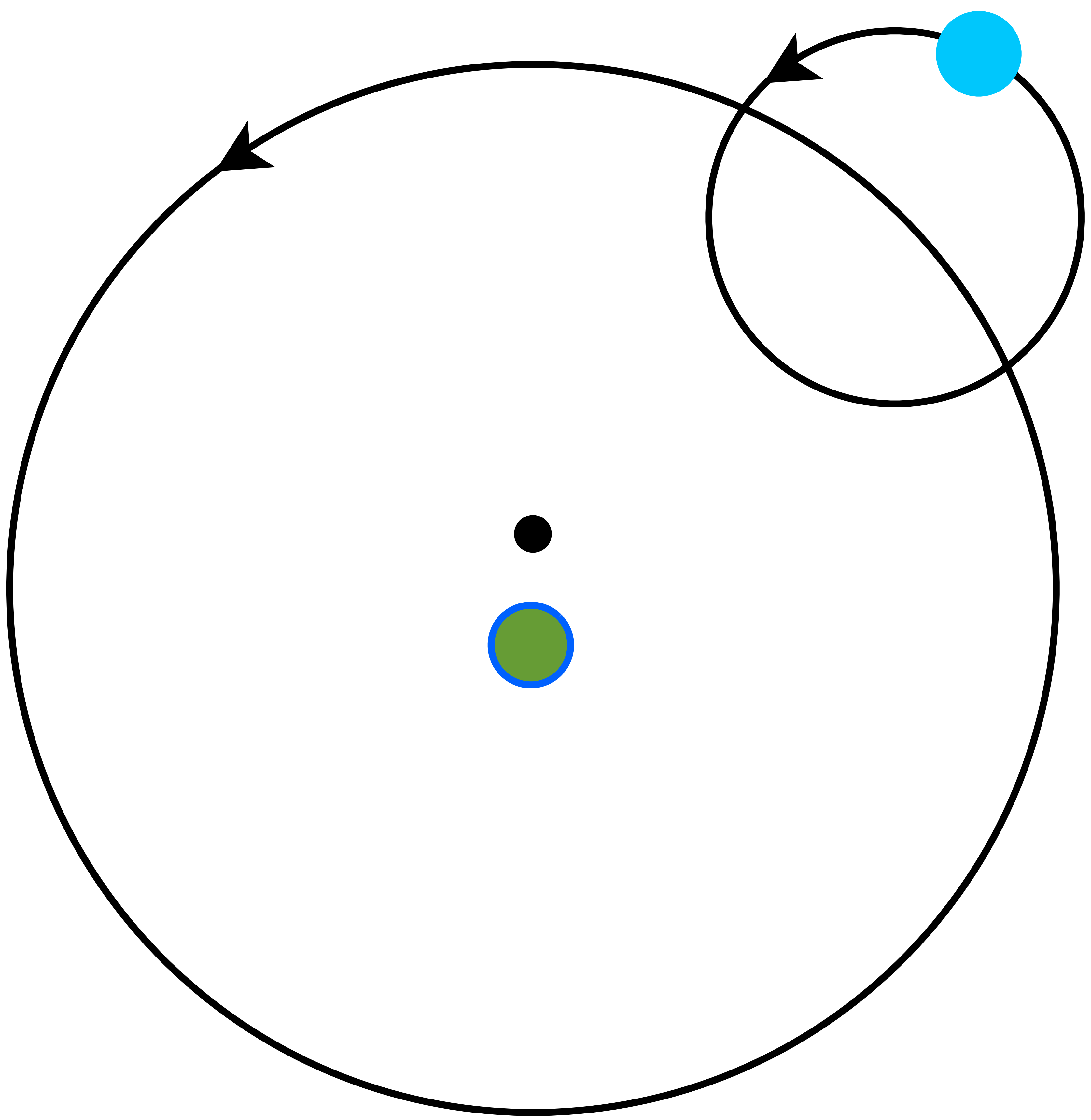
Blåsjö also wishes us to believe that by showing that Swerdlow misunderstood what Copernicus was saying, this somehow disproves Swerdlow's conclusion that Copernicus was copying Ibn al-Šāṭir's model. Although this is an unwarranted leap on Blåsjö's part, his analysis does provide a key to showing an even stronger connection between Ibn al-Šāṭir and Copernicus.

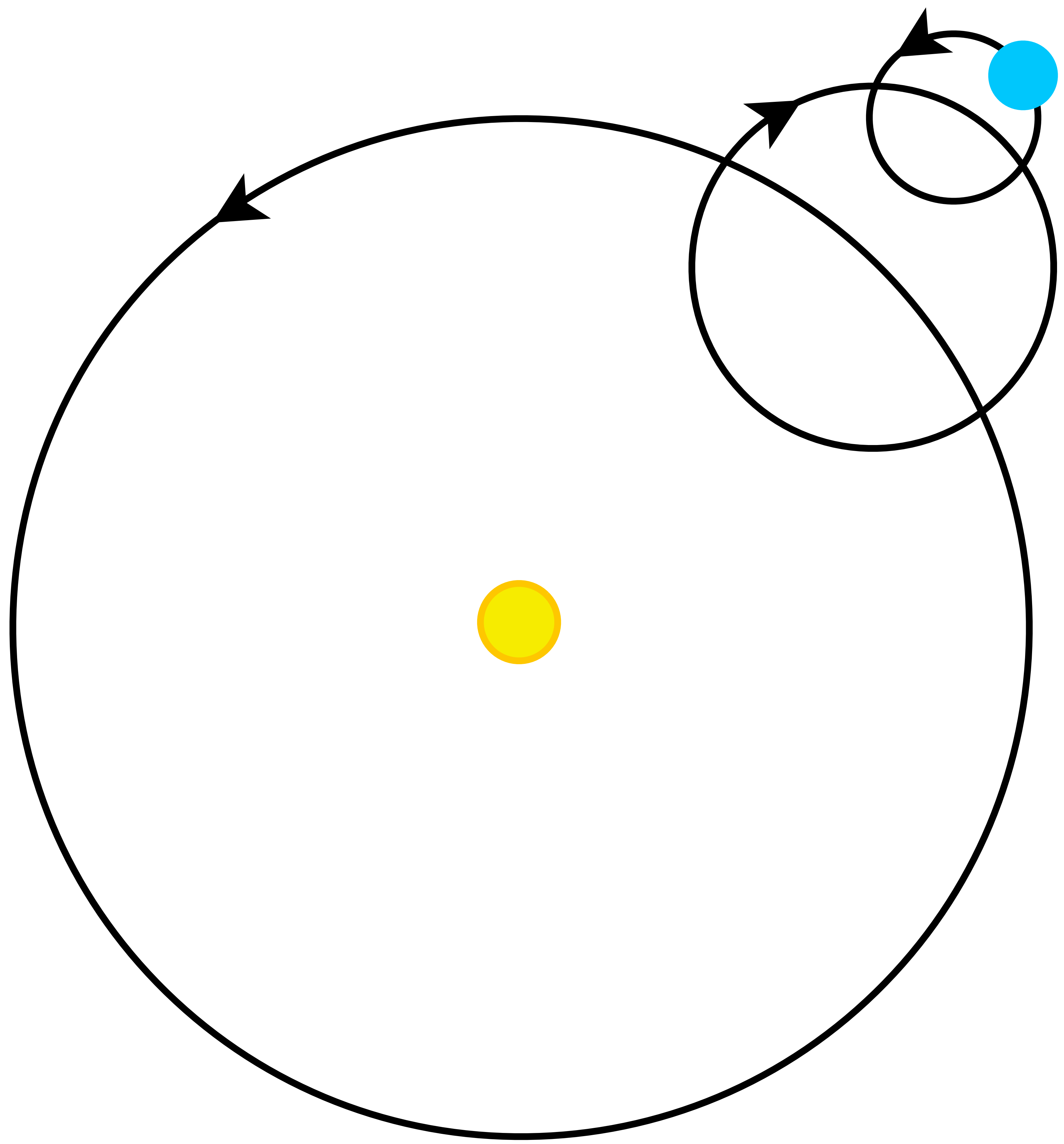
Of course I never said any such thing.

Ptolemy’s Venus:
epicycle + equant

≈

Copernicus’s
Commentariolus Venus:
epicycle + epicycle

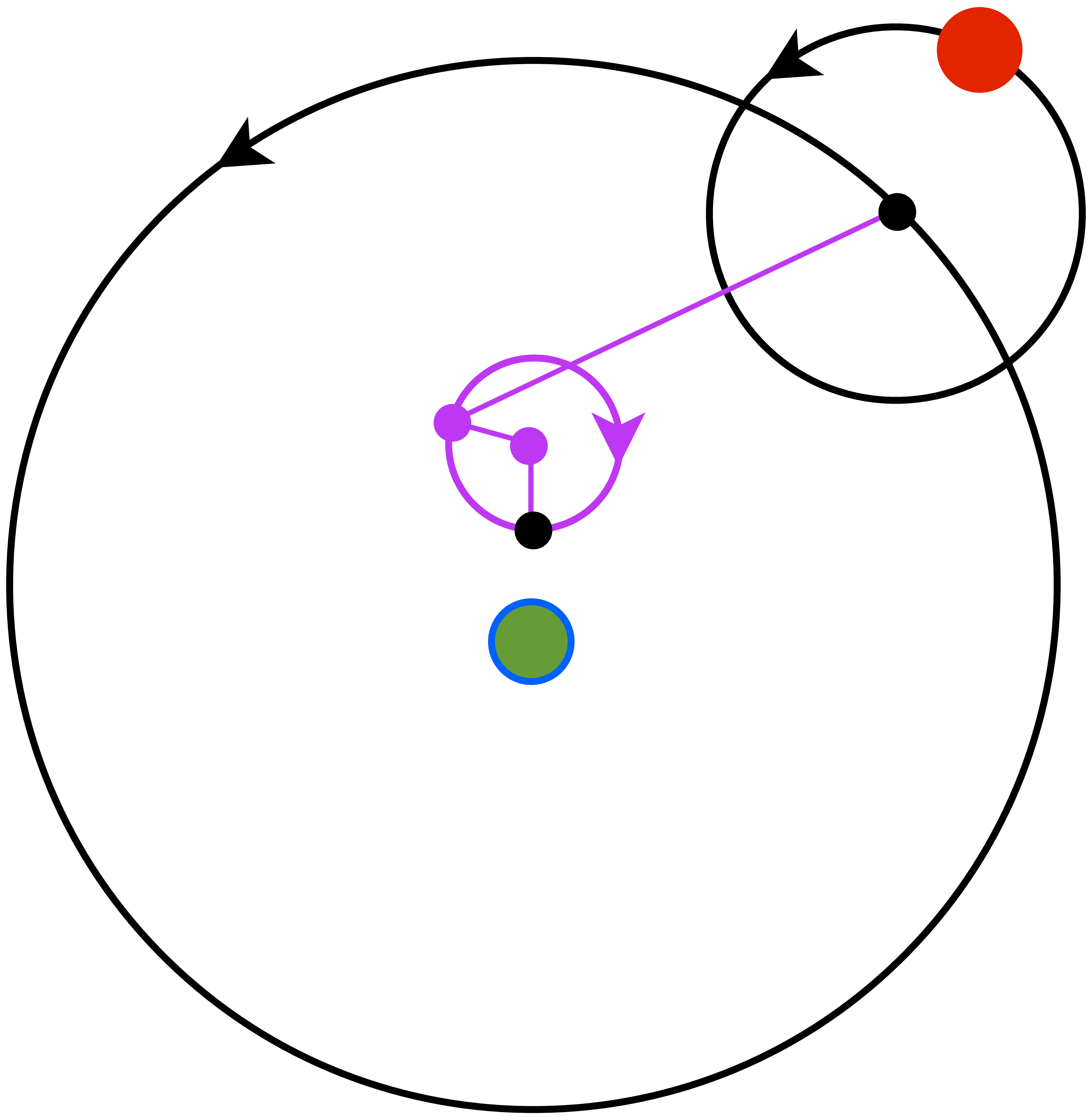


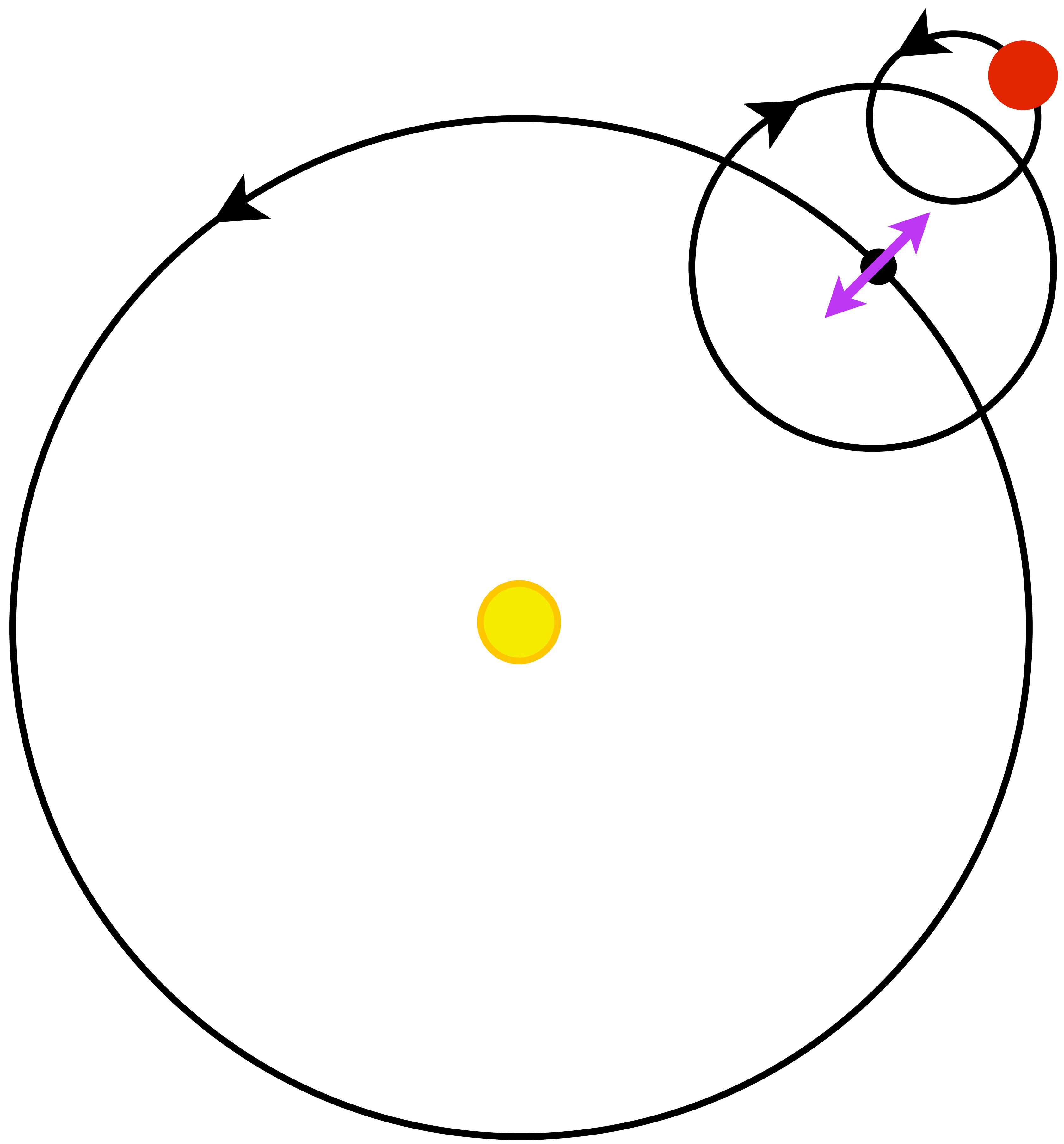


Ptolemy's Mercury:
epicycle + equant
+ variable radius

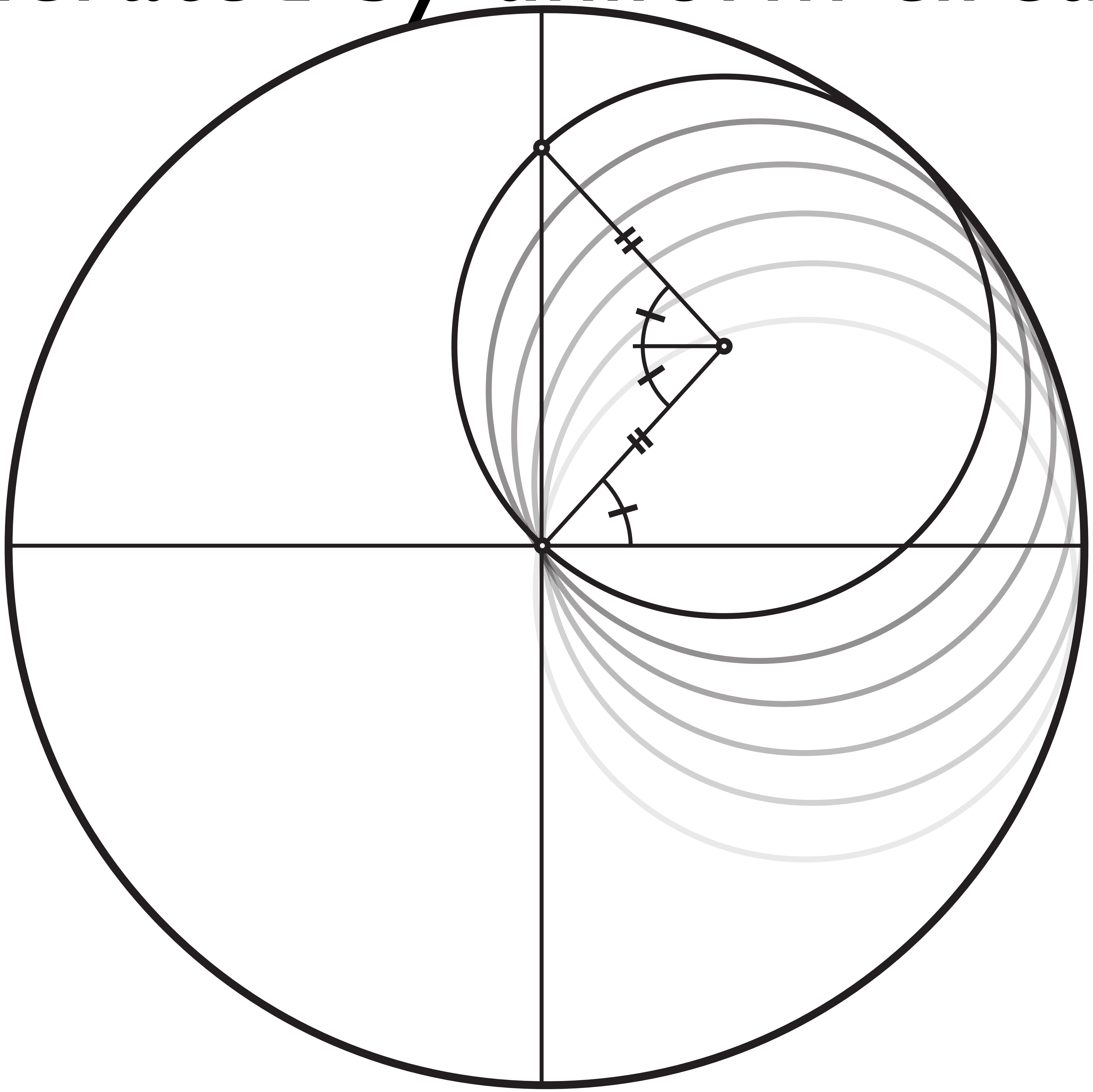
≈

Copernicus's
Commentariolus Mercury:
epicycle + epicycle
+ variable radius (Tusi)

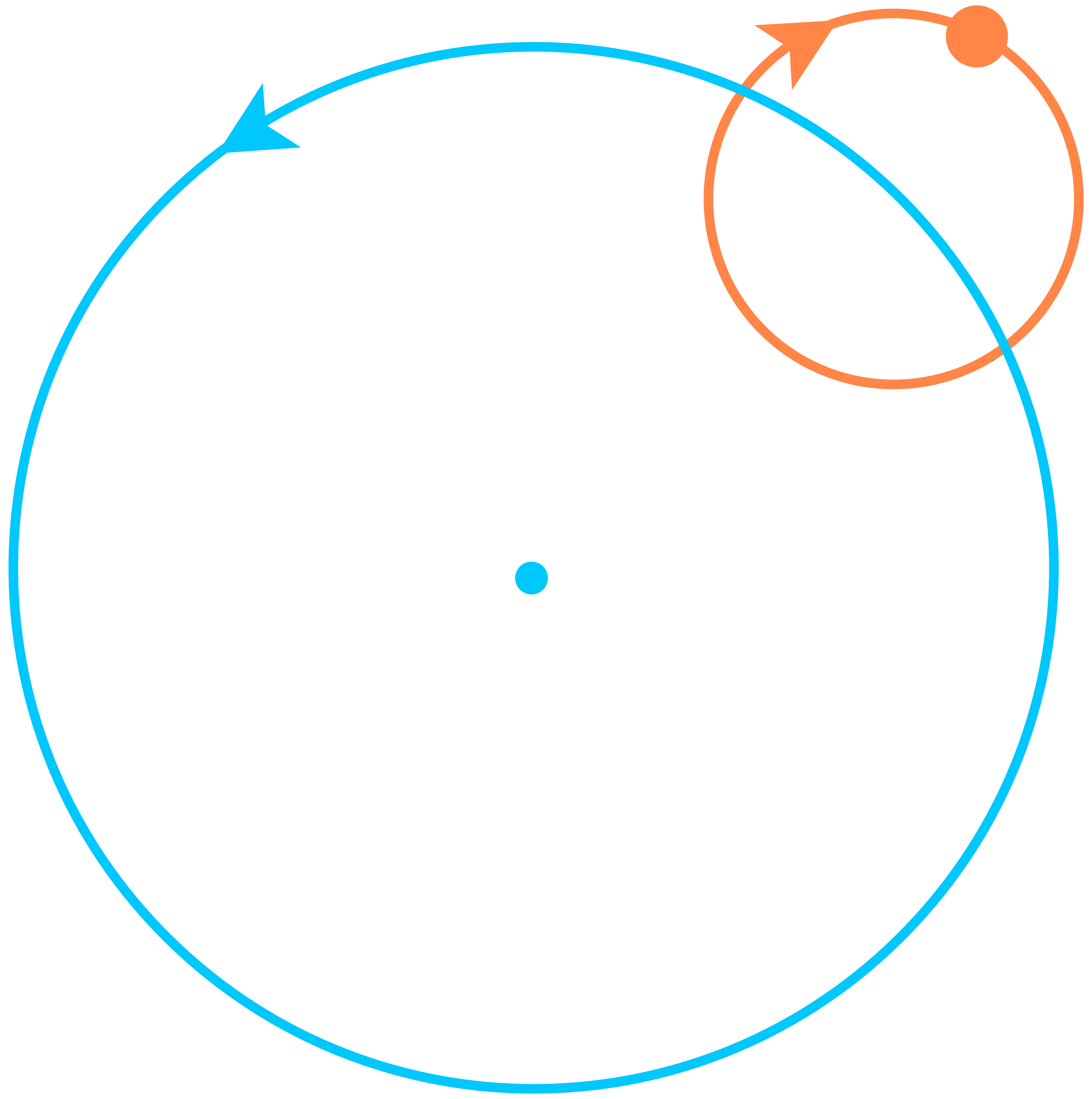




Tusi couple: rectilinear motion generated by uniform circular

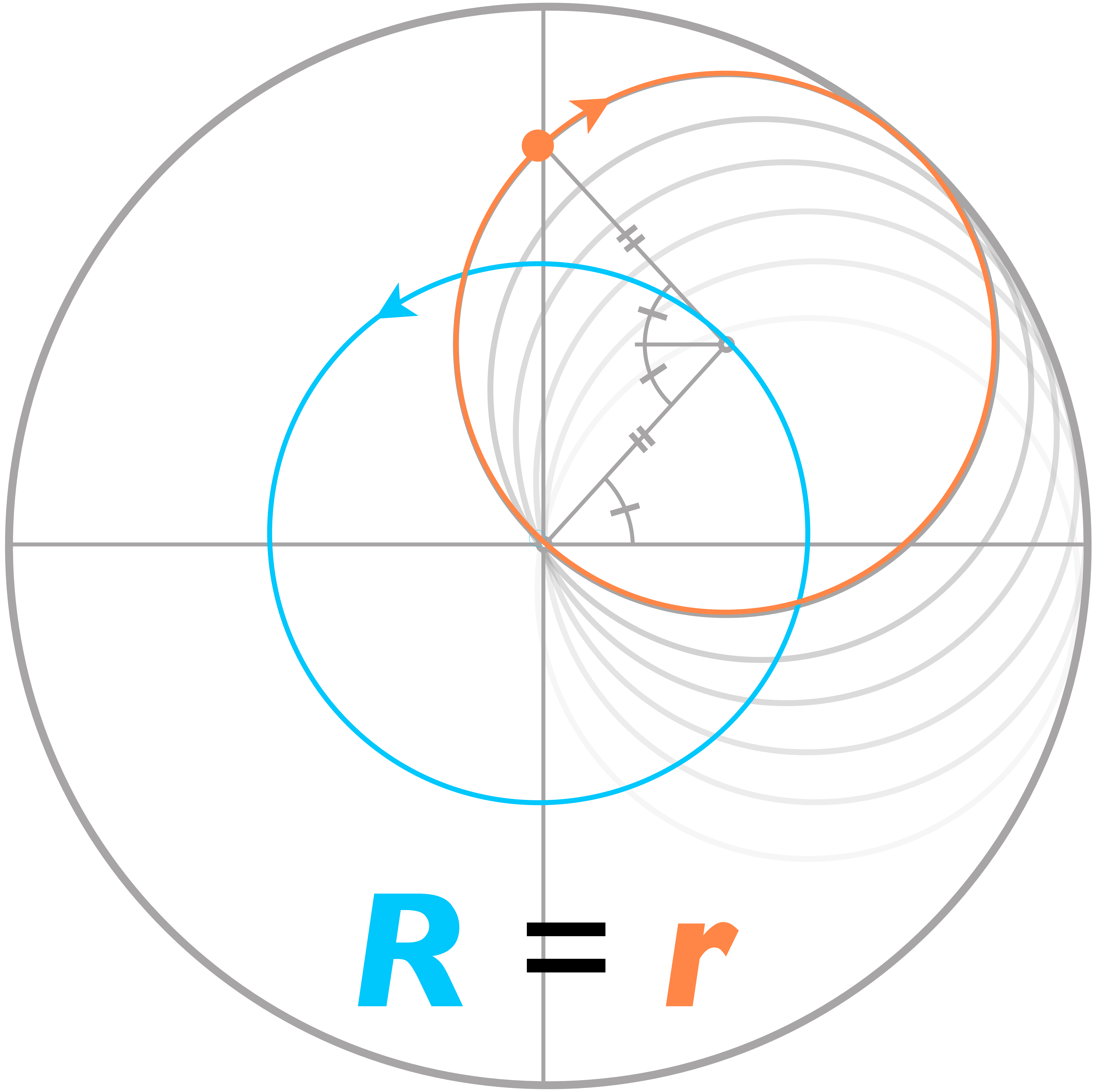


Standard
Ptolemaic epicycle
model



$R > r$

Tusi couple

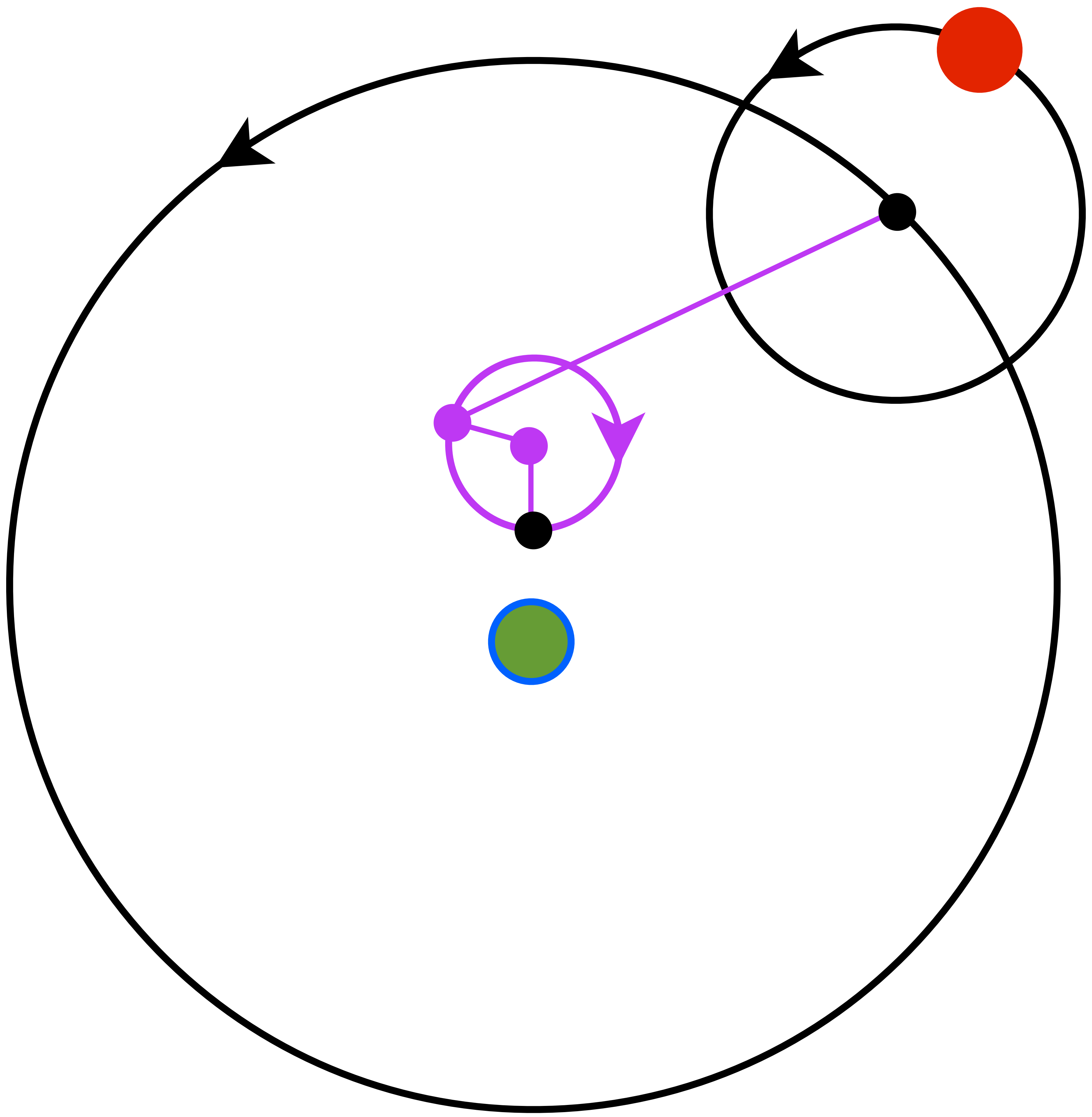


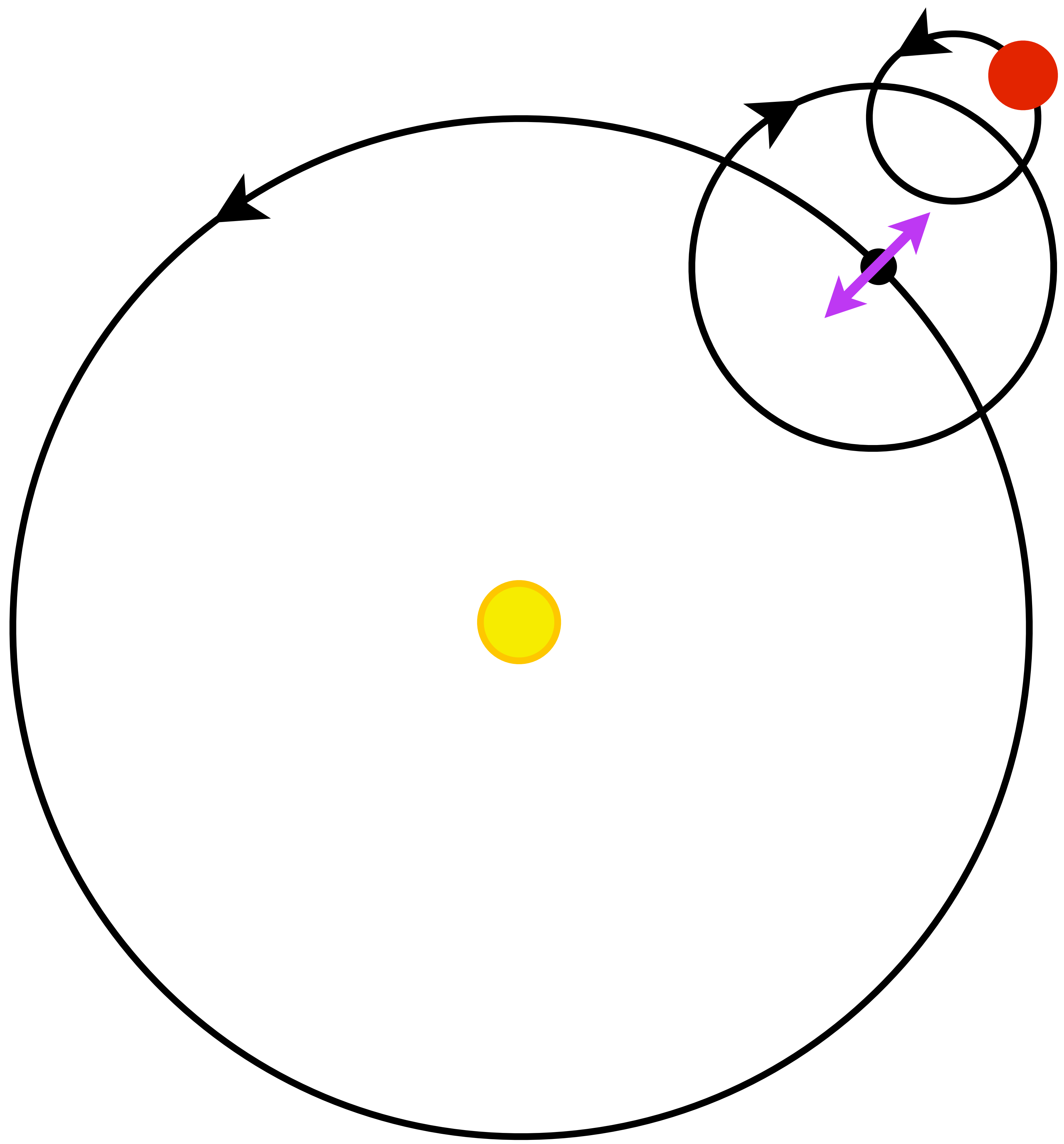
“natural”

<u>Ptolemy’s Mercury</u>:
epicycle + equant
+ variable radius

≈

Copernicus’s
Commentariolus Mercury:
epicycle + epicycle
+ variable radius (Tusi)





Ibn al-Šāṭir's Mercury model is quite distinct, and its virtual identity with the *De rev.* model is not something that can be dismissed as a " natural " outcome.

Allegedly can't be "natural" because there were many Mercury models.

There was a wide array of non-Ptolemaic Mercury models

Quṭb al-Dīn al-Šīrāzī claims to have invented nine different Mercury models [79], and Khafrī presents four

Ibn al-Šāṭir's Mercury model is quite distinct, and its virtual identity with the *De rev.* model is not something that can be dismissed as a "natural" outcome.

There was a wide array of non-Ptolemaic Mercury models Quṭb al-Dīn al-Šīrāzī claims to have invented nine different Mercury models [79], and Khafrī presents four

So making up models is easy.

Why would Copernicus copy anyone then?

Ibn al-Šāṭir's Mercury model is quite distinct, and its virtual identity with the *De rev.* model is not something that can be dismissed as a "natural" outcome.

No equant.

All with equants.

There was a wide array of non-Ptolemaic Mercury models Quṭb al-Dīn al-Šīrāzī claims to have invented nine different Mercury models[79], and Khafrī presents four

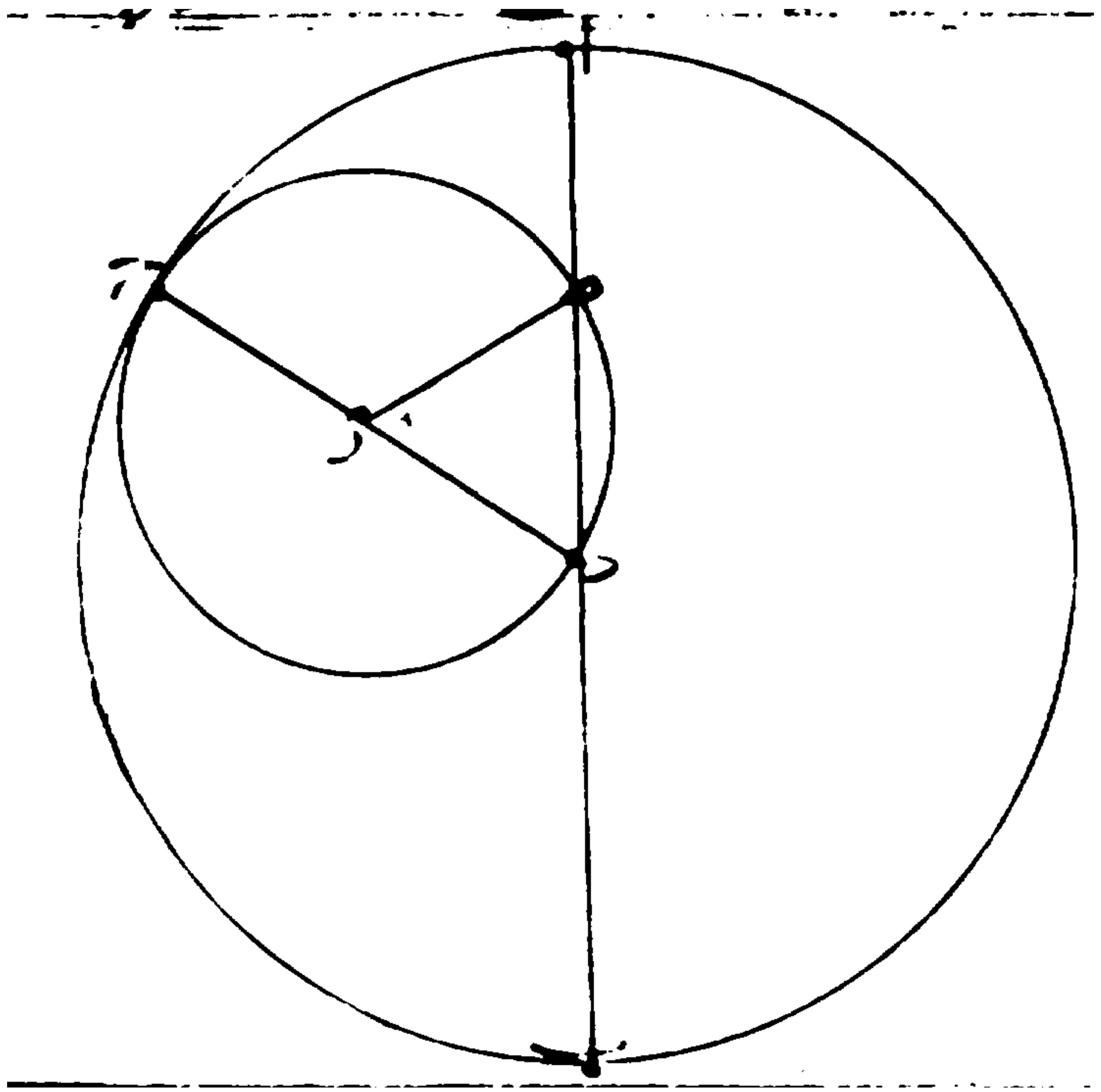
Lettering / Tusi diagram

COPERNICUS, THE MAN, THE WORK, AND ITS HISTORY

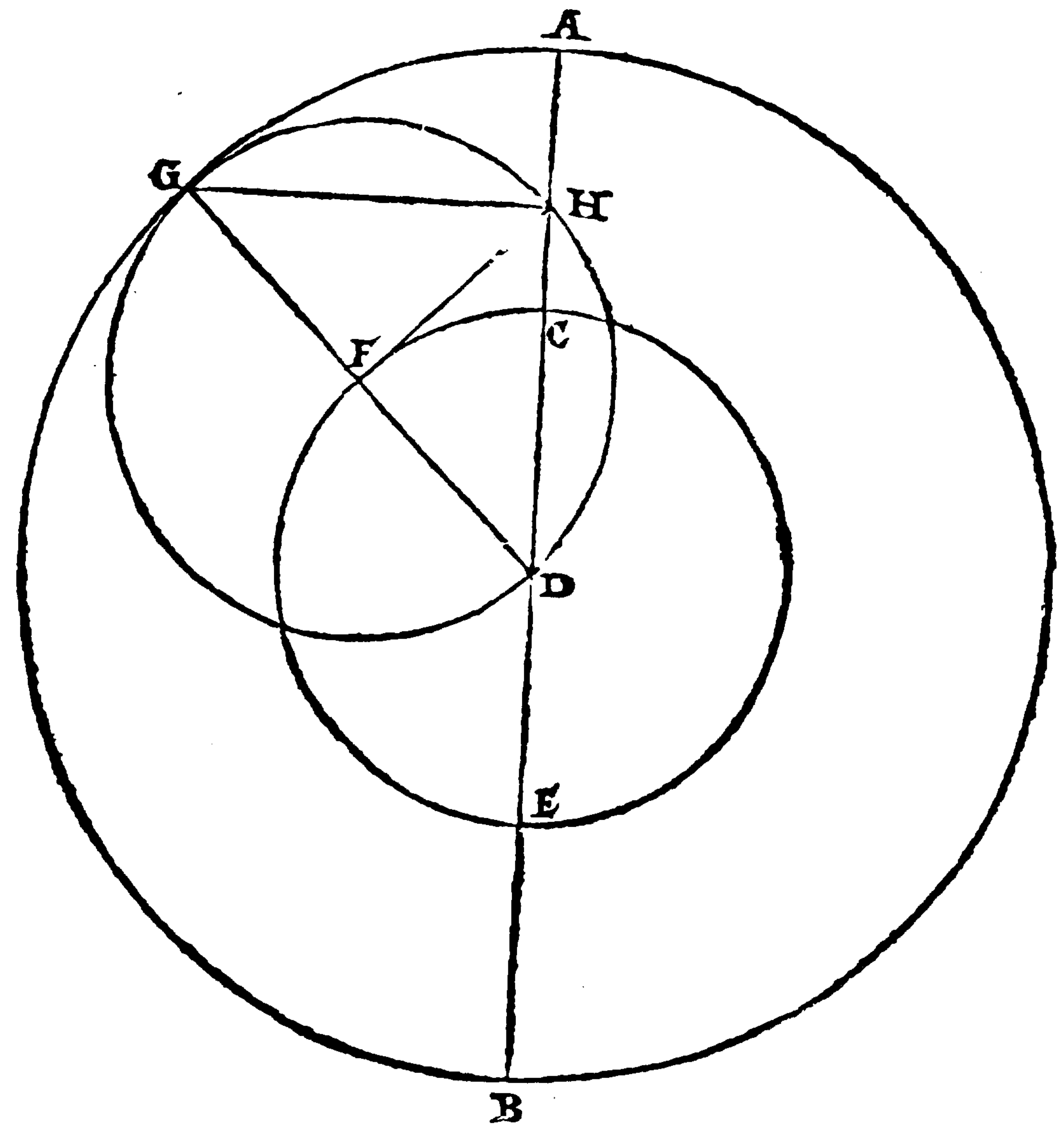
WILLY HARTNER

Professor of the History of Science, Johann Wolfgang Goethe University, Frankfurt

PROCEEDINGS OF THE AMERICAN PHILOSOPHICAL SOCIETY, VOL. 117, NO. 6, DECEMBER 1973



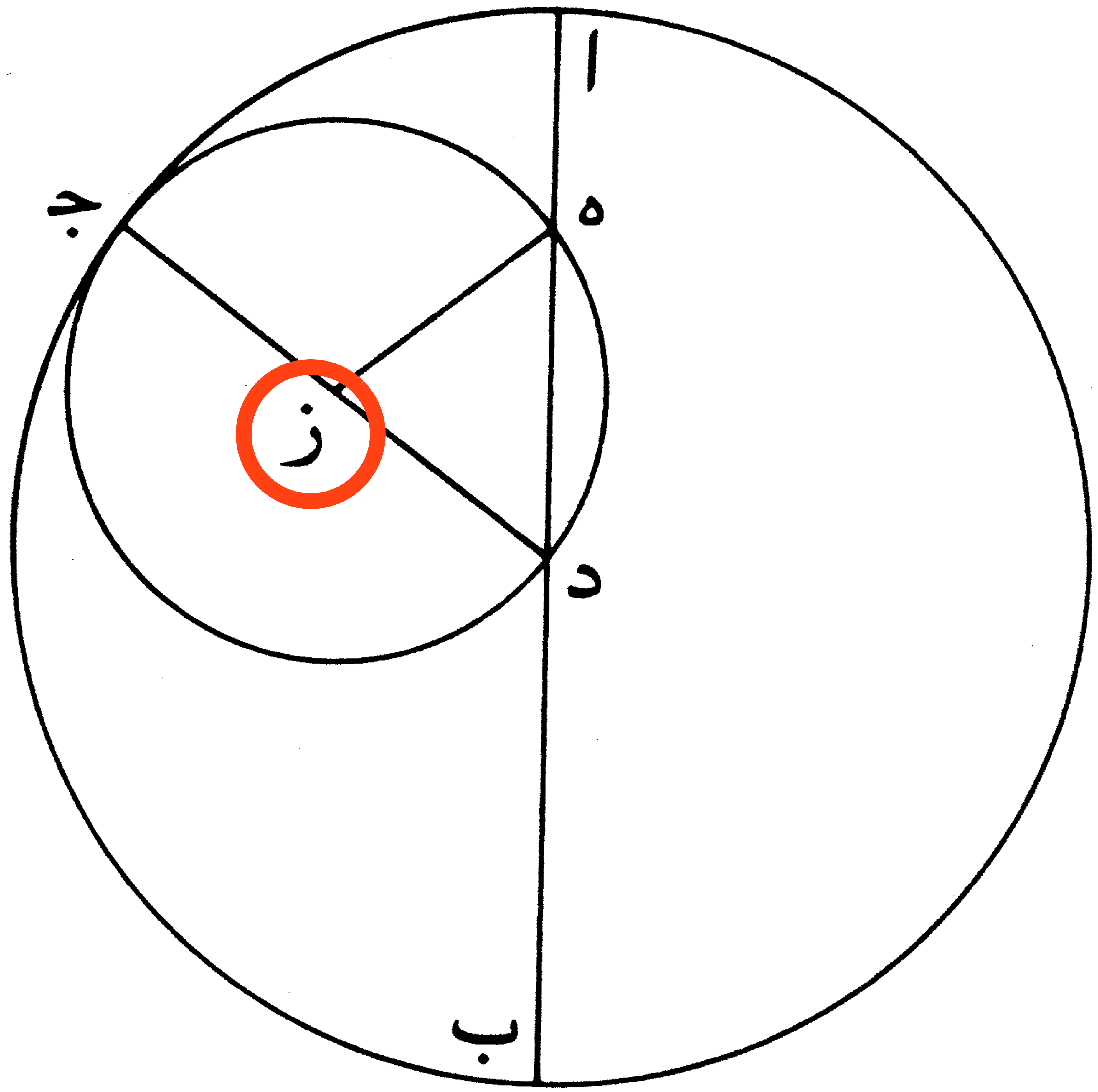
The Ṭūsī couple in Naṣīr al-Dīn's *Tadhkira fī ʿilm al-hay'a*

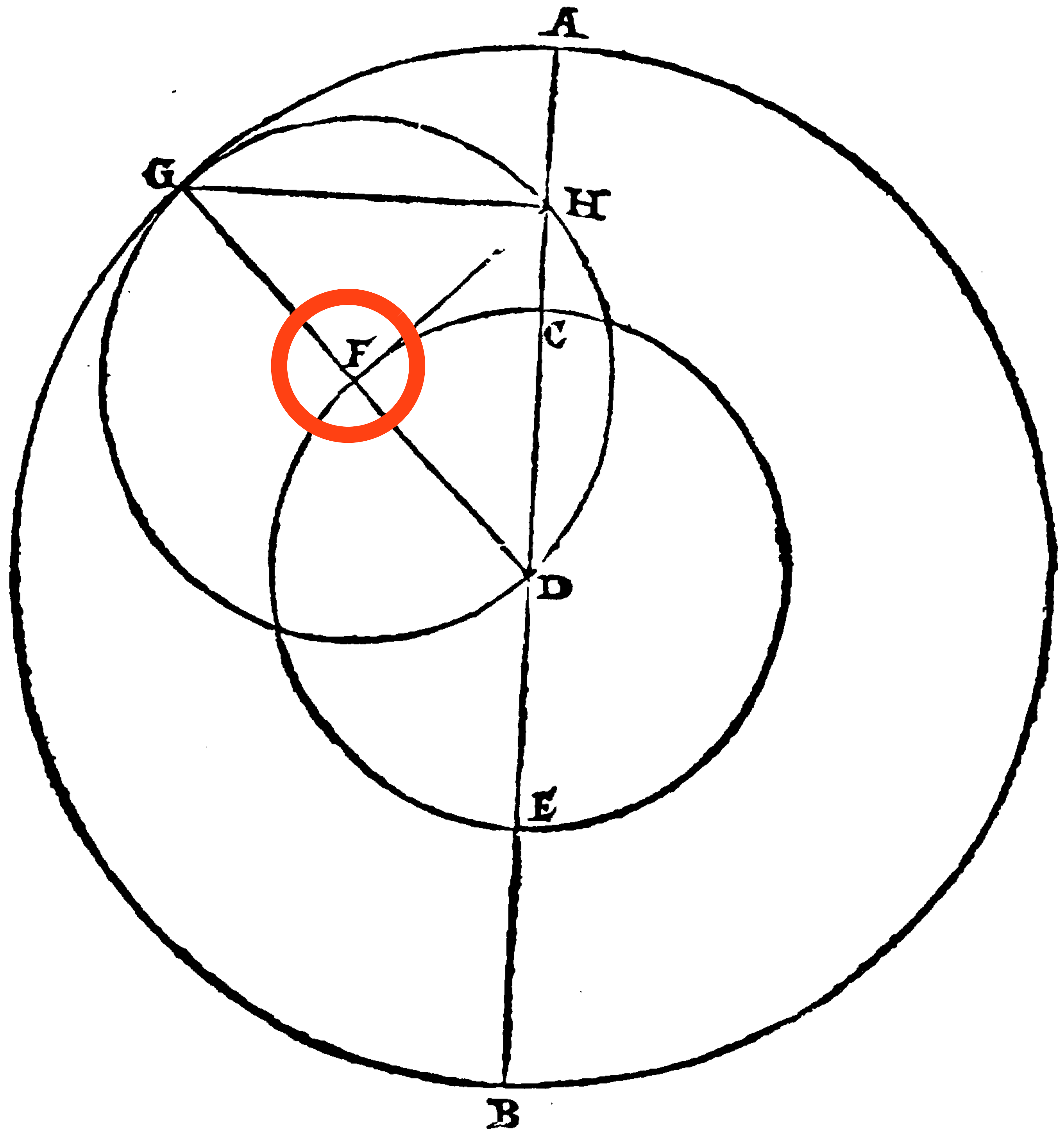


The same in the Editio Princeps of *De revolutionibus* (Nuremberg, 1543), fol. 67a.

However, what proves clearly that we have to do with a case of borrowing, is the lettering of the diagrams found in the Ṭūsī manuscripts and in *De revolutionibus*.

The letters are not even the same.





Copernicus’s *F* needs to be a *Z*.

Desperate attempts to defend an absurd thesis:

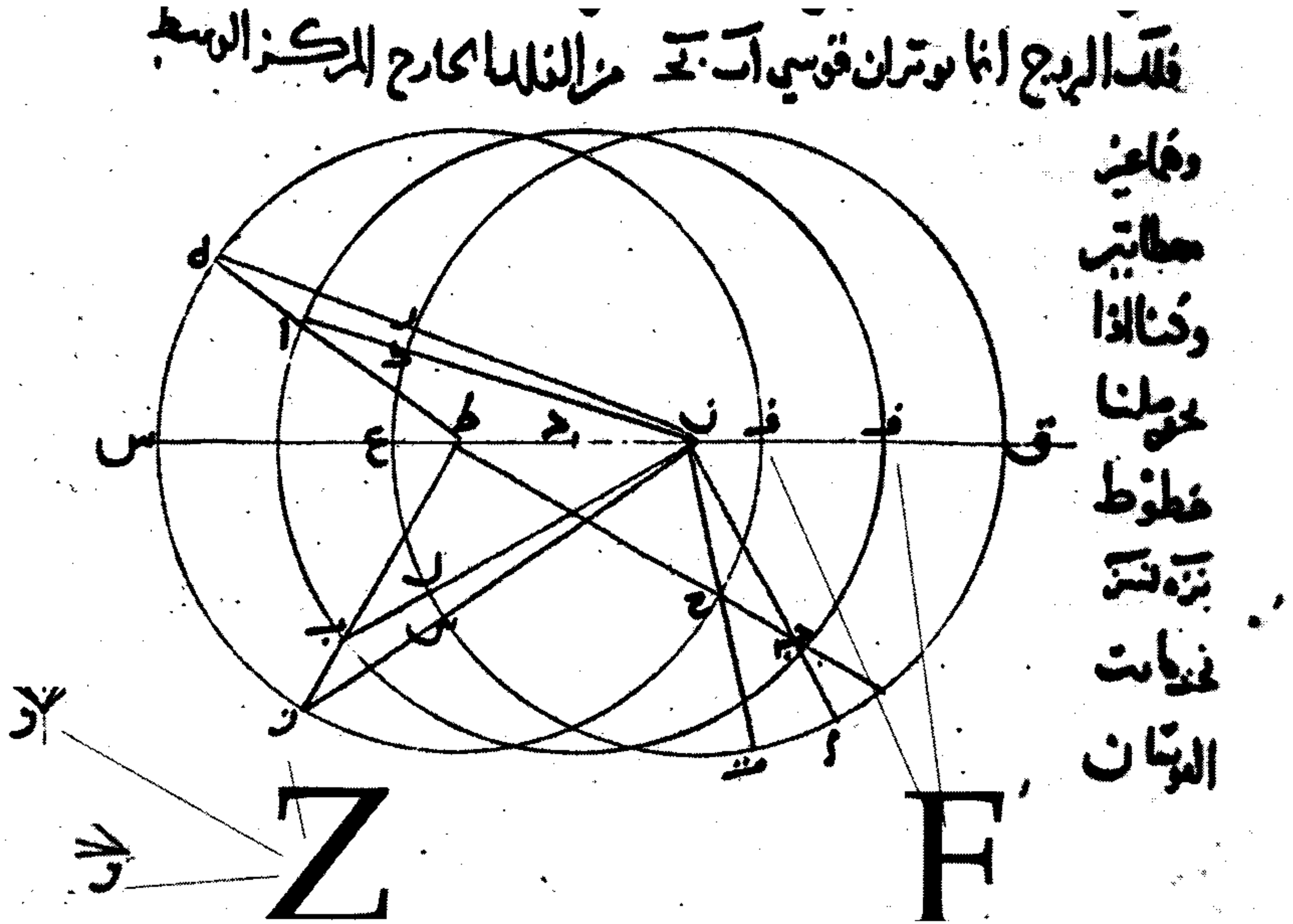
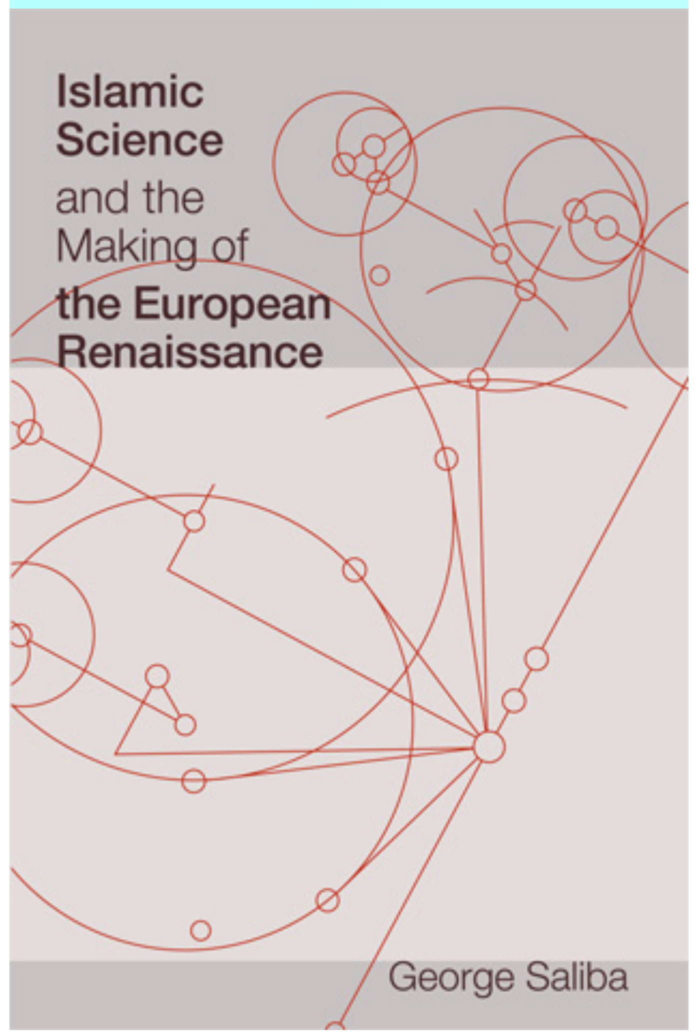


Figure 6.3
A medieval Arabic manuscript exhibiting the similarities between the letters *zain* = *Z* and *fāʾ* = *F*.

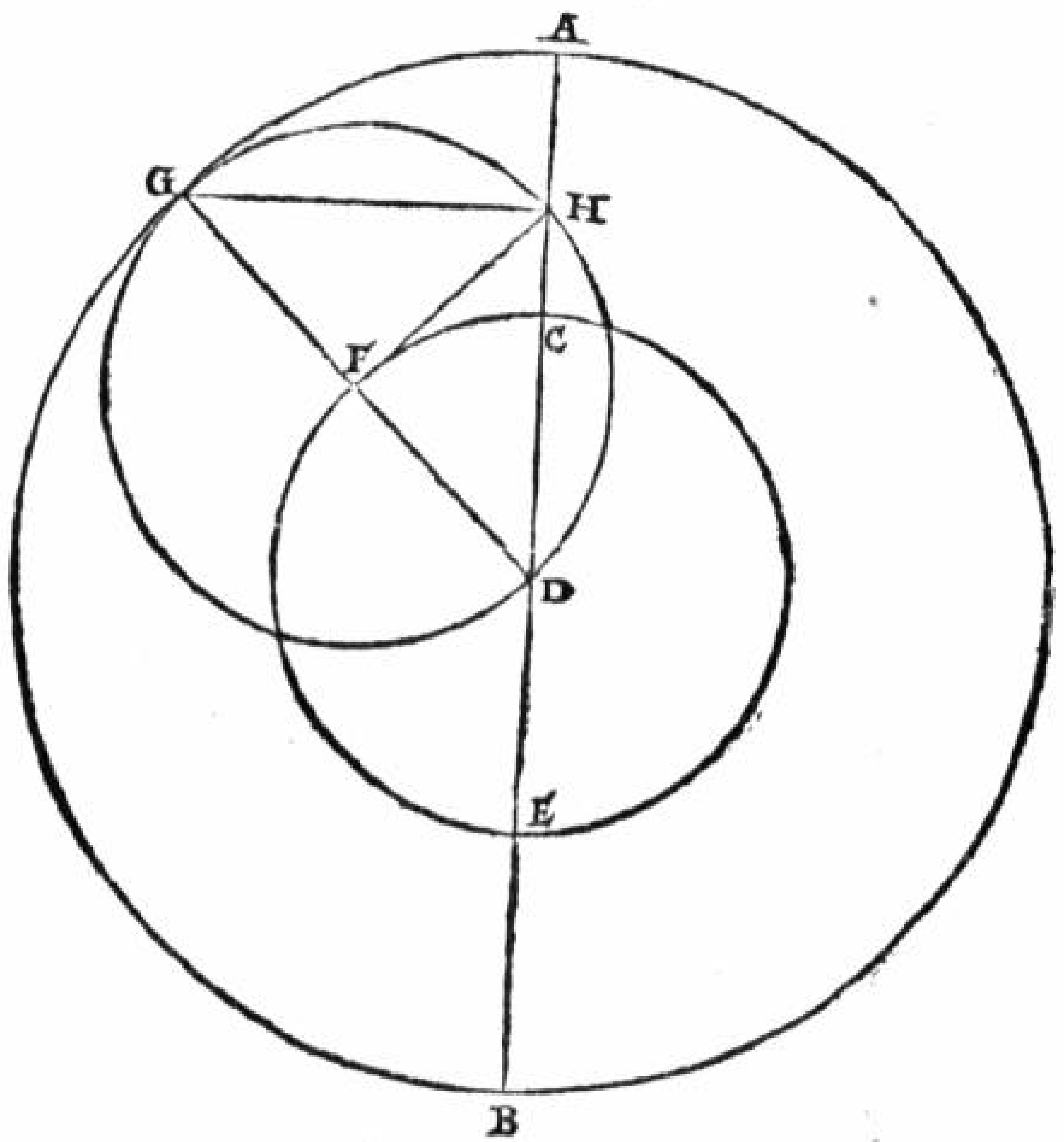
Lettering argument still repeated uncritically today in scholarly publications, such as:

Ragep, F. J.. Copernicus and his Islamic Predecessors: Some Historical Remarks. *History of Science* 45 (2007), 65–81.



Saliba, George. *Islamic Science and the Making of the European Renaissance*. MIT Press, 2007.

QVod igitur iste motus apparentijs consentiat am-
modo declarabimus. Interim uero quæret aliquis, quo nam modo possit illarum librationum æqualitas intelligi, cum à principio dictum sit, motum cęlestem æqualē esse, uel ex æqualibus ac circularibus cōpositum. Hic aūt utrobiq; duo motus in uno apparēt sub utrisq; terminis, qbus necesse est cessationē interuenire. Fatebimur quidem geminatos esse, at ex ęqualibus hoc modo demonstrant. Sit recta linea A B, quę quadrifariā secetur in C D E signis, & in D describātur circuli homocentri, ac in eodē plano A D B, & C D E, & in circūferentia interioris circuli assumat utcūq; F signū, & in ipso F cētro, interuallo uero F D circulus describatur G H D, qui



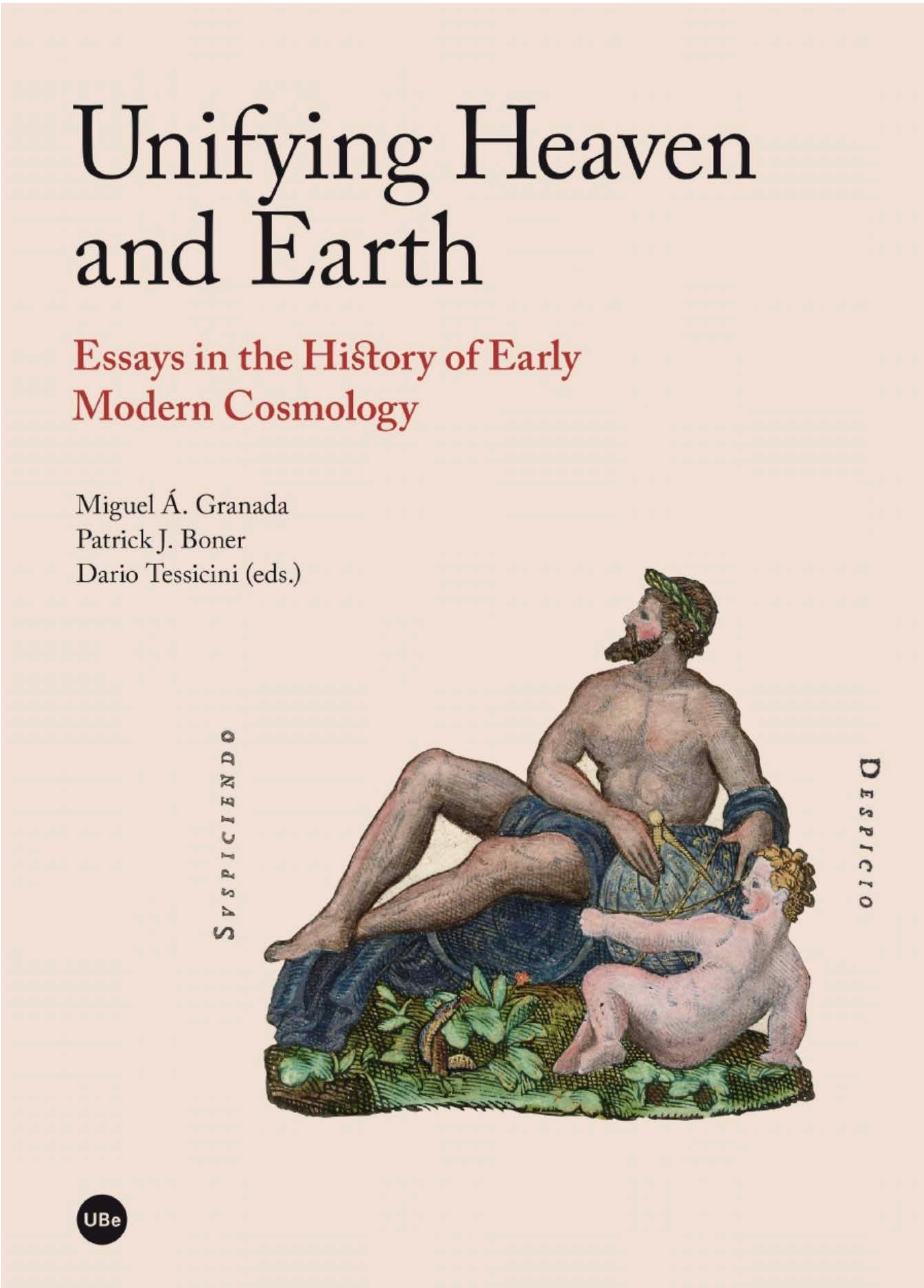
secet A B rectā lineā in H signo, & agat dimetiēs D F G. Ostēdendū est, q; geminis motibus circulorū G H D & C F E cōcurrētibus inuicē H mobile p eandē rectam lineā A B hinc inde reciprocādo repat. Quod erit, si intelligat H moueri in diuersam partē, & duplo magis ipso F. Quoniā idē angulus, q sub C D F in cētro circuli C F E & circūferētia ipsius G H D cōsistēs cōpræhēdit utrāq; circūferentiā circulorū ęqliū G H duplā ipsi F C, posito q; aliquādo in cōiunctiōe rectarū linearū A C D & D F G mobile H fuerit in G cōgruente cū A, & F in C. Nūc aūt in dextras ptes p F C motū est centrū F, & ipsum H p G H circumferentiā in sinistras duplo maiores ipsi C F.

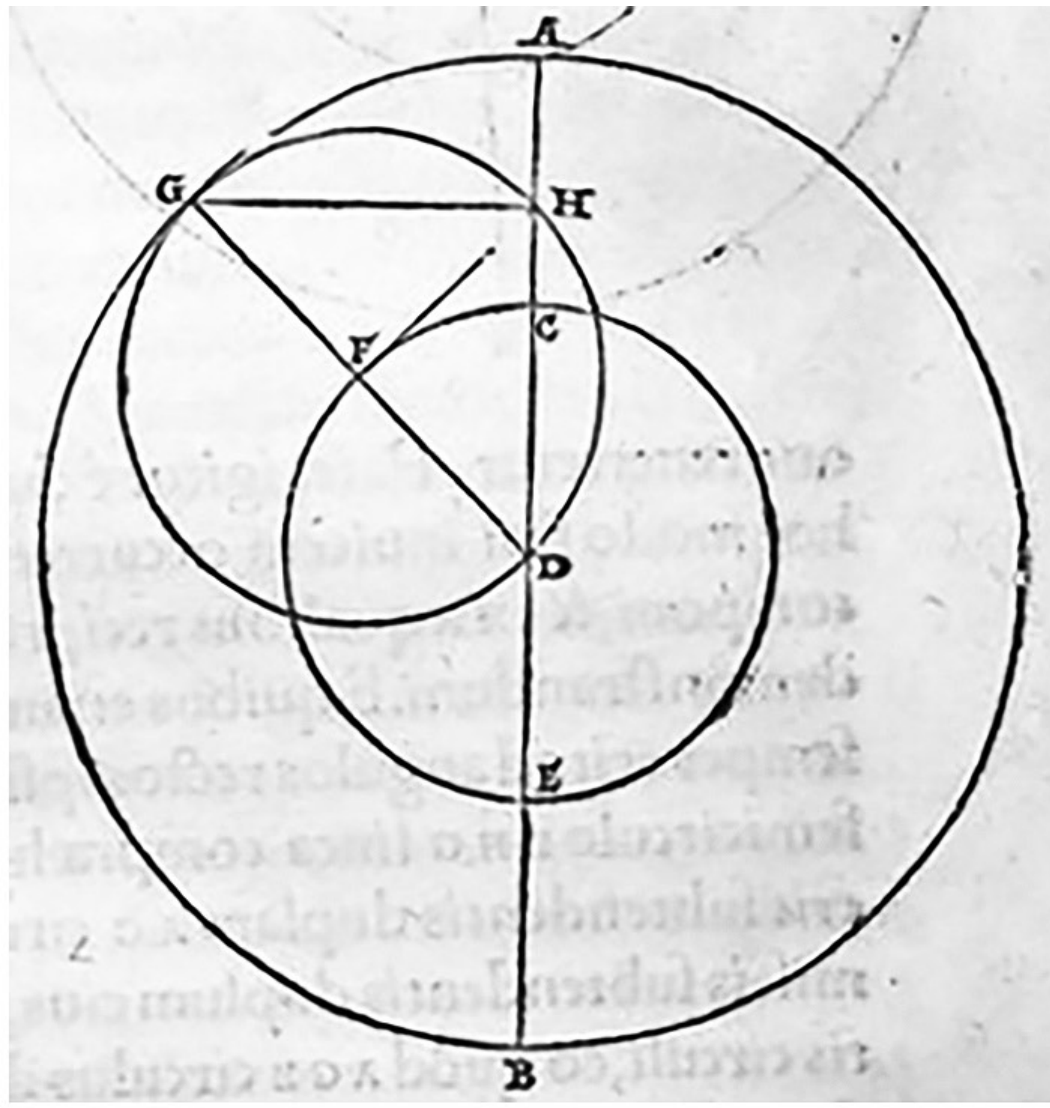
r iij uel

Copernicus's lettering is alphabetical (following the order of the proof),

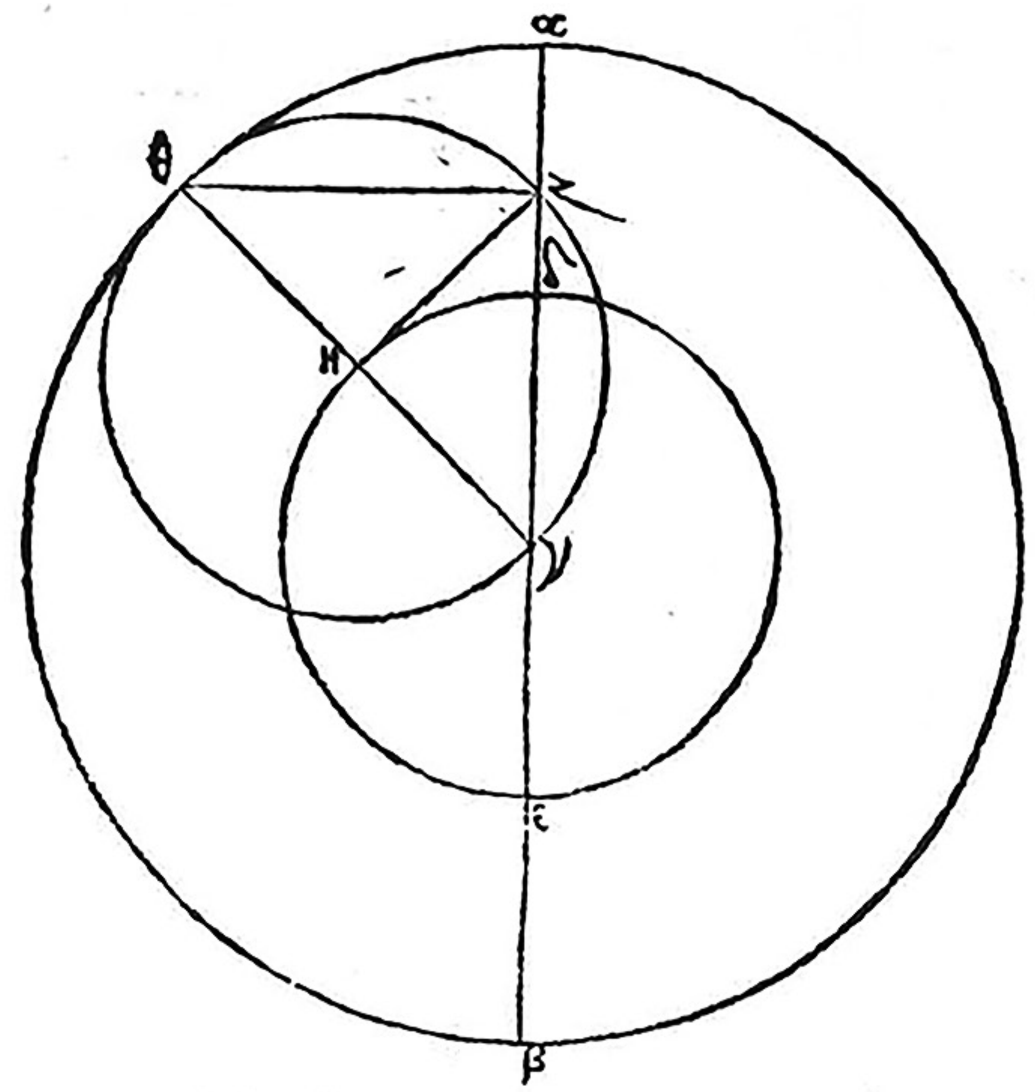
i.e., the most natural lettering possible.

[Barker & Heidarzadeh (2016)] Peter Barker & Tofigh Heidarzadeh, Copernicus, the Tusi Couple and East-West Exchange in the Fifteenth Century, in: Miguel Á. Granada, Patrick J. Boner & Dario Tessicini (eds.), *Unifying Heaven and Earth: Essays in the History of Early Modern Cosmology*, Publicacions i Edicions de la Universitat de Barcelona, 2016, 19–57.

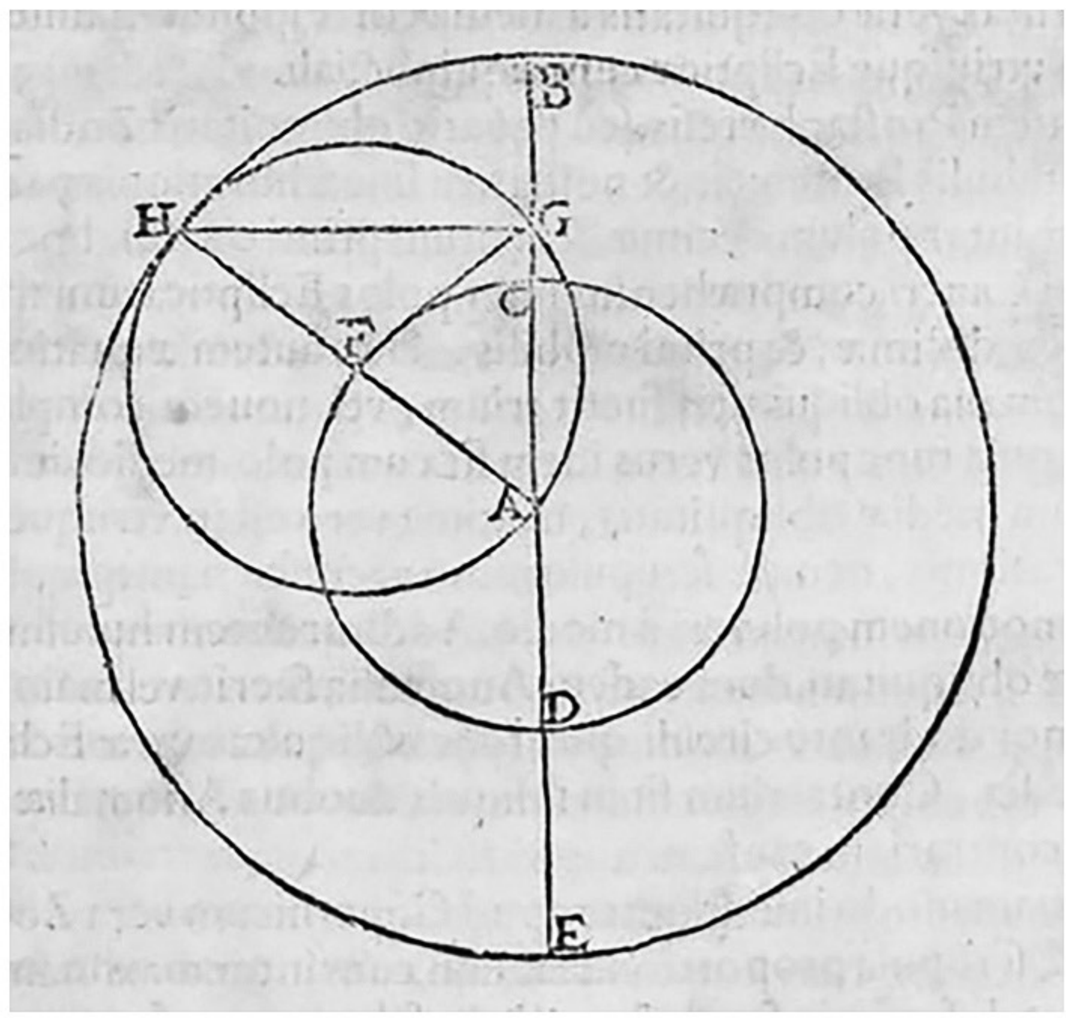




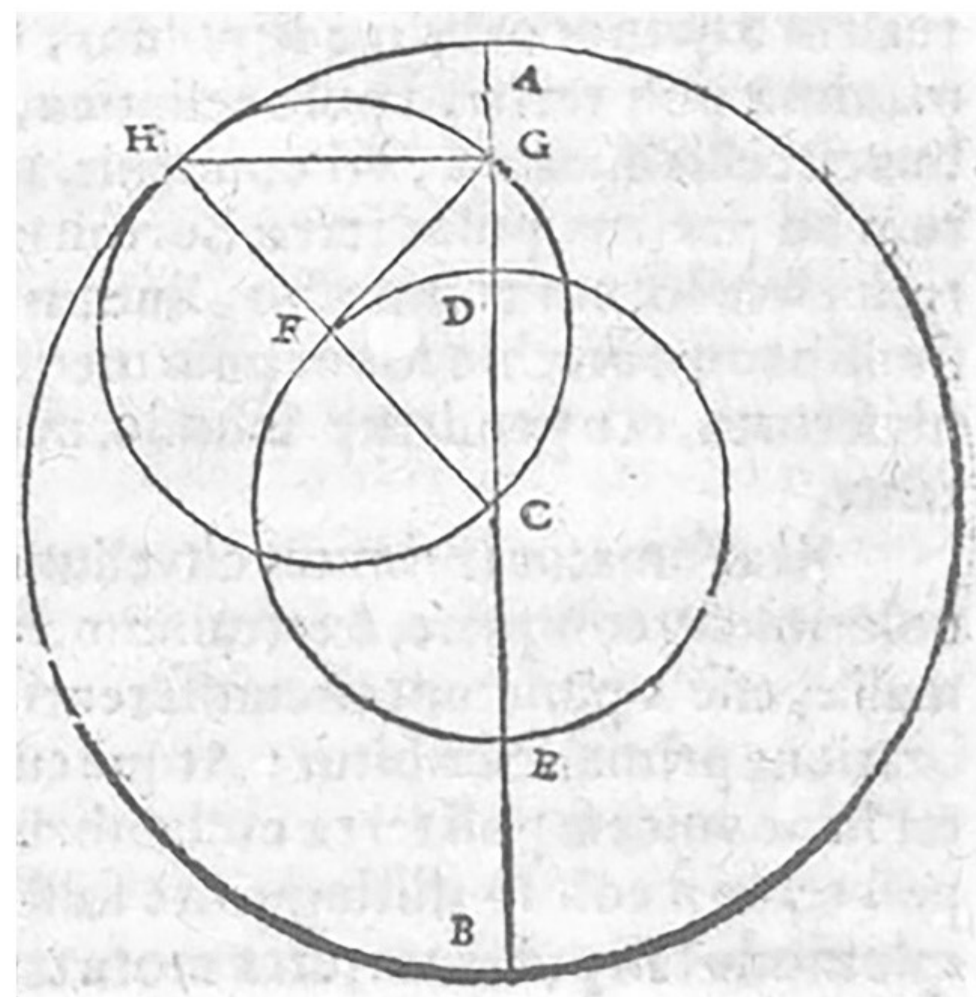
Copernicus (1543)



Hypotyposes (1568)

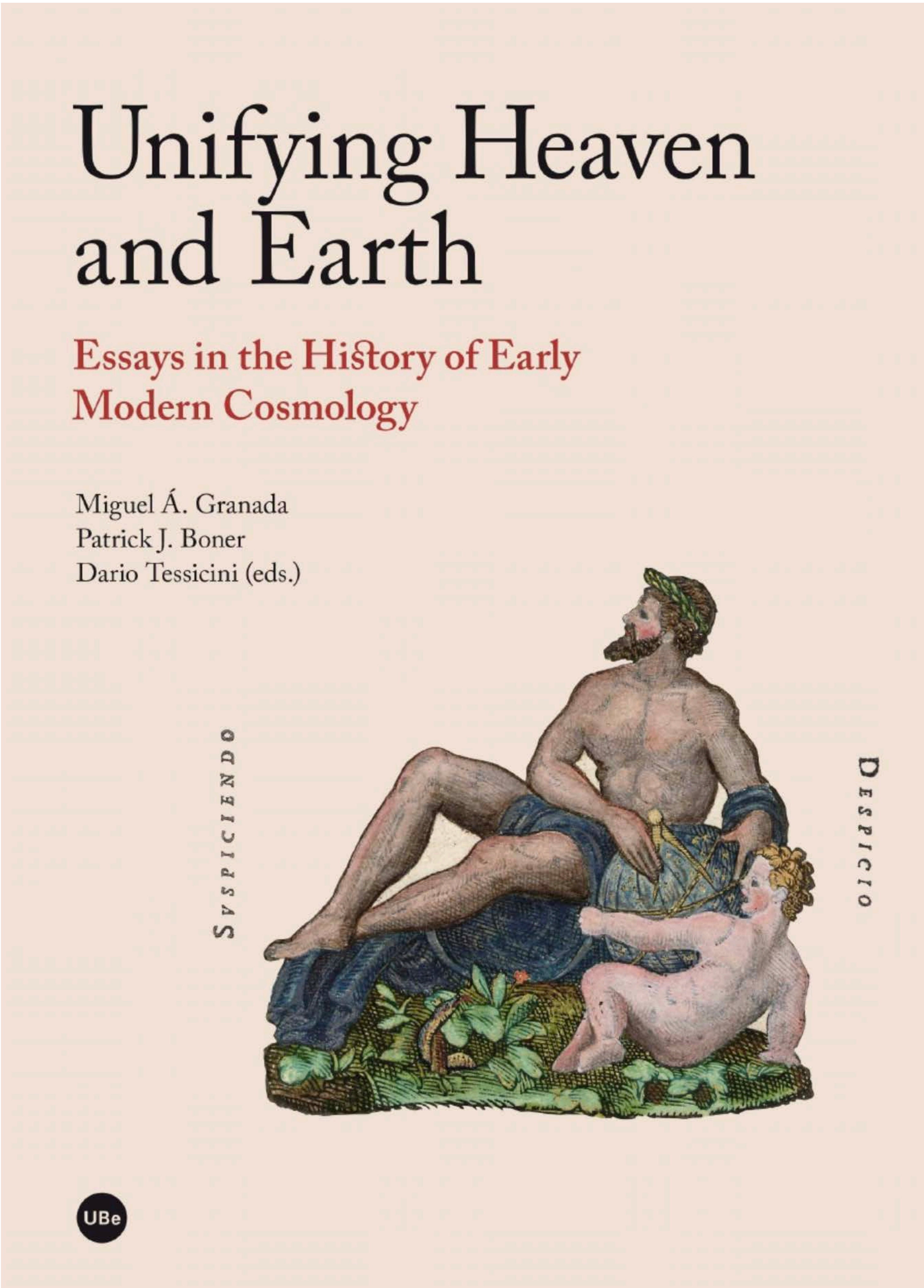


Magini (1589)

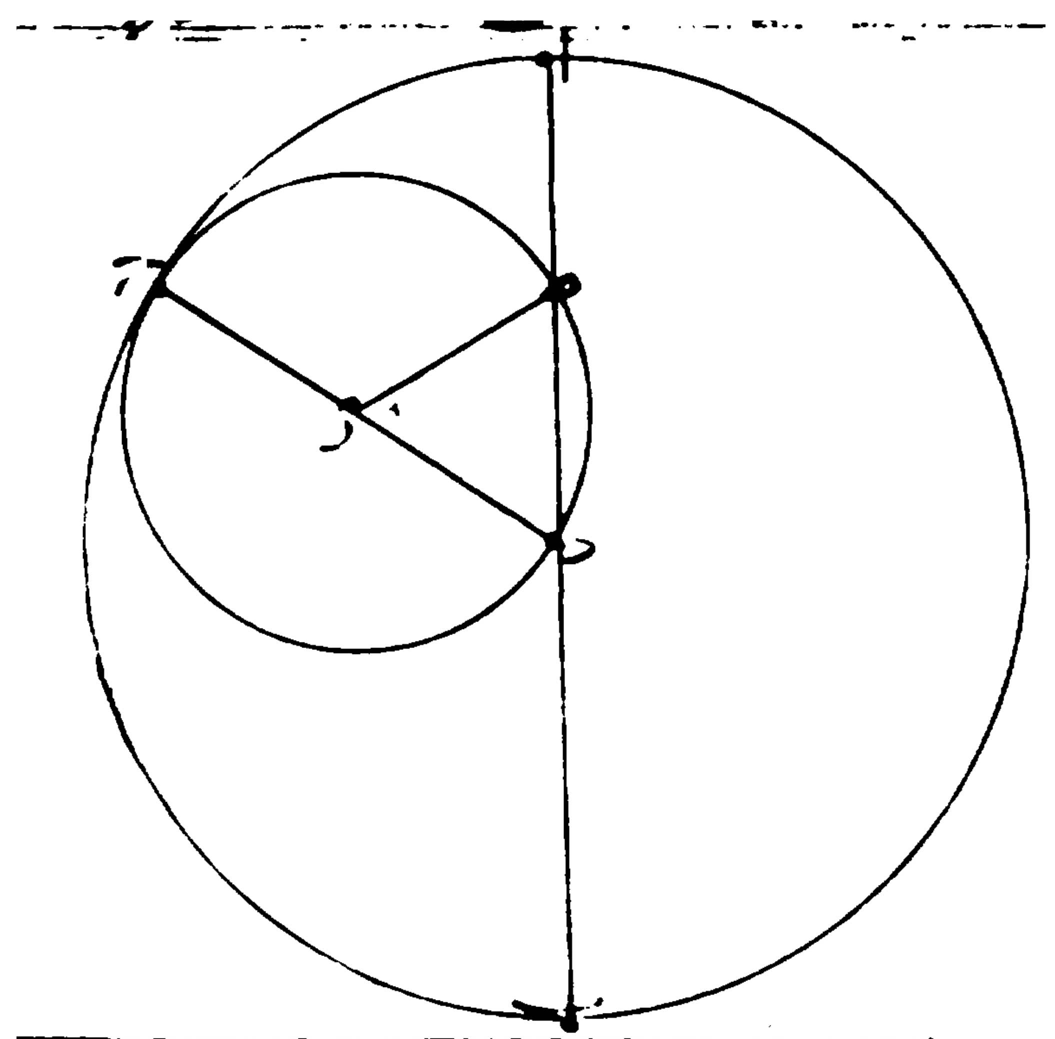


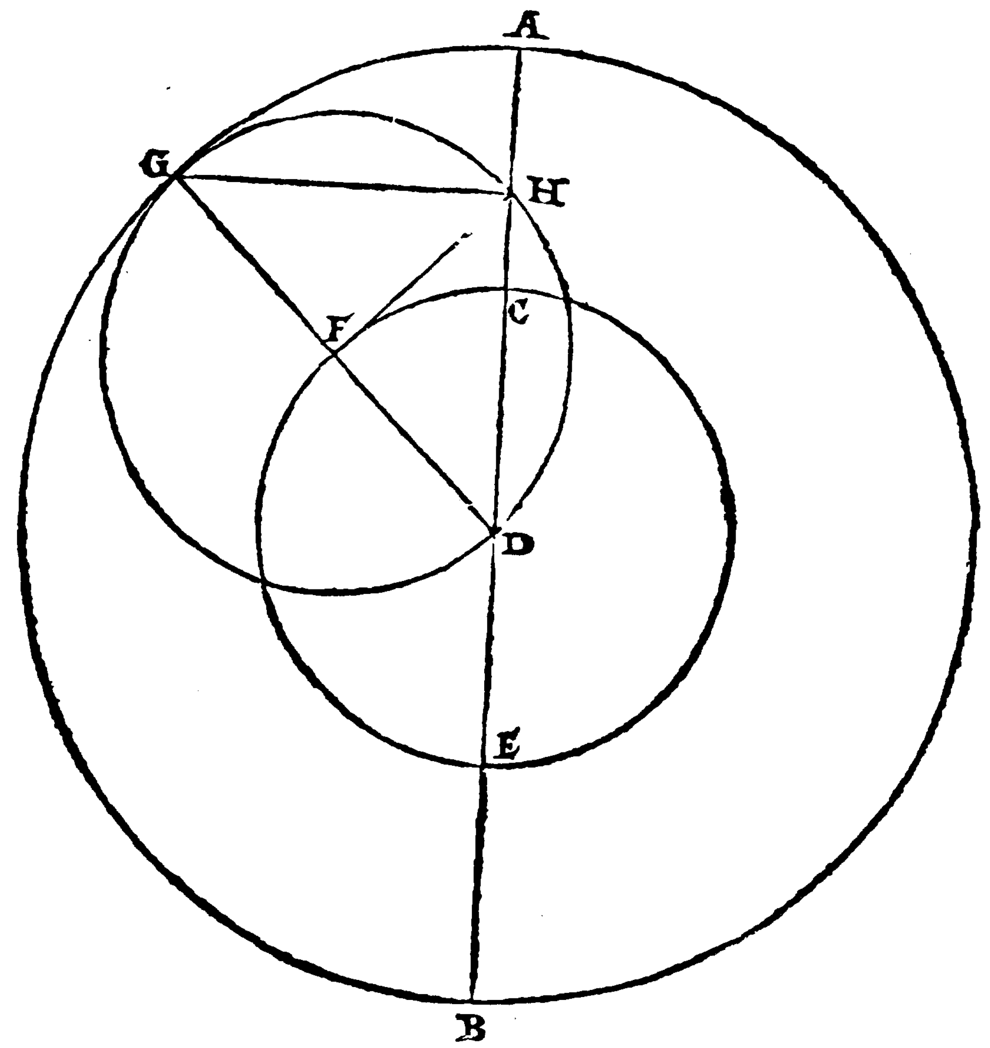
Maestlin (1596)

[Barker & Heidarzadeh (2016)] Peter Barker & Tofigh Heidarzadeh, Copernicus, the Tusi Couple and East-West Exchange in the Fifteenth Century, in: Miguel Á. Granada, Patrick J. Boner & Dario Tessicini (eds.), *Unifying Heaven and Earth: Essays in the History of Early Modern Cosmology*, Publicacions i Edicions de la Universitat de Barcelona, 2016, 19–57.



Why the same position of epicycle (top left) and direction of rotation (counterclockwise; "perhaps influenced by the convention of reading Arabic script from right to left")?





Nonsense, since this is the standard Ptolemaic convention.

HISTORIA SCIENTIARUM Vol. 33–1 (2023)

The Origin of the Reciprocation Device in Copernicus: Proclus In and Ṭūsī Out

Ken'ichi TAKAHASHI*

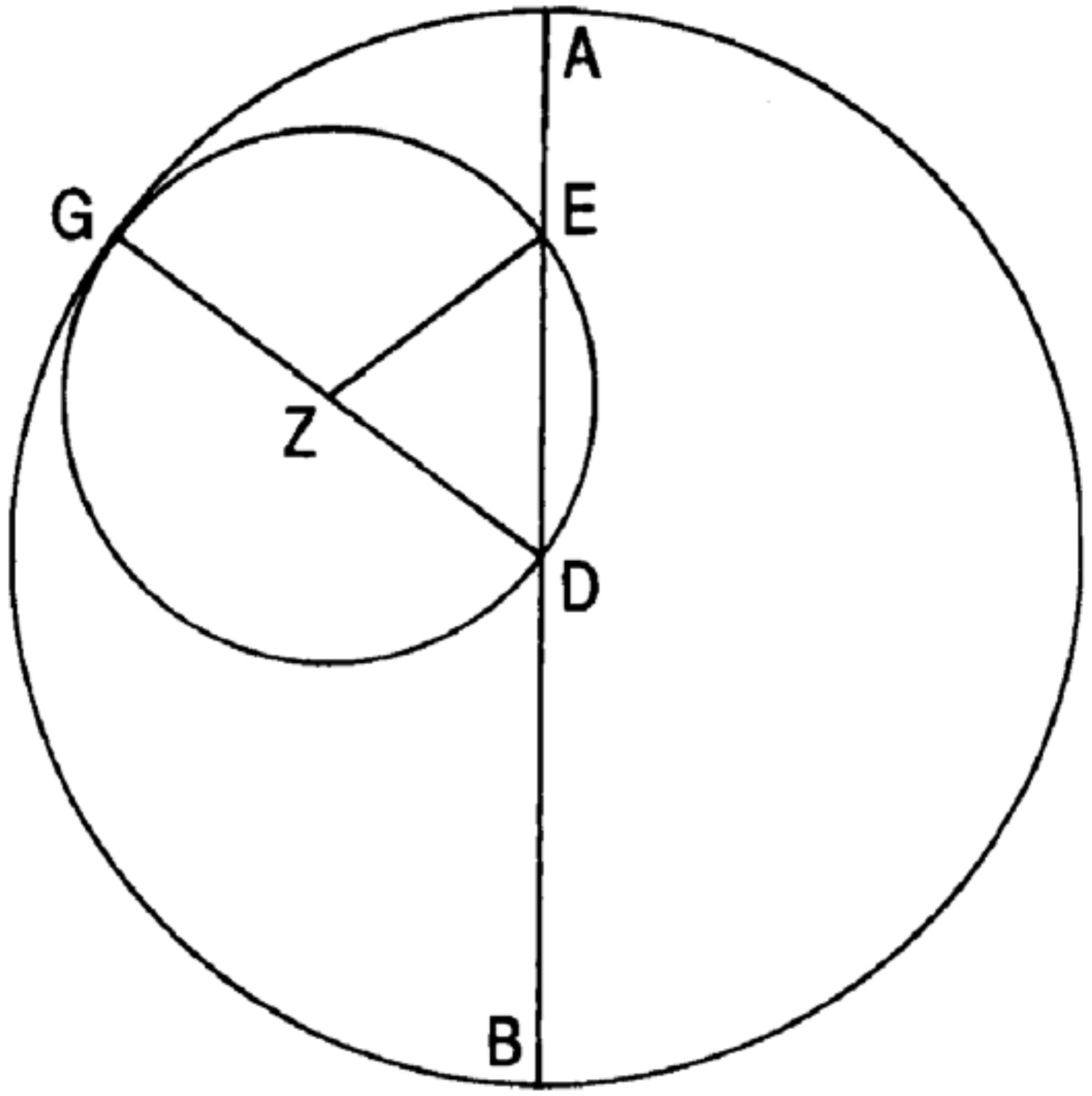


Fig. 1. Ṭūsī

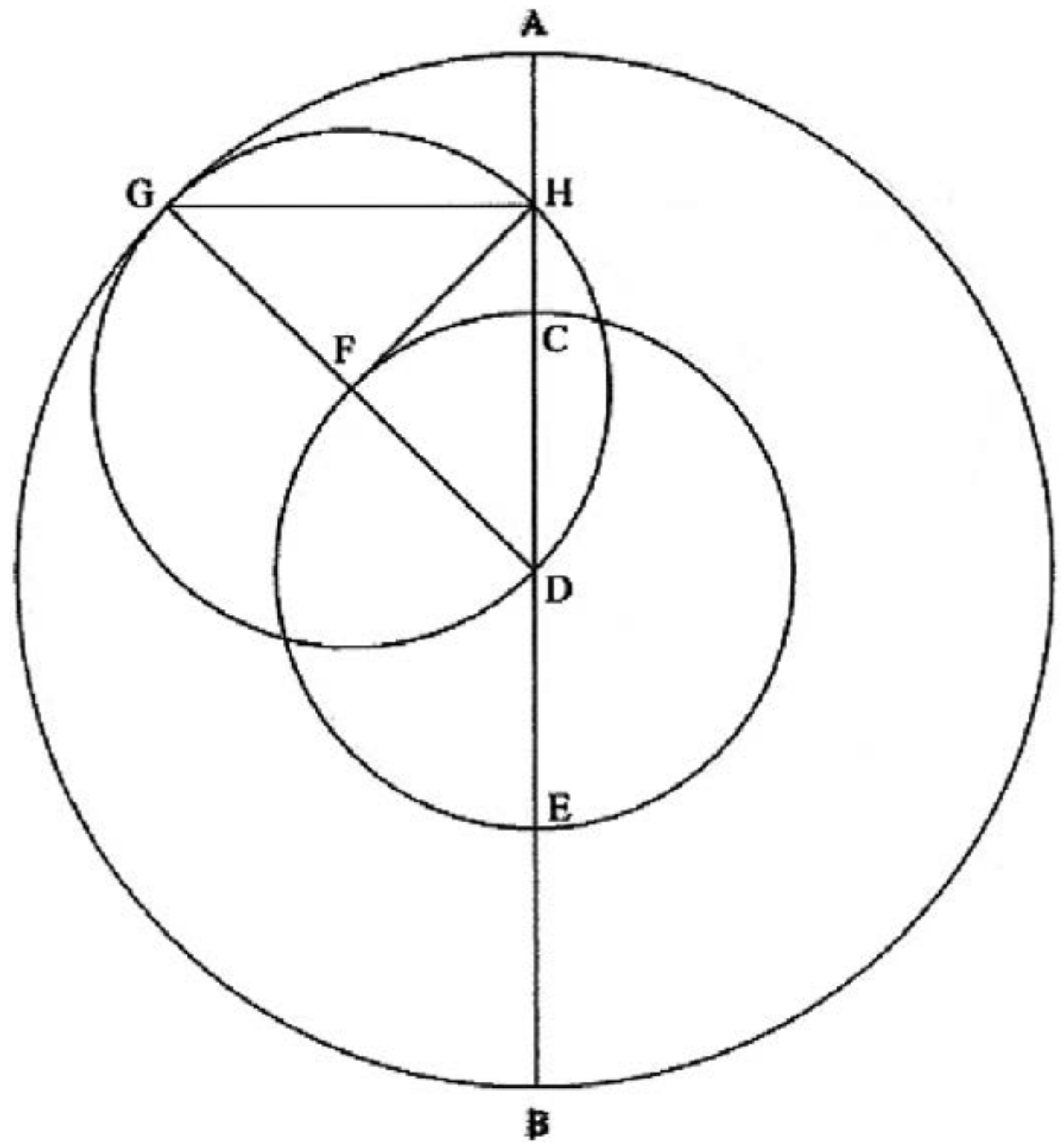
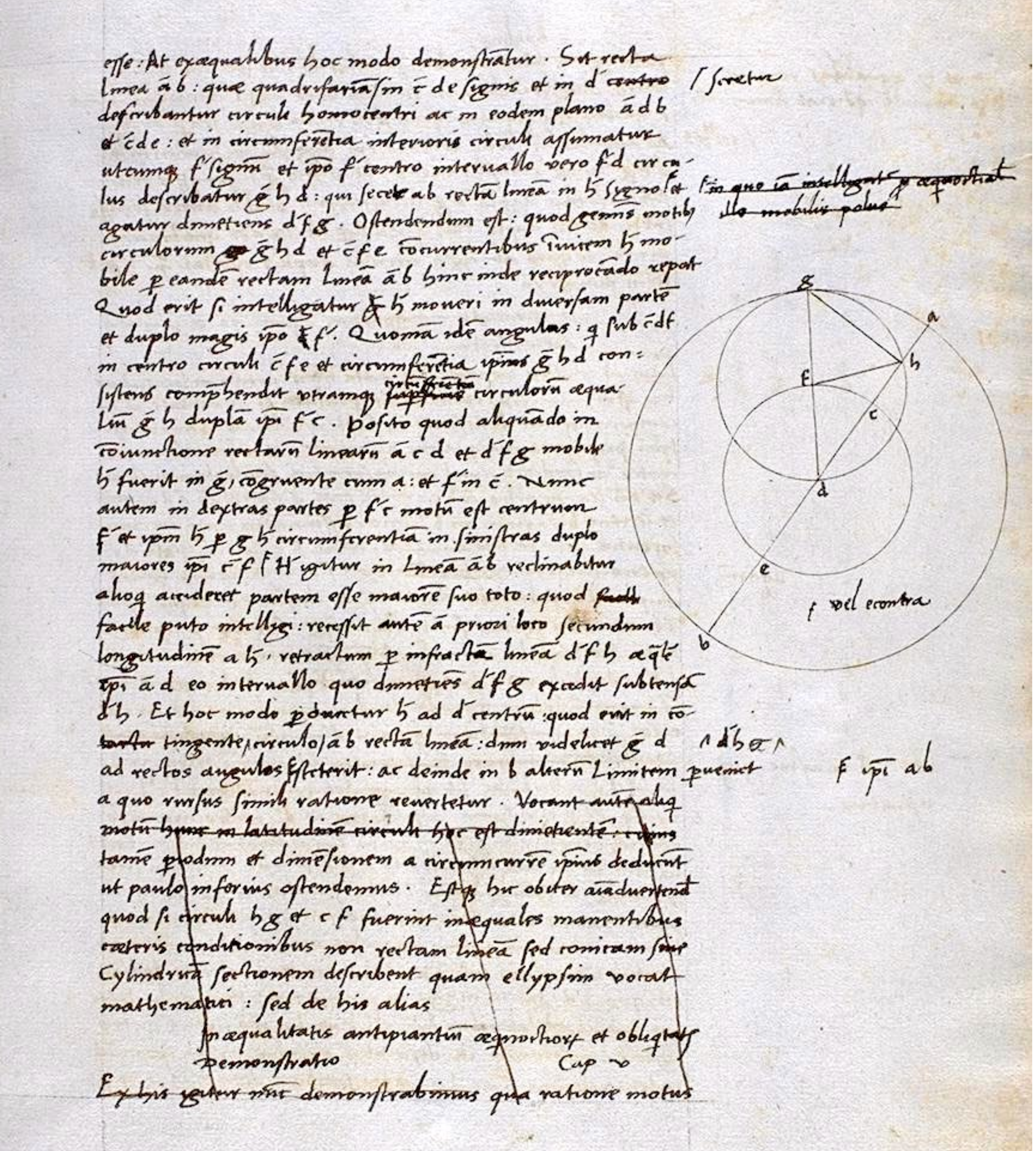


Fig. 2. Copernicus

necessary to see beforehand what components of their diagrams are indispensable to produce linear harmonic motion respectively for their mathematical proofs. In Ṭūsī (Fig. 1), they are both a moving point G on a large circle AGB and a point E moving on a small circle GED. In Copernicus (Fig. 2), however, they are points F and H moving respectively on small equal circles CFE and GHD, with *no use* of a large circle AGB. However, many historians seem to let their arguments get started just from a mere comparison of two diagrams, which, I am afraid, has unnoticeably narrowed their argument spheres and driven to wrong directions.

To sum up, our reconstructed diagram of the device (Fig. 5) tells us where lies the essential difference between Ṭūsī (Fig. 1) and Copernicus (Fig. 2): It is the difference of the function of large circle AGB; Copernican circle is employed, on the one hand, to show the amplitude of oscillation, which really is a convenient and easier way to show it, considering the lack of it in both Fracastoro and Amico, and on the other, to calculate the prostaphaereses geometrically; In contrast, Ṭūsīan large circle is employed to evade the physical illegitimacy of intersection of material two small equal spheres by introducing a large sphere which encompasses a smaller one.

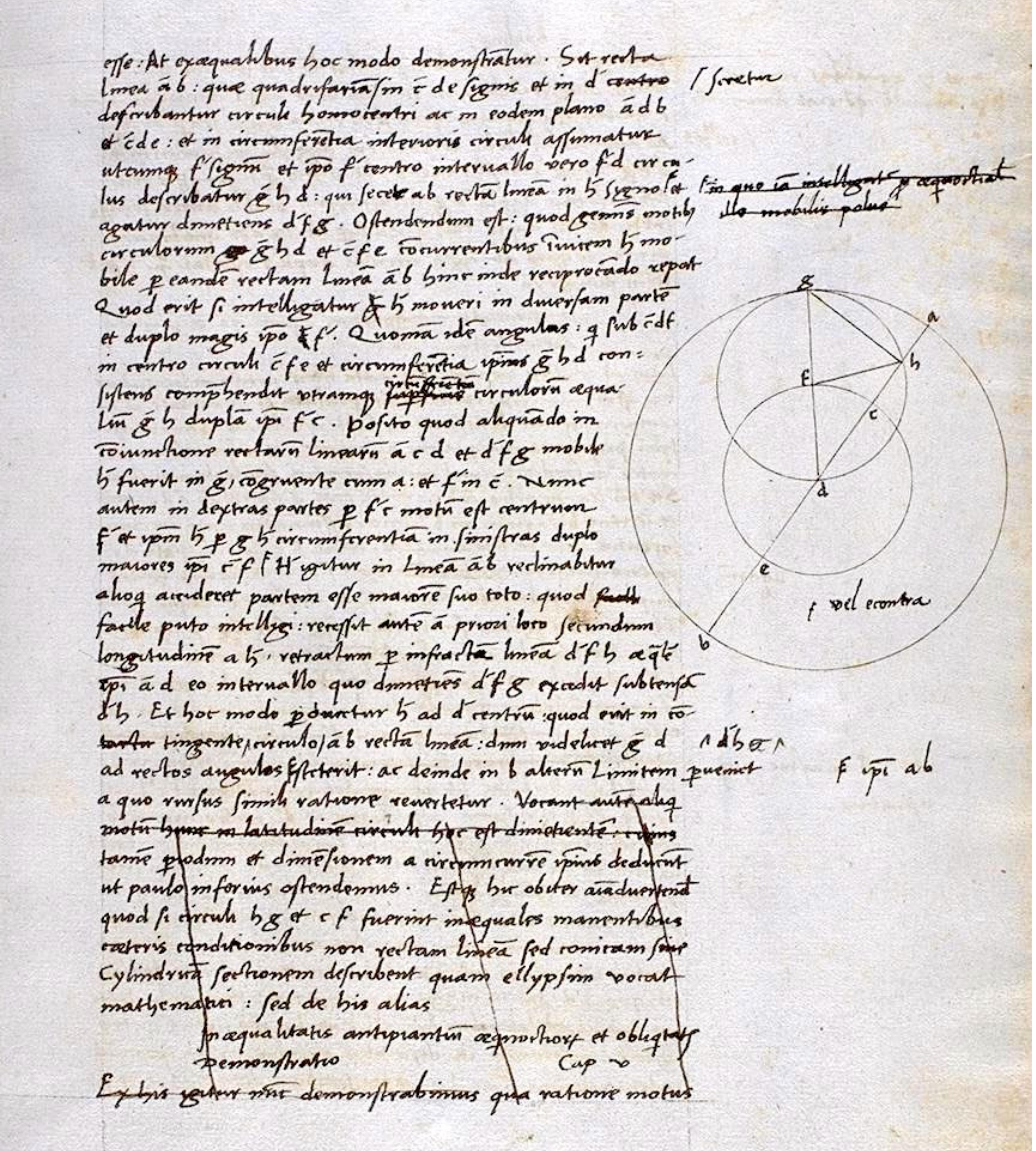
“Some have called this”



Copernicus’s autograph manuscript:

← Tusi couple explained.

← “Some have called this …”

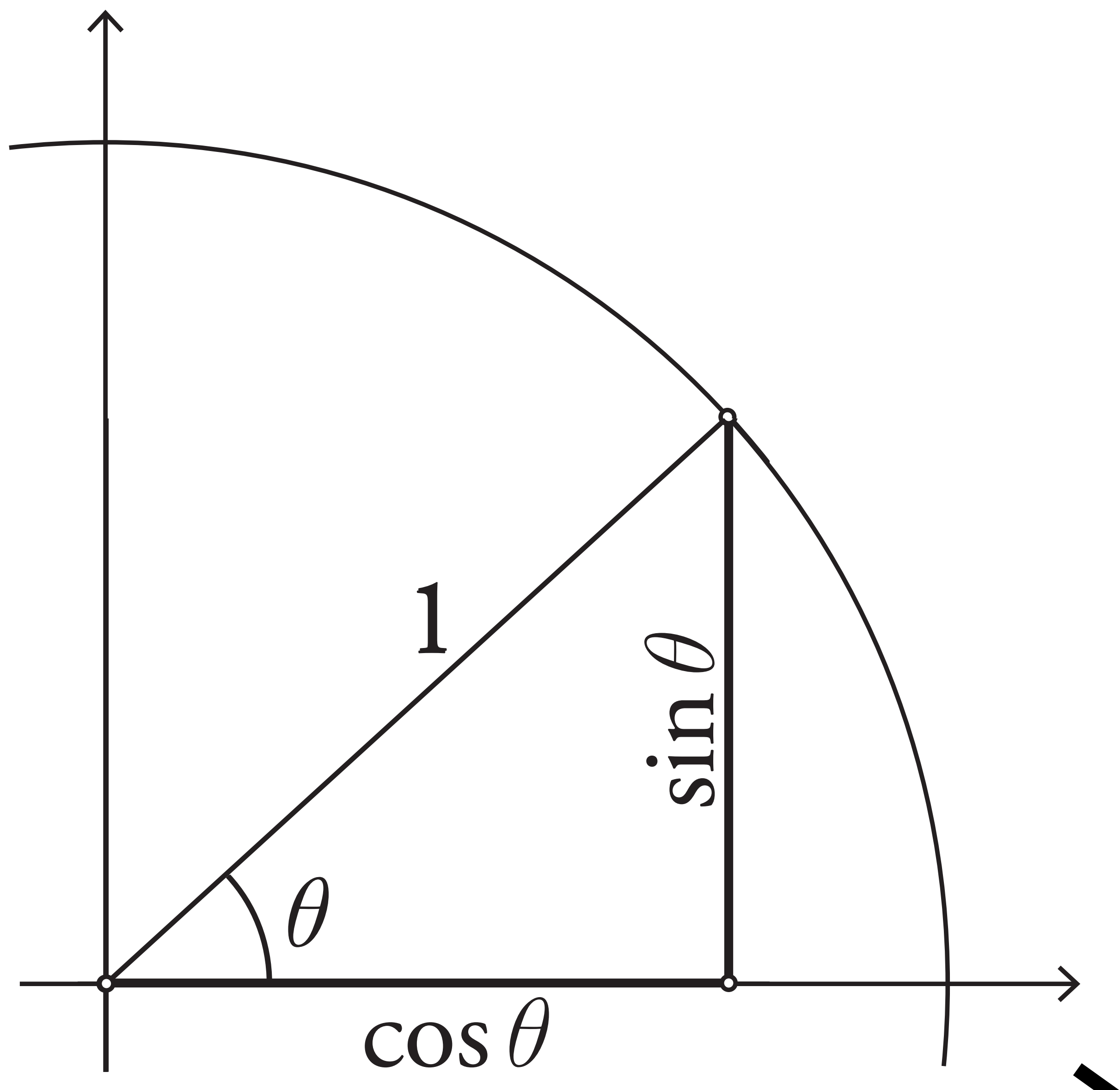


Copernicus's autograph manuscript:

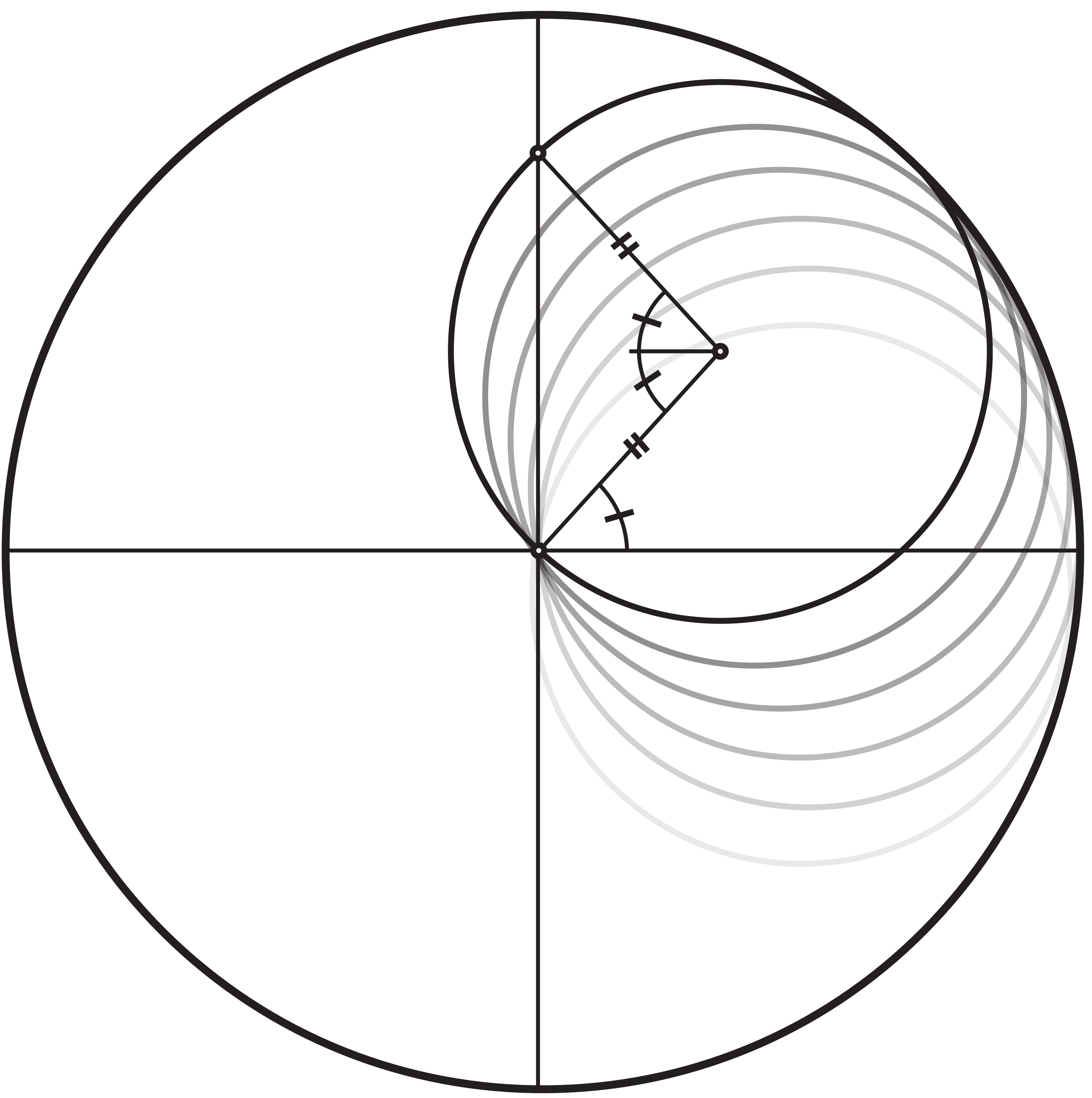
← Tusi couple explained.

←results in simple harmonic motion, y = cos(t)

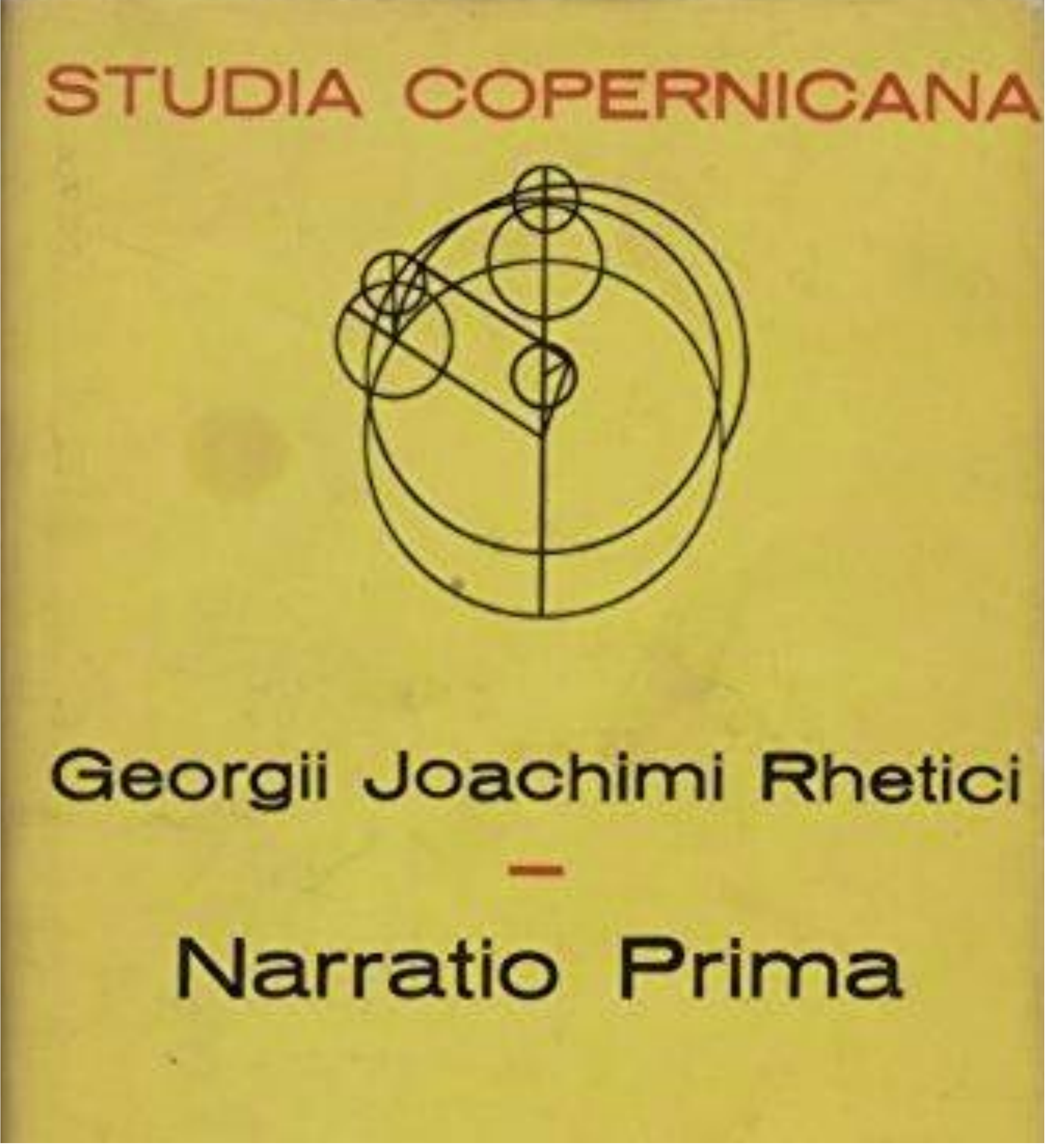
← "Some have called this …"



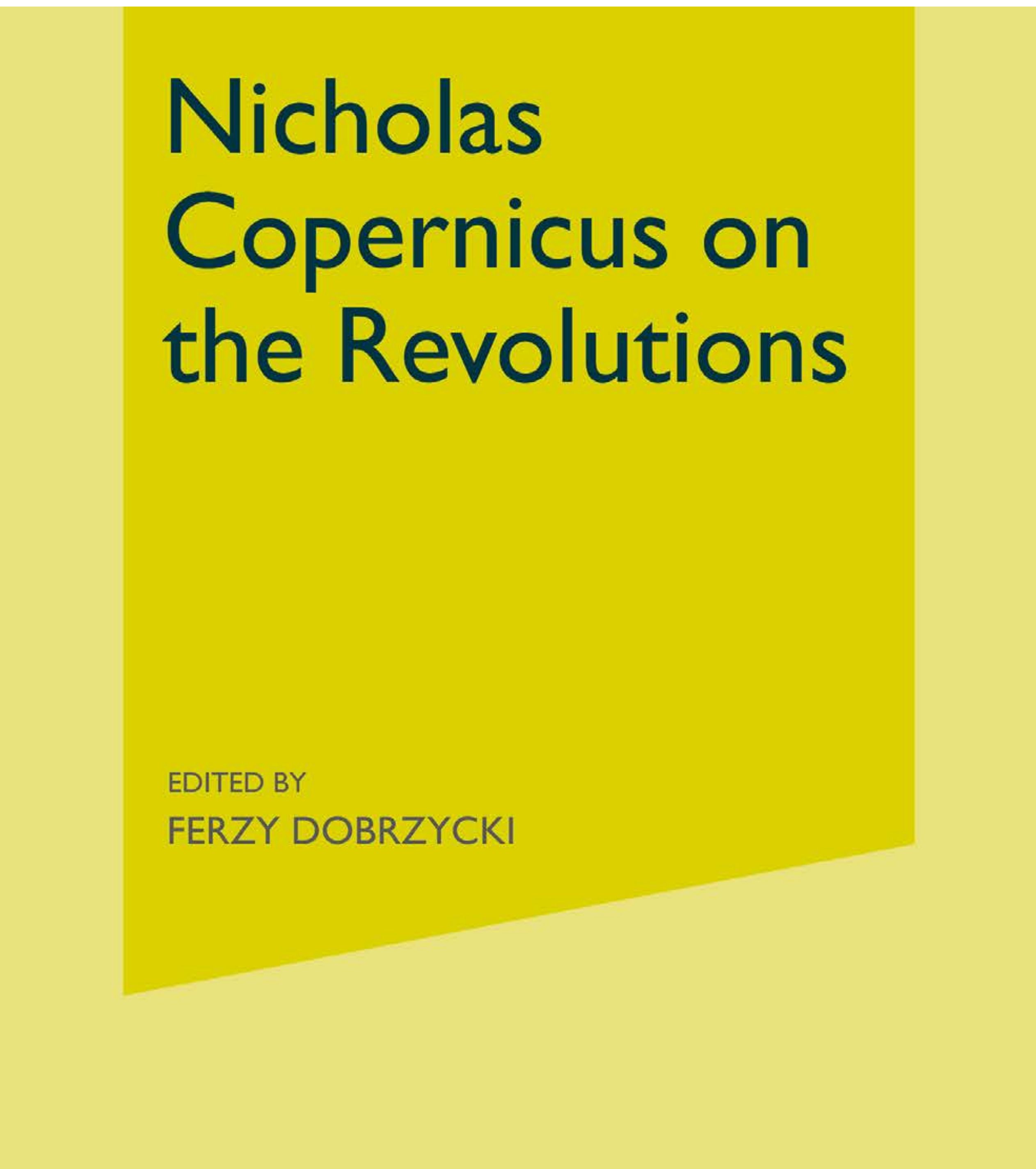
simple harmonic motion arises naturally in many contexts



$$y = \cos(t)$$

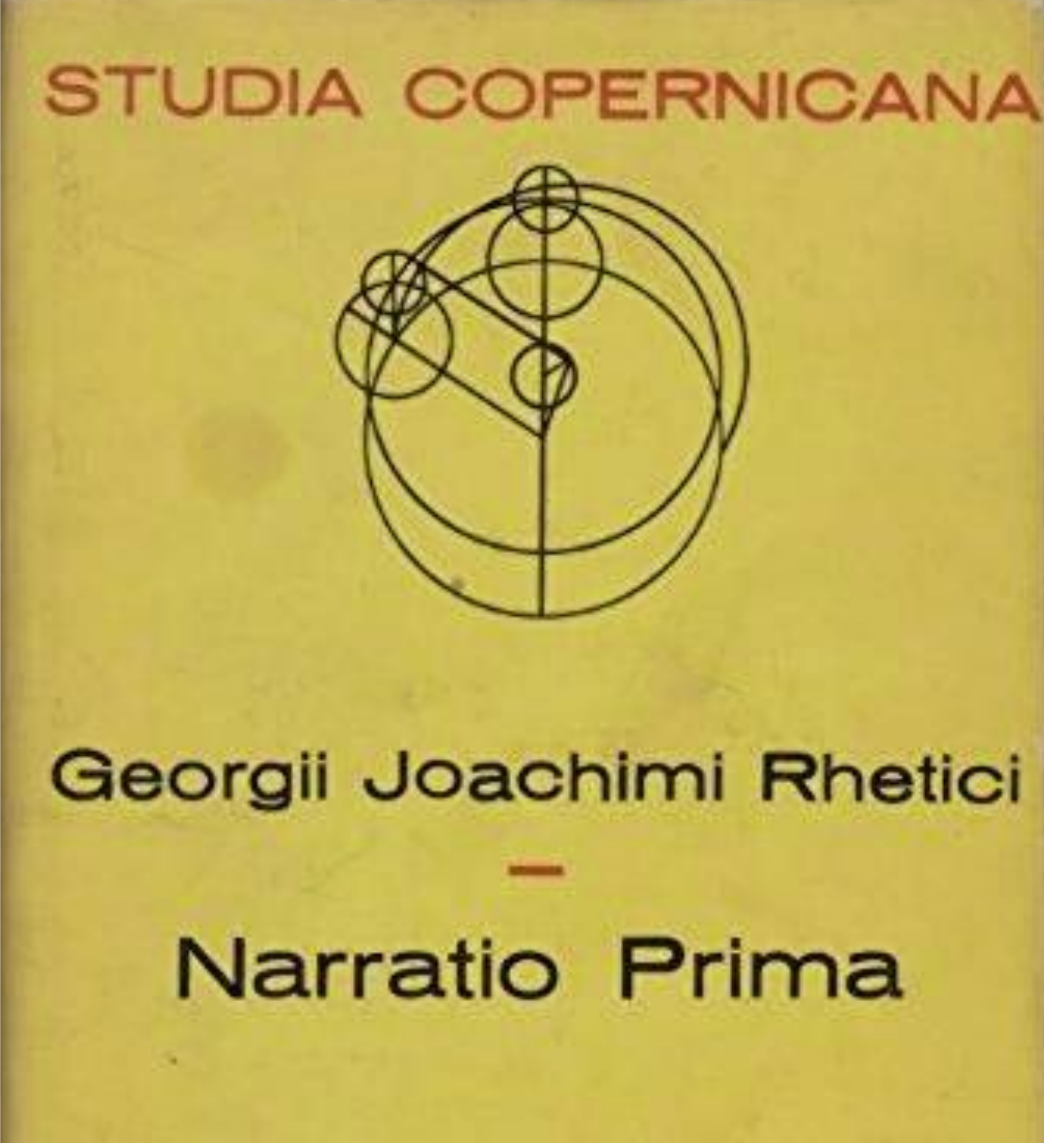


“it resembles the motion of objects hanging in the air”



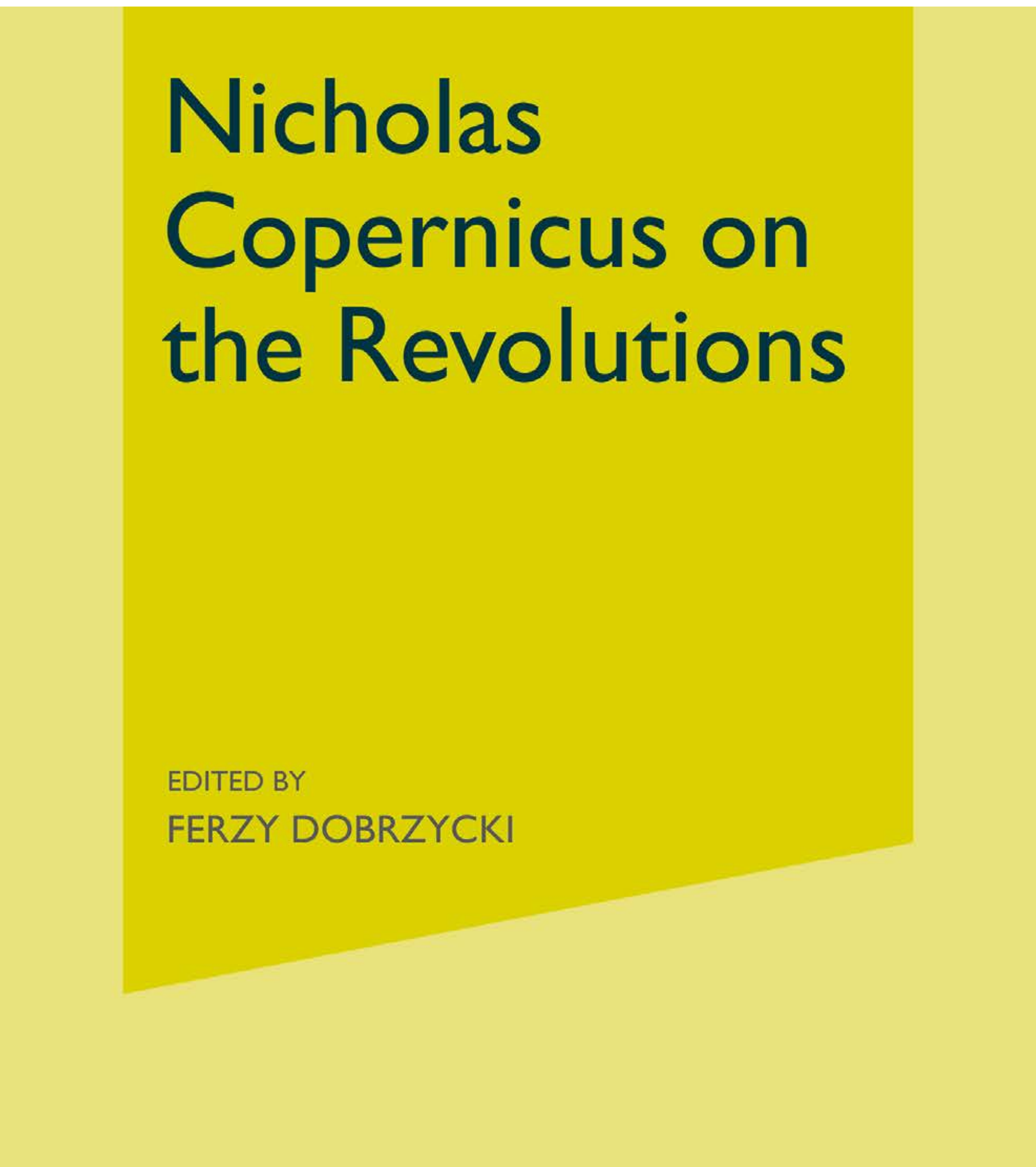
“like objects swinging along the same path between two limits, they become faster in the middle and slowest at the extremes”

$$y = \cos(t)$$



"the position on the diameter … is determined from the doctrine of chords"

i.e. trigonometry



"they treat … its magnitude in terms of chords"

$y = \cos(t)$

Galeano intermediary

Published April 10, 2018 by Tom Porter

Robert Morrison Awarded Guggenheim Fellowship to Study Islamic Influence on the Renaissance

Robert Morrison, Bowdoin's George Lincoln Skolfield Jr. Professor of Religion

One of the key figures in Morrison's research is a Jewish scholar called **Moses Galeano**, who also wrote under the Arabic and Turkish name Mūsā Jālīnūs. "He was an extraordinary person, crucial because he truly straddled both worlds," said Morrison. "He identified as a Jew but you wouldn't always know it. He was **extremely well informed** and was familiar with the Ottoman court as well as elites in Venice. He **brought some really high-level Islamic astronomy to Venice and Padua**, but he also translated a Latin astronomy text into Arabic for a high-ranking Ottoman judge and wrote a text in Ottoman Turkish that reported on Latin medical texts."

The Washington Post

What we lose when we lose Muslim immigrants

Islamic ingenuity built the modern scientific order

Perspective by Kathleen Crowther and Peter Barker
November 30, 2018 at 6:00 a.m. EST

“**Galeano knew all the astronomy borrowed by Copernicus**, who used the methods and ideas of Tusi, Urdi, Shatir and Qushji.”

As far as I can tell from actual scholarly articles:

- Galeano once mentioned Ibn al-Shatir passingly in a single sentence, while himself advocating an approach completely at odds with that entire tradition.

A Scholarly Intermediary between the Ottoman Empire and Renaissance Europe

By Robert Morrison*

Isis, 2014, 105:32–57

- Galeano was opposed to epicycles (on which all the astronomy allegedly "borrowed by Copernicus" is based) on philosophical grounds. He wrote briefly on this in a vein of qualitative cosmology, in what appears to be his only work on astronomy.

Robert Morrison

An Astronomical Treatise by Mūsā Jālīnūs alias Moses Galeano

Aleph 11.2 (2011) pp. 385-413

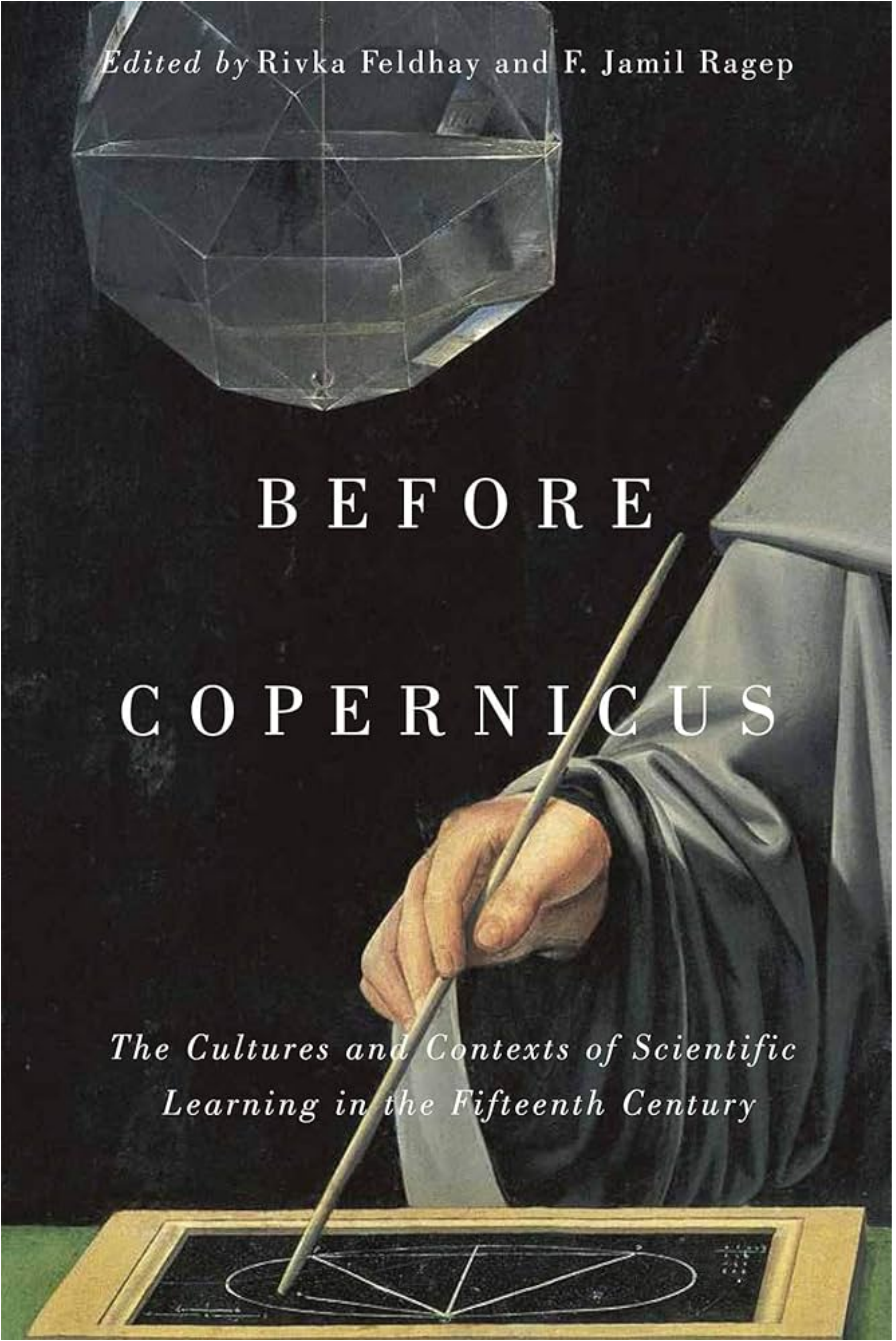
INDIANA UNIVERSITY PRESS

David A. King
Johann Wolfgang Goethe University, Frankfurt

Galeano's astrolabe is "non-functional" (51); "the operation [of it] boggles the mind, and we can be certain that it was never carried out" (74). It "put aesthetic considerations … before common sense" (74). "At least two of the pointers, including the one for the only bright star selected, are incorrectly positioned" (56). "The only bright star … is featured with the wrong longitude …, not 1° or 2° off, but 30°" (74). "The maker … most certainly was not … well-versed in star-lore" (74) and used not the best available star list but "some other very corrupt earlier source" (75).

Oresme


Oresme
Questiones de spera
14th century



From Tūn to Toruń: The Twists and Turns of the Ṭūsī-Couple

F. Jamil Ragep

Oresme is evidently aware of what we may call Naṣīr al-Dīn's physicalized Ṭūsī-couple as presented in the *Tadhkira*. But Oresme makes no claim to have invented this model on his own; and given his apparent lack of understanding of the necessity of having the epicycle move at twice the speed of the deferent, it would be implausible in the extreme to assume that he reinvented this model.

THE

QUESTIONES DE SPERA

OF

NICOLE ORESME.

LATIN TEXT WITH ENGLISH TRANSLATION,

COMMENTARY AND VARIANTS

A thesis submitted to the Graduate School of the University of Wisconsin in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

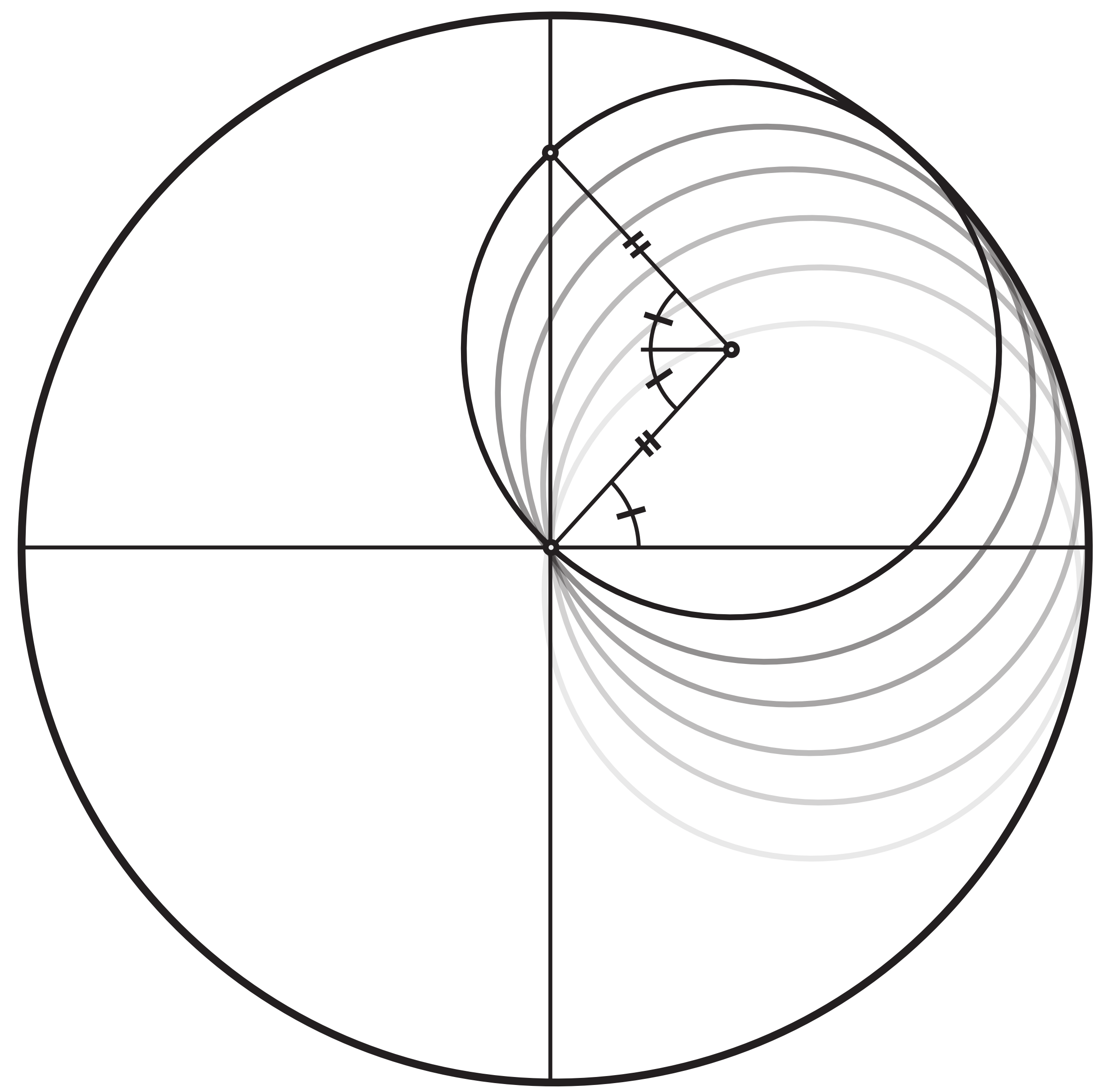
by

Garrett Droppers

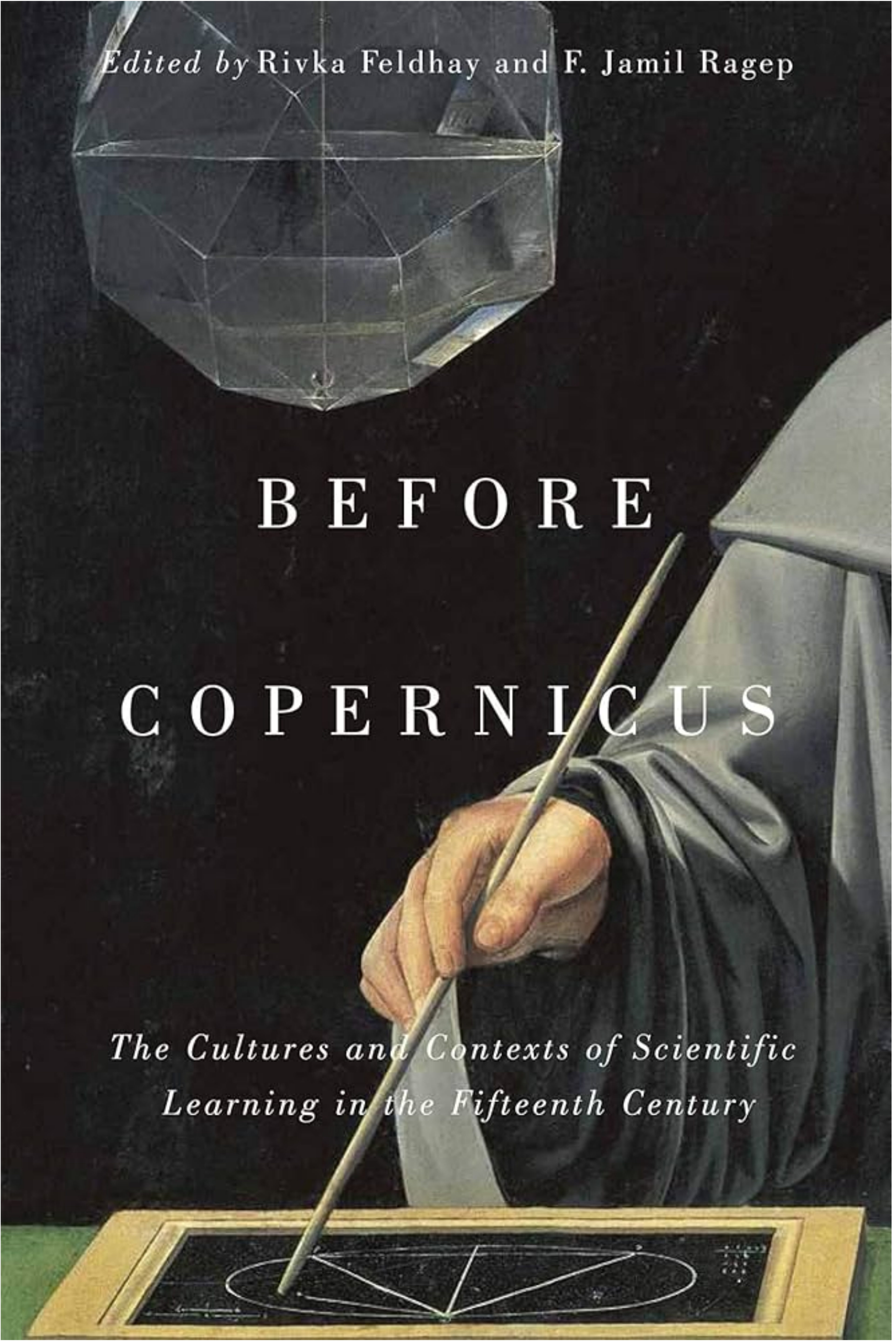
Degree to be awarded January 19 66

[Conclusion 1.] It is possible for some planet to be moved, according to something in its nature, perpetually in a rectilinear motion, a composite of several circular motions,

= Tusi couple?



No. Oresme is merely making the trivial qualitative point that a second circular motion can in principle somehow or other cancel the sideways component of a primary circular motion.



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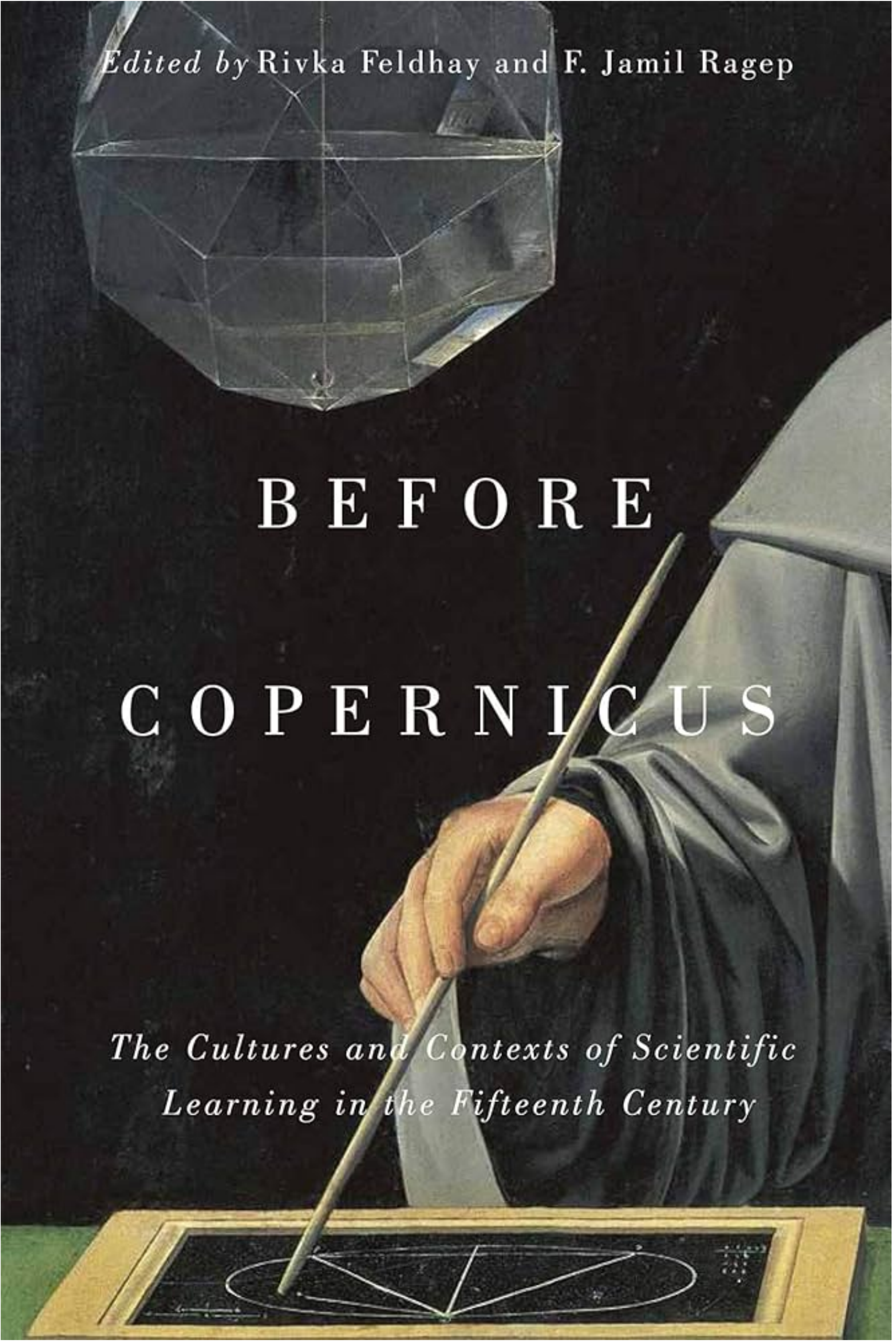
i.e., Oresme is not talking about the Tusi couple at all.

Indeed, Oresme erroneously believes that: It is impossible for a planet to be so moved if such circular motions are regular.



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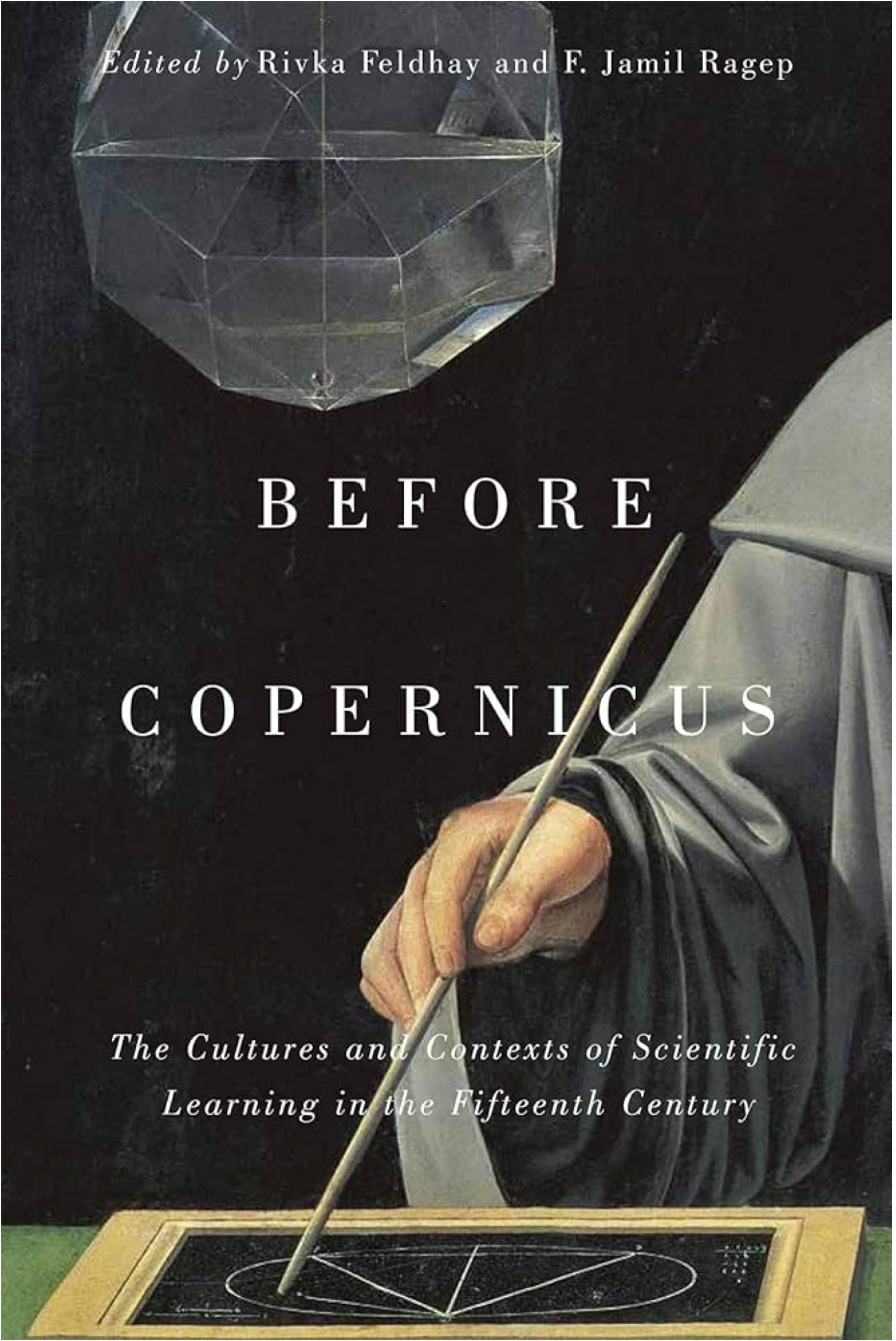
Oresme clearly does exactly that:

[Conclusions.] Concerning this question, I posit three fine conclusions.

[Conclusion 1.] It is possible for some planet to be moved, according to something in its nature, perpetually in a rectilinear motion, a composite of several circular motions,

Claims to novelty



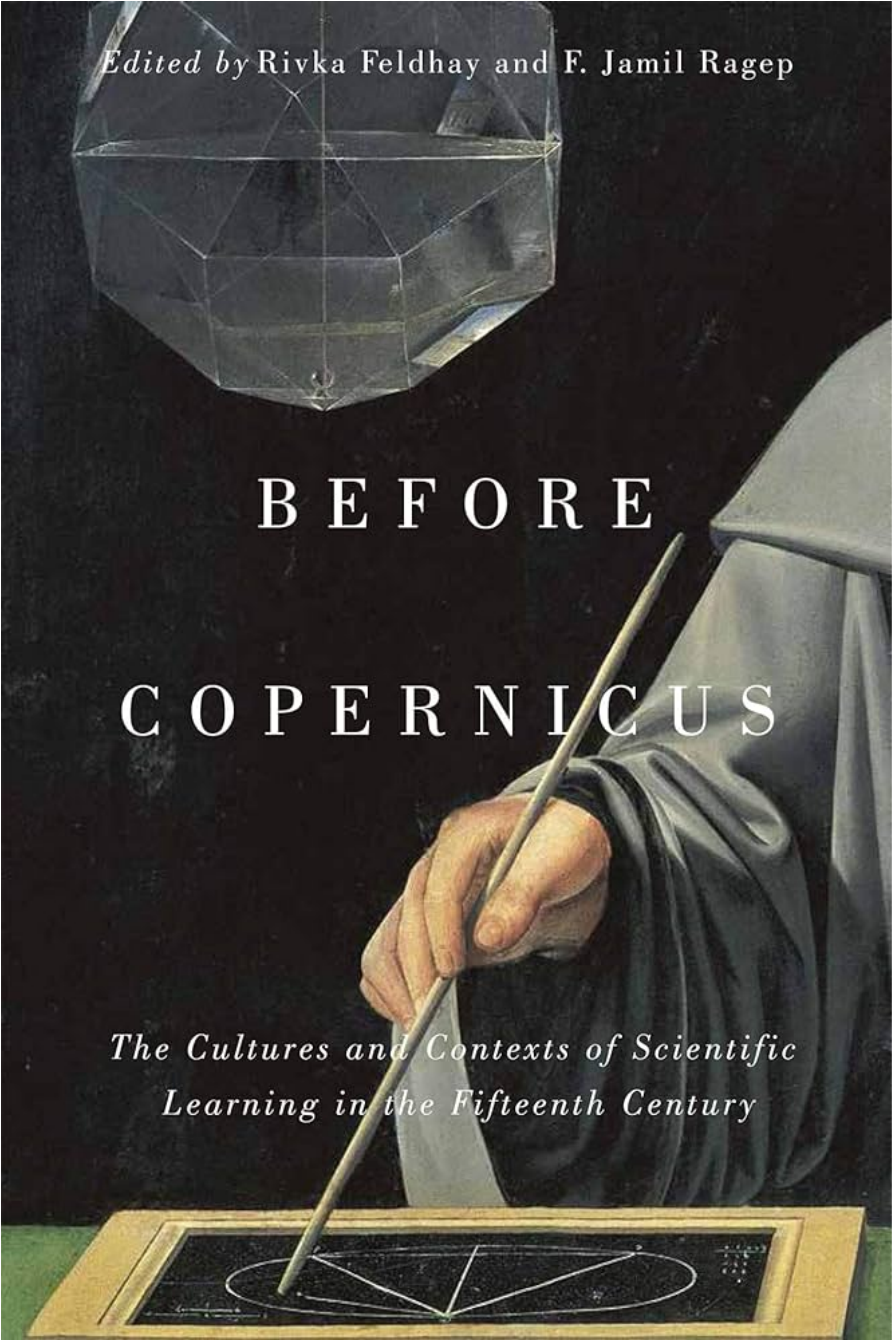
From Tūn to Toruń: The Twists and Turns of the Ṭūsī-Couple

F. Jamil Ragep

it would be quite unusual for someone who invented as significant a device as the Ṭūsī-couple not to claim it as his own.

How many mathematical treatises have you read where, in the middle of the mathematical exposition, the author chimes in and says "by the way, I came up with this myself, you know"?

Role of Arabic sources in early modern astronomy



From Tūn to Toruń: The Twists and Turns of the Ṭūsī-Couple

F. Jamil Ragep

And perhaps most importantly, why would someone seek to start from scratch when it was certainly known in the fifteenth and sixteenth centuries that Islamic astronomers still had much to teach their European counterparts?[105]

Let's look at the evidence cited for this "certainty":

105 This was even the case in the early seventeenth century. Feingold, "Decline and Fall."

Feingold, Mordechai. "Decline and Fall: Arabic Science in Seventeenth-Century England." In *Tradition, Transmission, Transformation: Proceedings of Two Conferences on Premodern Science Held at the University of Oklahoma*, ed. F. Jamil Ragep and Sally Ragep, 441–69. Leiden: Brill, 1996.

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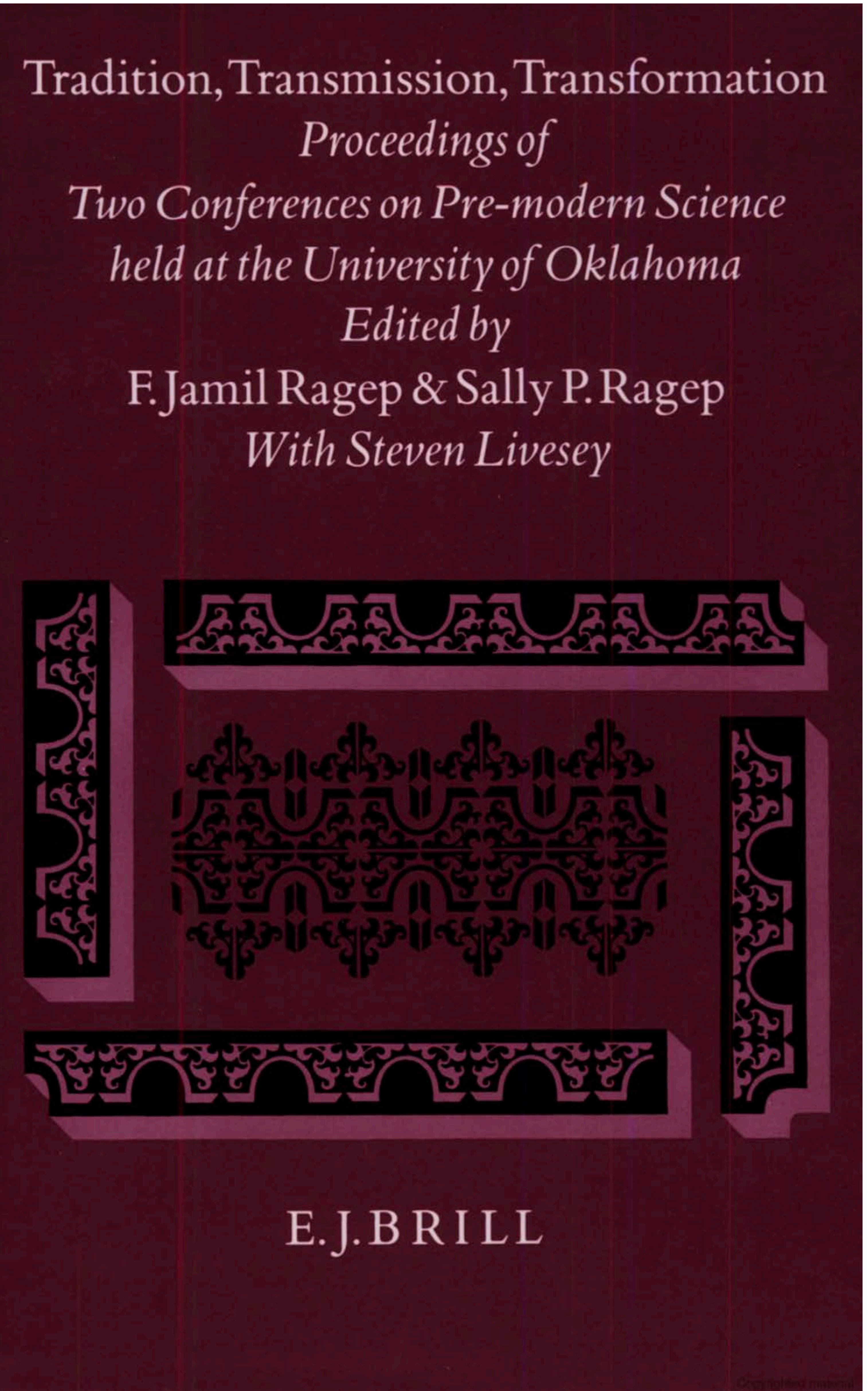


“Arabic [astronomy] was usually adjudged either as derivative of the Greeks or, at best, the fruit of sheer drudgery.” (445)

“how greate the losse of time was to study much the Eastern languages,” since “there was no treasure of things to be come at” (449)

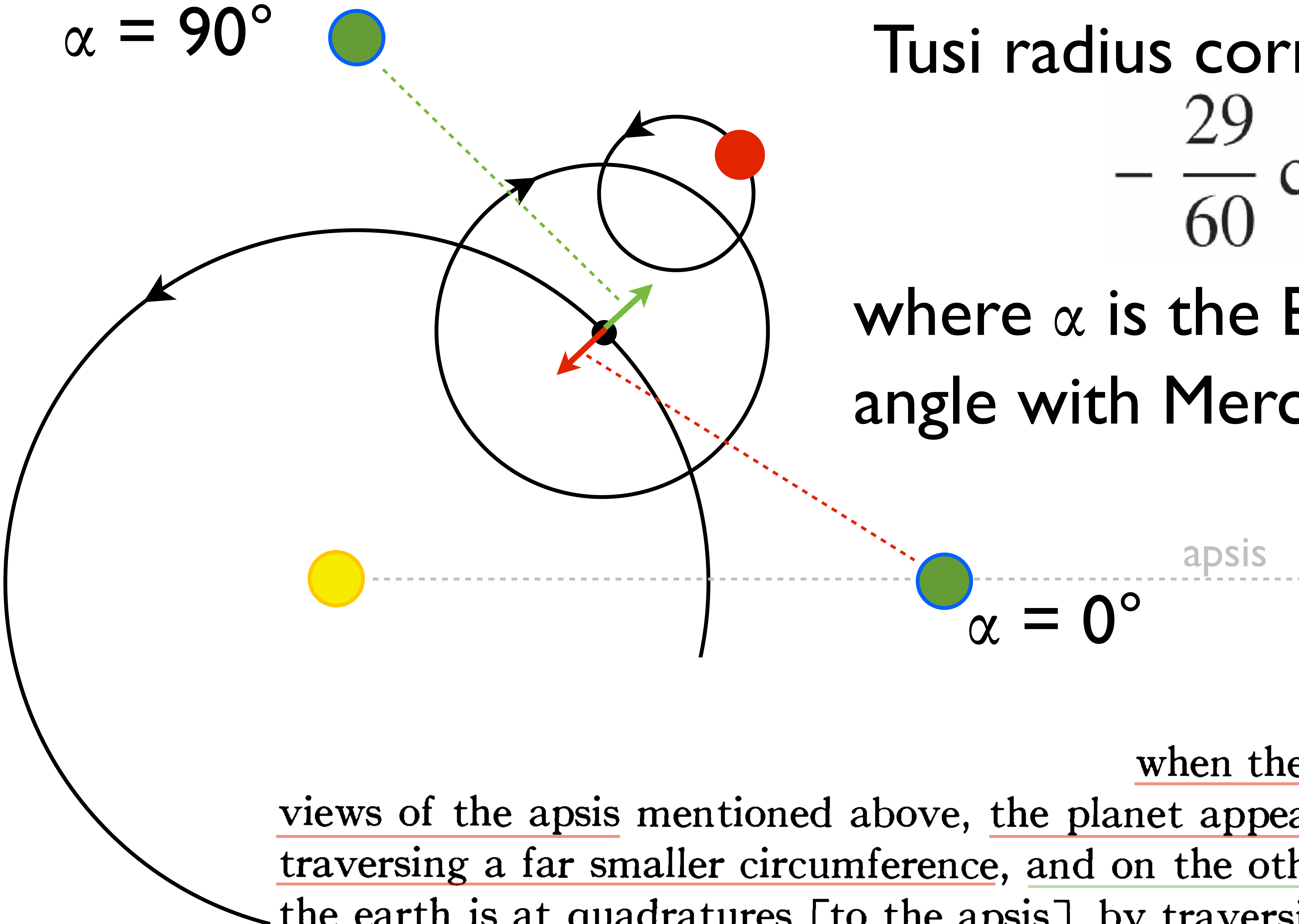
Francis Bacon: “The sciences which we possess come for the most part from the Greeks. ... Neither the Arabians nor the schoolmen need be mentioned; who in the intermediate time rather crushed the sciences with a multitude of treatises, than increased their weight” (443-444)

Joseph Glanvill: “These Successors of the Greeks did not advance their Learning beyond the imperfect Stature in which it was delievered to them.” (454)

William Wotton: “[The Arabs] translated the Grecian Learning into their own Language [but] had very little of their own, which was not taken from those Fountains. … There is little to be found amongst them, which any Body might not have understood as well as they, if he had carefully studied the Writings of their Grecian Masters. … There are vast Quantities of their Astronomical Observations [but not] any Thing in them, which those Arabian Astronomers did not, or might have not learnt from Ptolemee’s Almagest, if we set aside their Observations which their Grecian Masters taught them to make.” (455)

All of this is quoted from the one article Ragep himself singled out as support for his claim that it would have made little sense for people like Copernicus to think for themselves since they had so much to learn from the much wiser Arabic sources.

Mercury trines



Tusi radius correction =

$$-\frac{29}{60}\cos(2\alpha)$$

where α is the Earth's angle with Mercury's apsis.

when the earth is in the views of the apsis mentioned above, the planet appears to move by traversing a far smaller circumference, and on the other hand, when the earth is at quadratures [to the apsis], by traversing a far larger circumference than the proportion of the circles just given permits.

THE DERIVATION AND FIRST DRAFT OF COPERNICUS'S PLANETARY THEORY
A TRANSLATION OF THE COMMENTARIOLUS WITH COMMENTARY

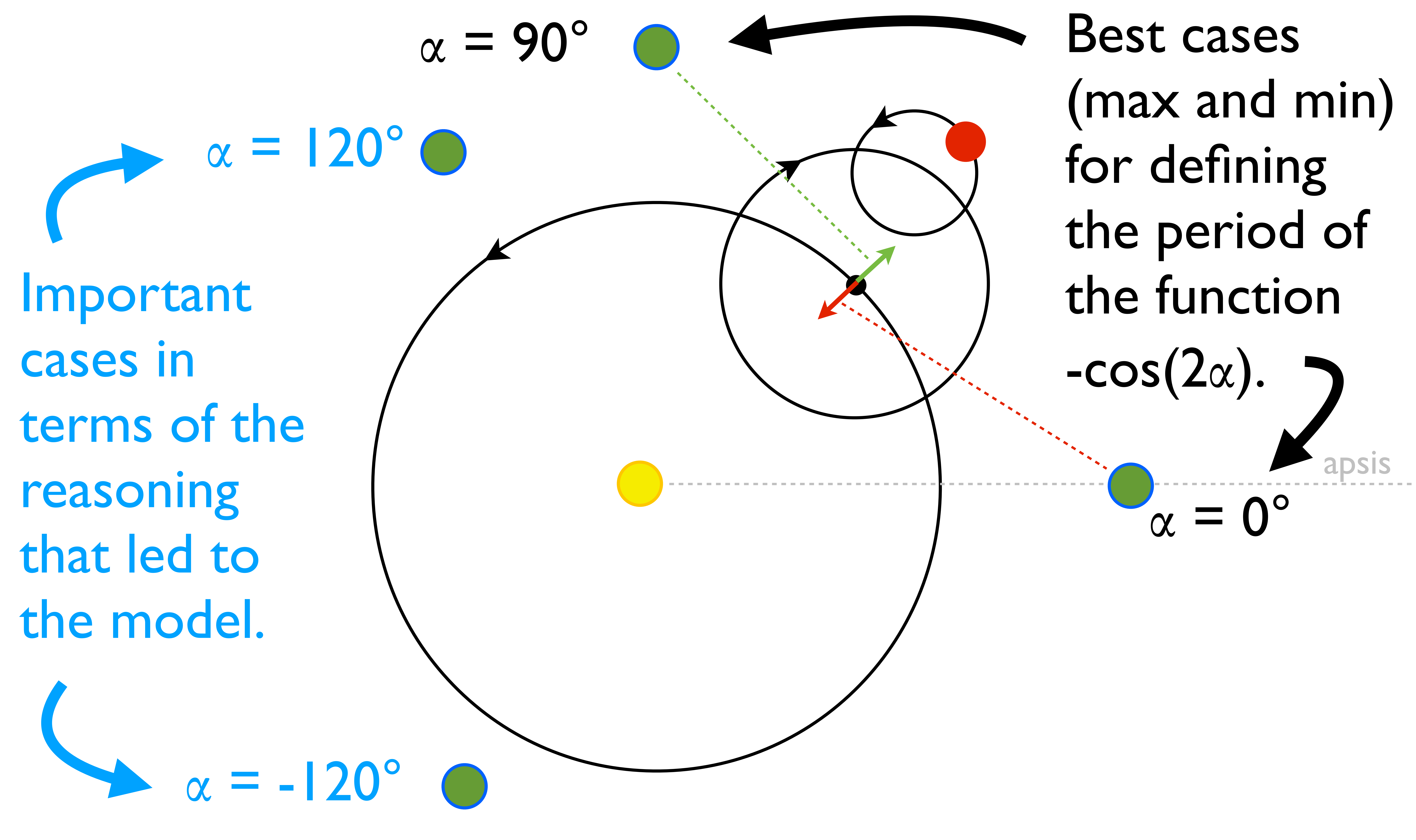
NOEL M. SWERDLOW

Assistant Professor of History, The University of Chicago

PROCEEDINGS OF THE AMERICAN PHILOSOPHICAL SOCIETY, VOL. 117, NO. 6, DECEMBER 1973

The principal effect of Ptolemy's model is to produce the greatest elongations at $\pm 120°$ from apogee. This is also true of Copernicus's model, as he demonstrates in *De rev.* V, 28, but he says nothing about it here.

Thus it could hardly be his own invention for, if it were, he would certainly have described its fundamental purpose rather than write the absurd statement


α = 90°
Best cases (max and min) for defining the period of the function -cos(2α).
α = 120°
Important cases in terms of the reasoning that led to the model.
apsis
α = 0°
α = -120°

Why didn't Copernicus mention the $\alpha = 120°$ case?

- His model is already completely defined in the mathematically cleanest way ($\alpha = 0°, 90°$).
- The Commentariolus is minimalistic. It doesn't try to teach astronomy or explain the heuristic process behind how the models were found.
- Ptolemy too defines his model in terms of the $\alpha = 0°, 90°$ cases.
- Behaviour at $\alpha = 120°$ is a corollary in Ptolemy, and hence is so also in Cop. insofar as the models correspond.

Nikfahm-Khubravan & Ragep attack **only** this. Pointless, since the previous three points are enough on their own.

Nikfahm-Khubravan & Ragep concede concerning my argument even for the forth point that:

Mathematically speaking, there is some truth to this

Behaviour at $\alpha = 120°$ is a corollary in Ptolemy, and hence is so also in Cop. insofar as the models correspond.

Nikfahm-Khubravan & Ragep object:

the models are not strictly speaking "equivalent."

True but irrelevant. The models are effectively equivalent for the purposes of the $\alpha = 120°$ case. Whether they are completely equivalent in every respect is not relevant for this argument.

Another aim of this paper is to deal with Blåsjö's claims regarding what he calls the "equivalence" of the Mercury models in the *Almagest* and the *Commentariolus*

Blåsjö's arguments for Copernicus' independence from Islamic influence, based on the elusive concept of "naturalness", would have very different models be classified as equivalent

it is simply wrong to claim that the *Commentariolus* model is equivalent to those of Ptolemy, Ibn al-Šāṭir, and *De rev.*, if one means by "equivalent" that they can produce equivalent results.

Blåsjö uses his notion of "equivalence" to assert that "There is no need for Copernicus to mention this since his intended readership would of course be very familiar with Ptolemaic theory and realize at once that this corollary carries over directly insofar as the two theories [that of Ptolemy and Copernicus] are equivalent[85]".

Nota bene: "insofar as"!

In other words, not exactly equivalent, but effectively equivalent for most purposes.

the fact that the Mercury model in the *Commentariolus* was not only impractical but also exceedingly difficult to test undermines Blåsjö's claim that finding the maximum elongations at 0, ±90, and 180° "eliminates the need for Copernicus to address the issue" of maximal elongation at ±120°, since somehow this latter is a corollary of the former.

- Maybe not easy to test for complete equivalence. (Irrelevant.)
- Very easy to test for equivalence in terms of maximal elongation. (What is actually needed.)

parenthetical and inconsequential remark

Thus to believe Blåsjö's ~~main contention~~, one needs to assume that Copernicus when writing the *Commentariolus*: a) would not mention the most prominent aspect of Mercury's model because this was a "corollary" to Ptolemy's "equivalent" model; and also assume, b) that Copernicus would put forth a model that did ~~not~~ produce equivalent results. Needless to say, we find this untenable.

nearly

of several plausible reasons, all stated explicitly by Blåsjö in his article, the forth and least important of which is that