

# ESTUDIOS BIZANTINOS

10  
(2022)



Universidad  
de Alcalá

EDITORIAL  
UNIVERSIDAD DE ALCALÁ

ISSN: 2952-1432 | e-ISSN: 2014-9999

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Depósito Legal: M-29689-2022  
Editorial Universidad de Alcalá  
Sociedad Española de Bizantinística  
ISSN: 2952-1432 | e-ISSN: 2014-9999  
Imprime: Solana e Hijos, Artes Gráficas

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## *A CONSUL OF THE PHILOSOPHERS ON WHAT IS GIVEN AND WHAT IS NOT IN THE COSMOS*

**FABIO ACERBI**

### *Résumé*

Un texte byzantin qui applique le “langage des données” au cercles principaux sur la sphère céleste est ici présenté, édité, traduit et comparé avec sa source grecque. Dans son seul témoin manuscrit, le texte est attribué à un “consul des philosophes” ; des noms sont proposés pour cet auteur.

**Mots clé:** Astronomie byzantine, Mathématiques byzantines, consul des philosophes, langage des données.

### *Abstract*

A Byzantine text, ascribed to a “consul of the philosophers”, applies the “language of the givens” to the main circles on the celestial sphere, showing which of them are “given”, and in what sense. This text is here presented, edited, translated, and compared with its source. A discussion about the author of the text is also provided.

**Keywords:** Byzantine astronomy, Byzantine mathematics, Consul of the philosophers, Language of the givens.

# A CONSUL OF THE PHILOSOPHERS ON WHAT IS GIVEN AND WHAT IS NOT IN THE COSMOS

FABIO ACERBI

## INTRODUCTION

A Byzantine text (“the Text” henceforth) appended to a witness of Aristotle’s *Metaphysics* is here presented, edited, and translated.<sup>1</sup> The Text is interesting on several counts. First, it consistently and sustainedly uses the “language of the givens”, a highly sectorial idiom whose founding exposition is Euclid’s *Data* and which is infrequently met in extant Greek mathematical works.<sup>2</sup> Byzantine texts of this kind are exceedingly rare.<sup>3</sup> The Text

\* The perceptive remarks of one of the referees have improved my argument.

<sup>1</sup> The existence of the Text was first reported in A. Tihon, “Les sciences exactes à Byzance”, *Byzantion* 79 (2009), 380–434: 399 n. 55.

<sup>2</sup> Euclid’s *Data* are edited in vol. VI of J.L. Heiberg, H. Menge, *Euclidis opera omnia*, I–VIII, Lipsiae 1883–1916; see also the study Ch.M.Taisbak, ΔΕΔΟΜΕΝΑ. *Euclid’s Data or the Importance of Being Given* (Acta Historica Scientiarum Naturalium et Medicinalium 45), Copenhagen 2003. For the “language of the givens” see most recently F. Acerbi, *The Logical Syntax of Greek Mathematics* (Sources and Studies in the History of Mathematics and the Physical Sciences), Heidelberg – New York 2021, sect. 2.4. This stylistic resource was mainly applied in the so-called “analytical *corpus*”, now almost entirely lost; the standard account of the analytical *corpus* is Pappus, *Collectio* VII.

<sup>3</sup> In the Byzantine technical *corpus*, the only structured exposition framed in the “language of the givens” I know of is Book VI of Barlaam’s *Logistic*, edited in P. Carelos, *Βαρλαάμ τοῦ Καλαβροῦ, Λογιστική. Barlaam von Seminara, Logistiké* (Corpus philosophorum Medii Aevi. Philosophi byzantini 8), Athens – Paris – Bruxelles 1996, 94–113. For Latin West, see

applies the “language of the givens” to the main circles on the celestial sphere, showing which of them are “given”, and in what sense. Second, the Text is less an exercise in checking whether assigned mathematical objects satisfy exotic definitions than an exercise in the logic of complex predicates. Third, the style of the Text is very characteristic, for its author—partly spurred by the subject-matter—exhibits such a fondness for conjunctions formulated by  $\tau\epsilon \dots \kappa\alpha\iota$  correlatives as I have never found in other Byzantine scientific works. This stylistic feature might be useful, because, Fourth, the Text is ascribed to a “consul of the philosophers” whose name can only be guessed, even if, as we shall see, some natural candidates are at hand. In keeping with this ascription, the Text has a marked pedagogic ring; it might be the redaction of lecture notes. The Text is virtually free of copying mistakes, suggesting that it was copied first-hand. Fifth, the Text *does not* contain gross misunderstandings of the “language of the givens”, something I regarded as surprising in the first place—granted, it *does* contain some quirks, but we shall see that the matter is not entirely trivial. Sixth, my surprise before the absence of gross misunderstandings vanished when I found the Greek source (“the Source” henceforth) of the Text.

In the following sections, I shall first present the Text and its only manuscript witness, then give its Greek text and an annotated translation. Finally, I shall give the Greek text and a translation of the Source, compare it with the Text, and review the candidates for our “consul of the philosophers”.

### **INTRODUCING THE TEXT**

The Text applies the “language of the givens” to the main circles on the celestial sphere, showing which of them are “given”, and in what sense. The relevant circles are listed at the beginning of the Text. These are first the so-called latitudinal circles: the equator; the two tropics, that is, the two circles parallel to the equator that are tangent to the ecliptic; the Arctic and Antarctic circles, namely, the two circles parallel to the equator that are tangent to the horizon, that is, the circles that, at an assigned latitude, delimit the portion of the celestial sphere which never set (resp. rise). Other relevant circles (which the Text also calls “latitudinal”) are the horizon, the meridian—which is the circle that passes

Jordanus de Nemore’s *De numeris datis*, edited in B.B. Hughes, *Jordanus de Nemore, De numeris datis* (Publications of the Center for Medieval and Renaissance Studies, UCLA 14), Berkeley – Los Angeles – London 1981.

through the north pole and the local zenith, and which the Sun crosses at midday—and the colures, which pass through the north pole and either the equinoctial or the solstitial points.<sup>4</sup> The ecliptic itself—that is, the yearly trajectory of the Sun—is a circle whose partitions (the zodiacal signs) divide the sphere in longitude. Finally, there are the circles of the Moon and of the planets. Some of these circles are great circles on the celestial sphere: these are the equator, the meridian, the colures, the ecliptic, and the horizon. The two tropics and the Arctic and Antarctic circles are not great circles; moreover, the size and the position of the latter two depend on the observer’s position, very much as the position of the horizon does. As is clear, then, some of these circles are intrinsic features of the celestial sphere, and as such they enjoy specifically invariant properties “in themselves”; other circles only enjoy their characteristic properties “with respect to us”.

What does it mean that some of these circles are “given in position” or “given in magnitude”? Roughly speaking, it means that such circles always hold the same place, or that their size is well-defined, respectively. To see how these notions were formalized, let us read in parallel *Data* def. 4 and 1 (in this order) and the corresponding definitions that open the Text:<sup>5</sup>

<i>DATA</i>	THE TEXT
τῆ θέσει δεδοσθαι λέγονται σημεία τε καὶ γραμμαὶ καὶ γωνία ἃ τὸν αὐτὸν ἀεὶ τόπον ἐπέχει	δεδοσθαι λέγεται σημεῖον τὲ καὶ γραμμὴ ἃ τὸν αὐτὸν ἔχει ἀεὶ τόπον
both points and lines and angles that always hold the same place are said to be given in position	both a point and a line that always hold the same place are said to be given
δεδομένα τῶ μεγέθει λέγεται χωρία τε καὶ γραμμαὶ καὶ γωνία οἷς δυνάμεθα ἴσα πορίσασθαι	μεγέθη δὲ δεδοσθαι λέγεται οἷς δυνάμεθα ἴσα πορίσασθαι
both regions and lines and angles for which we can procure equals are said to be given in magnitude	magnitudes for which we can procure equals are said to be given

In the *Data*, the intuitive notion of “place” is retained—accordingly, the Euclidean space is an absolute space—while “size” is replaced by the relational property of equality, which is as it were “saturated” by a magnitude we are able to “procure”; the result is the

<sup>4</sup> As we shall see, “colure” can also be used as a generic name.

<sup>5</sup> For the *Data*, see Heiberg, Menge, *Euclidis Opera Omnia* [cit. n. 2], VI, 2.9–10 and 2.2–3, respectively. The scarce variant readings in the text of the *Data* do not identify a specific line of tradition as the one followed by the Text.



predicate “being given in magnitude”. In the *Data*, as elsewhere in Greek geometry, “to procure” means being able to show, by means of an argument or of a construction, that there is indeed such an “equal” magnitude.<sup>6</sup> Comparing the Euclidean definitions and those that open the Text, a first quirk is apparent: the Text does not define “being given in position” and “being given in magnitude”, but defines “being given” for points and lines first, and then the same notion for generic magnitudes. In so doing, the Text somehow mixes up the qualifiers “in position” and “in magnitude”, which specify the generic relation “being given”, and the objects that fall under the range of the resulting predicates (the “magnitudes” in the second definition replace the specific geometric objects listed in *Data* def. 1). However, in what follows the Text keeps faithful to the original definitions, for it always refers to “being given in position” and “being given in magnitude”.

As we have seen above, and as the second paragraph of the Text explains, all the circles on the celestial sphere that are great circles are equal to one another. Consequently, they are given in magnitude according to *Data* def. 1. The tropics are also given in magnitude, for they are circles on the surface of the sphere that are placed at a well-defined distance from the equator. As there always are two twin circles at a well-defined distance from the equator, and such circles are equal to one another by symmetry, they are also “given in magnitude” according to *Data* def. 1. The reader might object that *any* circle on the surface of a sphere is placed at a well-defined distance from a suitable great circle and has a twin circle placed at the same distance. Will *any* circle on the surface of a sphere be given too? Yes, because the reader, by referring to a *well-defined* distance of any circle, necessarily means any *assigned* circle on the surface of an *assigned* sphere: the definitions of the *Data* give a mathematical meaning to the intuitive notion “being assigned”. This leads us to the main subtlety involved in the argument expounded in the Text. The point is that the celestial sphere is a second-order mathematical fiction: it is not a “real” mathematical sphere whose diameter is fixed, but a scale-invariant sphere which is used to compute angular distances only. In the *Almagest*, Ptolemy assigns a notional size to this sphere (or, better said, to any of its great circles), taking for instance its diameter to be 120 linear “degrees”.<sup>7</sup> Consequently, and in a mathematically impeccable way, the celestial sphere

<sup>6</sup> The equal magnitude may also be “procured” in a definition: a case in point is the definition of a right angle in *Elem.* I.def.10. A right angle is given in magnitude for this reason.

<sup>7</sup> See J.L. Heiberg, *Claudii Ptolemaei opera quae exstant omnia*, I.1–2, *Syntaxis Mathematica*, Lipsiae 1898–1903, I.1, 77.6–13.

is “given in magnitude”, and any of the circles on it whose size is well-defined—most obviously, any great circle—is “given in magnitude” both intuitively and, for non-great circles, via the trick of the twin circles. Conversely, there are circles on the surface of the celestial sphere that are not given in magnitude: these are the Arctic and the Antarctic circle, whose size depends on the elevation of the (north) pole above the horizon, that is, on the observer’s position in latitude. The “circles” of the Moon and of the planets are not given in magnitude either, because, as the Text asserts, “we cannot procure a circle equal to each of them”—actually, the trajectories traced by the planets on the surface of the sphere are not circles at all.

The issue of “being given in position” is even trickier, and the Text is forced to introduce a distinction that, while at home in philosophical arguments, is outlandish by mathematical standards. There are circles on the surface of the sphere that are obviously given in position: these are the equator and the tropics, for the daily motion of the heavens makes each of them rotate onto itself. Conversely, there are circles on the surface of the sphere that are obviously not given in position: these are the Arctic and the Antarctic circle, whose position depends, as said, on the observer’s position in latitude. The positions of the meridian and of the horizon also depend on the observer’s position; accordingly, these circles are not given in position. The status of the zodiac is more problematic, for on the one hand the daily motion of the heavens carries it around in the sky, but on the other hand—disregarding the precession of the equinoxes—its position is determined by the fixed stars. The Text solves this aporia in a typically philosophical way, namely, by introducing a linguistic distinction: the zodiac “is given in itself but is not given with respect to us”. A standard exegetic tool—an aporia raised by a seemingly paradoxical state of affairs—also operates in the discussion of the colures. For as the meridian and the colures pass through the poles of the equator, they go the one onto the other during the daily motion. Thus, the meridian and the colures are one and the same thing. Moreover, all of them are curtailed circles, for the horizon makes half of them invisible (this is true of any other great circle on the sphere, by the way). Accordingly, the meridian counts as two different objects depending on the observer being placed in a given location or in its antipode. These facts are upgraded to an aporia by the Text, which wonders “how come the one becomes two, and how come sometimes it is called ‘meridian’ sometimes it is named ‘colure’”.

As any of the two species of the predicate “to be given” may hold or not hold of the circles on the surface of the celestial sphere, four combinations are possible in con-

junction, namely, being given “both in position and in magnitude”, “neither in position nor in magnitude”, “in position but not in magnitude”, and “in magnitude but not in position”. The Text lists all of these combinations, along with the circles to which each of these complex predicates applies. I surmise that setting forth such a fourfold partition was the main goal of the Text.<sup>8</sup>

The Text also provides pieces of astronomical information not strictly related to the main subject-matter; the latter, of course, also includes a definition of the species of the “givens” and of all circles involved, as well as some relevant properties of these circles. The additional pieces of information are the varying inclination of the ecliptic with respect to the equator, a sketchy outline of the motions of the Sun, the Moon, and the planets, and accordingly a preliminary clarification of the terms “behind-leaving” (ὕπολειπτικός) and “forward-carrying” (προηγητικός)—the latter a synonym of “retrogradation”—which describe the direction of the motion of the heavenly bodies.<sup>9</sup>

The Text does not contribute any new mathematical results. This academic exercise makes sense only as the redaction of a lecture, perhaps a well-thought introduction—embedded in a logical framework, and made lively by a couple of aporias—to the system of circles on the celestial sphere. This framework explains the points of terminology, the presence of the additional notions, the several cross-references, the insistence on the logic of complex predicates, the exegetic tricks, which are fully justified only before an audience. The use of the “language of the givens” points to extensive readings of the *Almagest*, in whose Books I and III this stylistic resource is repeatedly deployed in its full mathematical import.<sup>10</sup> The argument of a course including such

<sup>8</sup> One is reminded of a similar exercise in the logic of complex predicates in Marinus’ *prolegomena* to the *Data*: see the discussion in F. Acerbi, *Euclide, Tutte le Opere*, Milano 2007, 2487–2499. Readers unfamiliar with Italian can find a similar discussion in M. Sialaros, R. Matera, J. Gerhold, G. Gamarra Jordán, “Searching for Definitions: Marinus’ *Introduction to Euclid’s Data*”, *SCIAMVS* 20 (2019), 119–155.

<sup>9</sup> Translating the Greek terminology is tricky: see G.J. Toomer, *Ptolemy’s Almagest*, London 1984, 20.

<sup>10</sup> The involved chapters are *Almagest* I.10 (in Heiberg, *Claudii Ptolemaei opera* [cit. n. 7], I.1, 37.20–42.6), I.13 (*ibid.*, 71.14–72.10, 73.11–74.8), III.5 (*ibid.*, 242.14–243.15, 245.5–246.5, 247.15–248.19, 250.8–251.9). I have not found anything similar to the Text in the scholia to the *Almagest* or to the *Data*.

an introductory lecture is a matter of speculation (astronomy? elementary logic?) and I shall not indulge in it. The relation of the Text with the Source will be investigated in the final section of this paper. Before doing that, let us read both.

### *THE MANUSCRIPT WITNESS OF THE TEXT*

The Text is uniquely witnessed in ff. 252r–258r of the manuscript Città del Vaticano, Biblioteca Apostolica Vaticana, gr. 255 (*Diktyon* 66886), a stemmatically independent copy of Aristotle's *Metaphysics*.<sup>11</sup> Vat. gr. 255 is a paper manuscript whose watermarks—all of them are alphabet letters—point to the first half of the 14<sup>th</sup> century. This is confirmed by the script, which Daniele Bianconi has kindly dated, on my request, to the central decades of the same century as for our text, to the first quarter of the same century as for the *Metaphysics*. Vat. gr. 255 is made of 3 recent folios + 3 folios, numbered 1 and 1<sup>a-b</sup>, added a little after the date of copy + 256 folios (= 32 quaternions), numbered 1<sup>c-d</sup>, 2–251, 251<sup>a-d</sup> + 7 folios at the end, now bound in disorder (the correct order is 256, 257, 252–255, 258). Folios 1r, 1<sup>b-v</sup>, 1<sup>c-v</sup>, 251<sup>a-d</sup> are blank; f. 258v contains only a later six-word inscription.

Aristotle's *Metaphysics*—which begins on the recto of f. 1<sup>d</sup>, after a blank folio—was copied from a defective exemplar: spaces for unreadable words are frequently left in the text. Two long passages that were omitted by the main copyist are restored by different, and slightly later, hands, on ff. 1v–1<sup>b-r</sup> and 251r–v. The two correctors used identical catching phrases to refer to the location of their integrations: they likely worked in collaboration. A different, and a bit later, hand copied again, on f. 1<sup>c-r</sup>, the beginning of the *Metaphysics*.

The Text, which is written by a hand different from any of the above, and which bears no relation with any of the arguments expounded in Aristotle's treatise, was appended to it, as shown by the quire structure of Vat. gr. 255.

<sup>11</sup> See the description in G. Mercati, P. Franchi de' Cavalieri, *Codices Vaticani graeci. Codices 1–329*, Romae 1923, 333–334. The manuscript is accessible online at [https://digi.vatlib.it/view/MSS\\_Vat.gr.255](https://digi.vatlib.it/view/MSS_Vat.gr.255). For the stemmatic position of Vat. gr. 255 (*siglum* V<sup>d</sup>), see D. Harlfinger, “Zur Überlieferungsgeschichte der *Metaphysik*”, in P. Aubenque (ed.), *Études sur la Métaphysique d'Aristote. Actes du VI<sup>e</sup> Symposium Aristotelicum*, Paris 1979, 7–36: 20 and 27 (stemma). All subsequent scholarship adopts Harlfinger's stemma as regards the position of V<sup>d</sup>.

It is likely that Vat. gr. 255 was present in the Vatican Library since its early years, as shown by the early inventories. Matters are complicated by the fact that Vat. gr. 257 (15<sup>th</sup> c.; *Diktyon* 66888) also contains the *Metaphysics* and nothing else. For this reason, two of the reference editions of the early Vatican inventories do not agree in their identifications of the item recorded in Vigili's catalogue of 1508–10.<sup>12</sup> However, it is almost certain that both manuscripts were recorded in some inventories, and as early as 1481.<sup>13</sup> Thanks to the presence of the *dictio probatoria*, the only unambiguous identifications relate Vat. gr. 255 and Vat. gr. 257 to specific items of the 1533 inventory.<sup>14</sup>

### **EDITION OF THE TEXT**

I have regularized punctuation and accents, with the sole exception of the enclitics, and introduced a segmentation of the Text. Sequences that correspond to statements we shall also find in the Source are underlined.

<sup>12</sup> Compare R. Devreesse, *Le fonds grec de la Bibliothèque Vaticane des origines à Paul V* (Studi e Testi 244), Città del Vaticano 1965, 57 (this is the earliest occurrence, in 1475), 108, 142, 161, 219, 245, 311 (Vat. gr. 255) and 92, 130, 198, 245, 281, 326, 406 (Vat. gr. 257), with G. Cardinali, *Inventari di manoscritti greci della Biblioteca Vaticana sotto il pontificato di Giulio II (1503-1513)* (Studi e Testi 491), Città del Vaticano 2015, 181, 297 (Vat. gr. 257). Apparently, Vat. gr. 255 had a *paonatio*/black binding, Vat. gr. 257 a red one.

<sup>13</sup> See Devreesse, *Le fonds* [cit. n. 12], 92, 142, 219, 245, 311 (Vat. gr. 255) and 108, 130, 198, 245, 281 (Vat. gr. 257), and the new editions of the 1518 inventory, M.L. Sosower, D.F. Jackson, A. Manfredi, *Index seu inventarium Bibliothecae Vaticanae divi Leonis pontificis optimi : anno 1518 c. Series graeca* (Studi e Testi 427), Città del Vaticano 2006, 87 nr. [670] (Vat. gr. 255) and 35 nr. [263] (Vat. gr. 257), and of the 1533 inventory, M.R. Dilts, M.L. Sosower, A. Manfredi, *Librorum Graecorum Bibliothecae Vaticanae Index a Nicolao De Maioranis compositus et Fausto Saboeo collatus Anno 1533* (Studi e Testi 384), Città del Vaticano 1998, 36 nr. 274 (Vat. gr. 257), and 100 nr. 851 (Vat. gr. 255, but the item is left unidentified in this edition).

<sup>14</sup> See Devreesse, *Le fonds* [cit. n. 12], 311, and Dilts, Sosower, Manfredi, *Librorum Graecorum* [cit. n. 13], 100. The word γένοϋς recorded in the inventory is the last of f. 1<sup>r</sup>; as for Vat. gr. 257, the *dictio probatoria* is ἐνδέχεται on f. 3<sup>r</sup>. Note that the item where Vat. gr. 255 is described qualifies it as *sine tabulis*, whereas all other inventories record the presence of a binding. For the *dictio probatoria*, see D. Williman, K. Corsano, “Tracing Provenances by *Dictio Probatoria*”, *Scriptorium* 53 (1999), 124–145, and Dilts, Sosower, Manfredi, *Librorum Graecorum* [cit. n. 13], IX–XVIII.



|<sub>256r</sub> τοῦ ὑπάτου τῶν φιλοσόφων

<1> δεδόσθαι λέγεται σημεῖον τὸ καὶ γραμμὴ ἃ τὸν αὐτὸν ἔχει αἰεὶ τόπον· μεγέθη δὲ δεδό-  
σθαι λέγεται οἷς δυνάμεθα ἴσα πορίσασθαι. καὶ ὅπως μὲν ἕκαστον τούτων ἔχει, ἐφεξῆς θε-  
 5 θεωρητέον· χρῆ δὲ γινώσκειν ὡς παρὰ μὲν τῷ γεωμέτρῃ τὰ δεδομένα ἐξ ἀφαιρέσεως ἀπο-  
 δείκνυται καὶ καθολικώτερον καὶ ἀπλούστερον. ἐπὶ μέντοι ἀστρονομίας οὐκ ἐκτὸς ταῦτα  
 θεωρεῖται τῆς ὕλης· διὸ καὶ σαφεστέρα ἐνταῦθα ἢ τῶν τοιούτων δεδομένων κατανόησις.  
 φασὲν γὰρ τὴν οὐρανίαν σφαῖραν κατὰ μὲν πλάτος εἰς πέντε διαιρεῖσθαι παραλλήλους  
 κύκλους – δύο μὲν τοὺς ὀρίζοντας τὰ τε ἀειφανῆ καὶ τὰ ἀφανῆ, δύο δὲ ἐτέρους τὸν τε θε-  
 10 μῆκος τοῖς δώδεκα λεγομένοις ζωδίοις – ἅπερ ἀλληλουχούμενα καὶ ἐνούμενα τὸν ζωδι-  
 ακὸν καὶ λοξὸν ἀποτελεῖ κύκλον – κατὰ δὲ βάθος τοῖς τῶν ἑπτὰ πλανήτων διαιρεῖται κύ-  
 κλοις ἢ σφαῖρα.

<2> |<sub>256v</sub> εἰσὶ δὲ καὶ ἕτεροι κύκλοι, ὃ τε ὀρίζων ὁ μεσημβρινὸς καὶ οἱ κόλουροι, κατὰ  
 πλάτος καὶ αὐτοὶ δοκοῦντες διαιρεῖν τὸ οὐράνιον σῶμα. τούτων ὅσοι μὲν δίχα διαι-  
 15 ροῦσι τὴν σφαῖραν μέγιστοι τῶν ἄλλων εἰσὶ καὶ ἀλλήλοις ἴσοι· ὥσπερ γὰρ ἐπὶ τοῦ κύ-  
 κλου ἢ διὰ τοῦ κέντρου ἠγμένῃ εὐθειᾷ, ἣν καὶ διάμετρον λέγομεν, μεγίστη ἐστὶ τῶν  
 παρ' ἐκάτερα εὐθειῶν, οὕτω καὶ ἐπὶ τῆς σφαίρας ὁ δίχα διαιρῶν κύκλος τὴν σφαῖραν  
 μέγιστος τῶν παρ' ἐκάτερα κύκλων ἐστίν. εἰσὶ δὲ οὗτοι ὃ τε ὀρίζων ὁ ἰσημερινός, ὁ με-  
 20 σημβρινός καὶ ὁ ζωδιακός· πάντες γὰρ οὗτοι δίχα τὴν σφαῖραν τέμνουσιν καὶ εἰσὶν  
 ἴσοι.

<3> ἀλλ' ὁ μὲν ἰσημερινὸς καὶ θέσει καὶ μεγέθει δέδοται, θέσει μὲν ὅτι τὸν αὐτὸν  
αἰεὶ τόπον κατέχει· εἴρηται γὰρ ἐν τοῖς ὅροις ὅτι σημεῖα καὶ γραμμαὶ δεδόσθαι λέγε-  
 25 ται τὰ τὸν αὐτὸν αἰεὶ τόπον ἔχοντα, γραμμὴ δὲ καὶ ὁ κύκλος, καὶ ἔνθα γραμμὴ, καὶ ση-  
 μεῖον, οὐ μὴν τὸ ἀνάπαλιν. πῶς δὲ ὁ ἰσημερινὸς τὸν αὐτὸν αἰεὶ τόπον ἔχει (ἢ γὰρ θέ-  
 σις ἐν τόπῳ); ὅτι διὰ τοῦ Κριοῦ καὶ τοῦ Ζυγοῦ δίεσιν οὗτος, Κριὸς δὲ καὶ Ζυγὸς |<sub>257r</sub>  
 ἀμετάπτωτα καὶ τὸν αὐτὸν αἰεὶ τόπον κατέχοντα. οἶονεὶ γὰρ πέπηγεν ἐν τῷ οὐρανῷ τὰ  
 ζωδία πάντα, καὶ ἔστιν ἀμετακίνητα, ὥστε εἰ ἐν τοῖς ἀμετακινήτοις τῶν ἀστρῶν θεω-  
 30 ρεῖται ὁ ἰσημερινός, καὶ οὗτος ἀμετακίνητός ἐστι καὶ τὸν αὐτὸν αἰεὶ τόπον ἔχει, καὶ τῇ  
 θέσει δέδοται. δέδοται δὲ καὶ τῷ μεγέθει, ὡς εἴρηται· ἔστι γὰρ αὐτῷ πορίσασθαι ἴσον,  
 οὐ μόνον τὸν ὀρίζοντα, ἀλλὰ καὶ τὸν μεσημβρινὸν καὶ τὸν ζωδιακόν – ἢ τοῦ ζωδια-  
 κοῦ τὸ μεσαίτατον· οἱ μὲν γὰρ ἄλλοι κύκλοι γραμμικοὶ καὶ ἀπλατεῖς ἐπινενόηνται, ὁ  
 δὲ ζωδιακός καὶ πλάτος ἔχειν ἀξιόλογον λέγεται, ὥστε ὁ μεσαίτατος ἐν αὐτῷ κύκλος  
 μόνος εἰς δύο τέμνων τὴν σφαῖραν εὐρίσκεται.

<4> ἀλλὰ δὴ καὶ οἱ παρ' ἐκάτερα αὐτοῦ ὁ τε θερινὸς τροπικὸς καὶ ὁ χειμερινὸς τρο-  
35 πικὸς καὶ τῆ θέσει καὶ τῷ μεγέθει δέδονται, τῆ μὲν θέσει ὅτι οὐδέτερος αὐτῶν τὸν  
ζωδιακὸν ὑπερβαίνει· ὁ μὲν γὰρ κατὰ τὴν ἀρχὴν τοῦ Καρκίνου καὶ οἶονεὶ τὸ πρῶτον  
λεπτὸν ἢ σημεῖον λαμβάνεται, μεθ' ἣν ἀρχὴν ἢ μεθ' ὃ πρῶτον λεπτὸν – καθ' ὃ |<sub>257v</sub> καὶ  
ἢ μεγίστη πασῶν ἡμερῶν γίνεται – τὴν θερινὴν τροπὴν συμβέβηκε γίνεσθαι. εἰ δ' ὁ  
ζωδιακὸς καὶ ὁ ἐν τούτῳ Καρκίνος καὶ ἡ τοῦ Καρκίνου ἀρχὴ πάντως ἀμετακίνητα καὶ  
40 τὸν αὐτὸν ἀεὶ τόπον ἔχοντα, καὶ ὁ θερινὸς τροπικὸς ἄρα τῷ τόπῳ τὲ καὶ τῆ ἐν αὐτῷ  
θέσει δέδοται. οὕτω δὲ καὶ ὁ χειμερινὸς τροπικὸς δέδοται τῷ τόπῳ τὲ καὶ τῆ θέσει· εἰς  
γὰρ τὸ πρῶτον τοῦ Αἰγόκερω λεπτὸν ἐπινενόηται τε καὶ γίνεται. ὡσαύτως δὲ καὶ τῷ  
μεγέθει οὗτοι οἱ δύο κύκλοι δέδονται· τῷ τε γὰρ θερινῷ τροπικῷ ἔστιν ἴσον πορίσα-  
σθαι τὸν χειμερινὸν τροπικόν, καὶ τῷ χειμερινῷ τροπικῷ τὸν θερινὸν τροπικόν ἔμπα-  
45 λι· ὧν γὰρ ἡ πρὸς τὸν ζωδιακὸν διάστασις ἴση, καὶ αὐτοὶ ἴσοι. ἀλλ' οὗτοι μὲν οἱ τρεῖς,  
ὁ τε ἰσημερινὸς ὁ θερινὸς τροπικὸς καὶ ὁ χειμερινὸς τροπικὸς τῆ τε θέσει τῷ τε μεγέ-  
θει δέδονται, ὡσπερ εἴρηται.

<5> ἐκ τοῦ ἐναντίου δὲ ὁ ἀρκτικὸς καὶ ἀνταρκτικὸς, τουτέστιν ὁ τε τὰ ἀειφανῆ ὀρί-  
ζων καὶ ὁ τὰ ἀφανῆ, οὔτε τῆ θέσει οὔτε τῷ μεγέθει δέδονται. ἔστι δ' ὅτε καὶ παντελῶς  
50 οὐκ εἰσὶν, οὔθ' ὁ μὲν |<sub>252r</sub> ἀφανῆς ὧν οὔτε ἀειφανῆς ὁ ἕτερος· ἐν γὰρ τῆ διακεκαυμένῃ  
καὶ ἀοικήτῳ διὰ τῶν πόλων ἐκατέρων δίεισιν ὁ ὀρίζων, καὶ πάντα τὰ ἄστρα τὰ τε βο-  
ρειότερα καὶ τὰ νοτιώτερα καὶ ἀνατέλλουσι καὶ δύνουσι, ὥστε οὔτε τὰ βορειότερα  
ἀειφανῆ εἰσὶν οὔτε τὰ νοτιώτερα ἀφανῆ. εἰς δὲ τὰς παρ' ἐκάτερα ἐγκλίσεις τῆς γῆς,  
παρ' οἷς μὲν βορειότατοί τε καὶ νοτιώτατοί εἰσι, εἰς μὲν τὴν ἡμετέραν εὐκρατον βο-  
55 ρειότατος ὁ ἀειφανῆς μικρὸν ἔχων τὸν πόλον ἐξαίροντα καὶ μικρὸν τὸν τοῦ ἀειφα-  
νοῦς κύκλον γράφων, ὁ δὲ ἀφανῆς νοτιώτατος μικρὸν ὑπεράνω τοῦ πόλου τὸν ὀρίζο-  
ντα ἔχων ἐξαίροντα καὶ μικρὸν γράφων τὸν τῶν ἀφανῶν κύκλον. ἐπεὶ δὲ εἰς τὴν καθ'  
ἡμᾶς εὐκρατον ἑπτὰ παραλλήλοις κλίμασι τὸ τῆς γῆς ἔγκλιμα τέμνεται, καθ' ἕκαστον  
κλίμα, ὡς ἐπὶ τὸ βορειότερον ἀρχομένων ἡμῶν ὁ πόλος τὲ πλεῖον ἐξαίρειται ὁ βόρει-  
60 ος καὶ ὁ κύκλος τῶν ἀειφανῶν μείζων γίνεται. ὡσαύτως δὲ ὁ νότιος πόλος πλεῖον κα-  
ταβιβάζεται καὶ ὁ ὀρίζων ὑψηλότερος γίνεται, ἀναλόγως δὲ καὶ ὁ τὰ ἀφανῆ γράφων  
κύκλος μείζων γίνεται. καθ' ἑαυτοὺς μὲν οὖν ὁ τε ἀρκτικὸς καὶ ὁ ἀνταρκτικὸς οὔτε τῆ  
θέσει οὔτε |<sub>252v</sub> τῷ μεγέθει δέδονται – πρὸς γὰρ τὰς διαφόρους οἰκήσεις καὶ τὰ διάφο-  
ρα τῆς γῆς κλίματα τὴν τε θέσιν καὶ τὸ μέγεθος ὑπαλλάττουσι – πρὸς ἀλλήλους δὲ  
65 οὔτε τὴν θέσιν οὔτε τὸ μέγεθος ἀλλοιοῦσιν, ἀλλ' οἶονεὶ καὶ κατ' ἀμφοτέρα δέδονται·  
ὅτε γὰρ ὁ τῶν ἀειφανῶν κύκλος βορειότατός ἐστι καὶ σμικρότατος, τῆνικαῦτα καὶ ὁ  
τῶν ἀφανῶν κύκλος νοτιώτατός ἐστι καὶ σμικρότατος, ὅτε δὲ ἐκ τοῦ ἐναντίου ὁ τῶν

ἀειφανῶν μέγιστος, καὶ ὁ τῶν ἀφανῶν μέγιστος καὶ τῆ τε θέσει ὅμοιος καὶ τῷ μεγέθει ἴσος, ἐν τῷ μεταξὺ δὲ τῶν τε μικροτάτων καὶ τῶν μεγίστων κατὰ τὸ ἀνάλογον, ὥστε  
70 καθ' ἑαυτοὺς μὲν οὗτοι οἱ δύο κύκλοι ὁ ἀρκτικός καὶ ὁ ἀνταρκτικός οὔτε τῆ θέσει οὔτε τῷ μεγέθει δέδονται, πρὸς ἀλλήλους δὲ τῆ τε θέσει καὶ τῷ μεγέθει δέδονται. καὶ περὶ μὲν τῶν παραλλήλων ταῦτα.

<6> ὁ δὲ ζῳδιακὸς καὶ αὐτὸς τῆ τε θέσει καθ' ἑαυτὸν καὶ τῷ μεγέθει δέδοται· τὸν τε γὰρ τόπον τὸν αὐτὸν εὐρίσκεται κατέχων αἰεὶ, καὶ ἔστιν ἡμῖν πορίσασθαι αὐτῷ ἴσον  
75 ἕτερον, τὸν τε ἰσημερινὸν τὸν μεσημβρινὸν καὶ τὸν ὀρίζοντα· πάντες γὰρ οὗτοι δι-  
χοτομοῦσι |<sub>253r</sub> τὴν σφαῖραν. εἴρηται δὲ “καθ' ἑαυτὸν” ὅτι ὡς πρὸς ἡμᾶς οὐ τηρεῖ τὴν  
αὐτὴν αἰεὶ θέσιν· ἔστι γὰρ λοξὸς οὐ παράλληλος, καὶ παρ' οἷς μὲν ἔστι βορειότερος  
παρ' οἷς δὲ νοτιώτερος, καὶ ὡς πρὸς τὴν ὀρθὴν σφαῖραν παρ' οἷς μὲν πλαγιώτερος παρ'  
οἷς δὲ ὀρθώτερος, τουτέστι παρ' οἷς μὲν ὀξυγωνιώτερος παρ' οἷς δὲ ὀρθογωνιώτερος  
80 παρ' οἷς δὲ ἀμβλυγωνιώτερος. ἐπεὶ γὰρ ἔστι σημεῖον τοῦ ὀρθὴν εἶναι τὴν σφαῖραν ὁ  
ἰσημερινὸς τέμνεται δὲ ὁ ἰσημερινὸς τῷ ζῳδιακῷ, ἐγγὺς μὲν τῆς τομῆς ὀξυγωνιώτερα  
ἔστιν ἡ λόξωσις, ἀπωτάτω δὲ τῆς τομῆς οἰοῖται ἀμβλυγώνιος, μεταξὺ δὲ τούτων οἰο-  
νεὶ ὀρθωγώνιος. οὕτω μὲν οὖν καὶ περὶ τοῦ ζῳδιακοῦ, ὅς καὶ κατὰ μῆκος τέμνει τὴν  
σφαῖραν, ὡς εἴρηται.

<7> ἐπεὶ δὲ τὸ πλήρες τῆς διαιρέσεως οὔτε τὸ ἐξ ἀμφοτέρων καταφατικὸν ἀπαιτεῖ  
μόνον, οἷον τὸ καὶ τῆ θέσει καὶ τῷ μεγέθει δεδόσθαι, οὔτε δὲ τὸ ἐξ ἀμφοτέρων ἀπο-  
φατικὸν μόνον, οἷον τὸ μήτε τῆ θέσει μήτε τῷ μεγέθει δεδόσθαι, ἀλλὰ καὶ τὸ ἐξ ἀμφο-  
τέρων συμμιγές, οἷον θέσει μὲν δεδόσθαι μεγέθει δ' οὐ, ἢ θέσει μὲν μὴ<sup>15</sup> δεδόσθαι με-  
γέθει δέ, ἴδωμεν καὶ ταῦτα παρ' οἷς τῶν οὐρανίων |<sub>253v</sub> εὐρίσκεται. ὁ μὲν οὖν μεσημ-  
90 βρινὸς καὶ ὁ ὀρίζων τῆ θέσει μὲν οὐ δέδονται τῷ μεγέθει δὲ δέδονται· ὁ μὲν γὰρ τό-  
πος αὐτοῖς παρὰ τὰς διαφοροὺς οἰκήσεις ὑπὴλλακται· οὐ γὰρ ἔστιν ἡ γῆ οὐδὲ ἡ ταύτης  
ἐπιφάνεια ὁμαλῆς καὶ ἐπίπεδος ἀλλὰ σφαιρική καὶ ἀνώμαλος<sup>16</sup>. διὰ τοῦτο οὔτε παρὰ  
πᾶσιν ὁ αὐτὸς ὀρίζων, ἀλλὰ παρ' οἷς μὲν ταπεινότερος παρ' οἷς δὲ ὑψηλότερος, οὐθ' ὁ  
μεσημβρινὸς ὁ αὐτὸς παρὰ πᾶσιν· οὔτε γὰρ ἡ ἀνατολὴ καὶ ἡ δύσις ἡ αὐτὴ παρὰ πᾶσι  
95 διὰ τὰ μεσολαβοῦντα τῆς γῆς κυρτώματα καὶ ἐγκλίματα, οὔτε μεσουράνημα τὸ αὐτό·  
τὸ γὰρ τοῦ ἡλίου μεσουράνημα τὸν μεσημβρινὸν δείκνυσιν ὑπὲρ κεφαλῆς ἡμῶν τη-  
νικαῦτα τοῦ ἡλίου ὄντος. τῷ μεγέθει δὲ καὶ οὗτοι δέδονται· τῷ τε γὰρ ὀρίζοντι ἔστιν

<sup>15</sup> μὴ s.l.

<sup>16</sup> ἀνόμαλος cod.



ἴσον πορίσασθαι τὸν μεσημβρινόν, καὶ τῷ μεσημβρινῷ τὸν ὀρίζοντα. ταῦτα καὶ περὶ τούτων.

- 100 <8> ἐφεξῆς δὲ περὶ τῶν κατὰ βάθος ἴδωμεν κύκλων. εἰσὶ δὲ οὗτοι ἑπτὰ, ὁ τοῦ Κρόνου, ὁ τοῦ Διός, ὁ τοῦ Ἄρεως, ὁ τοῦ ἡλίου, ὁ τῆς Ἀφροδίτης, ὁ τοῦ Ἑρμοῦ καὶ ὁ τῆς σελήνης. καὶ πάντες μὲν οἱ |<sub>254r</sub> ῥηθέντες ἀστέρες ἰδίαν καὶ προαιρετικὴν κινουῦνται κίνησιν, ἀλλ' οὐ πάντες ὁμοίως. ἡλιος μὲν γὰρ καὶ σελήνη ὑπολειπτικαὶ εἰσίν, ἀεὶ ἐπὶ τὰ ἐπόμενα τρέχοντες τὰ προηγούμενα δὲ ὑπολείπονται. ἔστι<sup>17</sup> δὲ [[ὁ]] προηγούμενον<sup>18</sup>
- 105 μὲν οἶον τυχὸν ὁ Κριὸς τὸ ἐπόμενον δὲ οἶον ὁ Ταῦρος, καὶ πάλιν προηγούμενον μὲν ὁ Ταῦρος ἐπόμενον δὲ ὁ Δίδυμος, καὶ ἀεὶ ὁ ἡλιος καὶ ἡ σελήνη ἀπὸ τῶν προηγουμένων ἐπὶ τὰ ἐπόμενα ποιοῦνται τὴν κίνησιν (οἶον ἀπὸ Κριοῦ εἰς Ταῦρον καὶ ἀπὸ τοῦ Ταύρου εἰς τοὺς Διδύμους), καὶ τὰ μὲν ἐπόμενα καταλαμβάνουσι τὰ προηγούμενα δὲ ὑπολείπουσι. διὸ καὶ ὑπολειπτικοὶ λέγονται ὅ τε ἡλιος καὶ ἡ σελήνη, καὶ ὁ τοιοῦτος δρόμος
- 110 αὐτῶν ὑπόλειψις ὀνομάζεται. προηγητικοὶ δὲ λέγονται οἱ ἄλλοι ἀστέρες, ὁ Κρόνος, ὁ Ζεὺς, ὁ Ἄρης, ἡ Ἀφροδίτη καὶ ὁ Ἑρμῆς, ὅτι οὐ μόνον πρὸς ἀνατολὰς ποιοῦνται τὴν κίνησιν, τουτέστιν ἐκ τῶν προηγουμένων εἰς τὰ ἐπόμενα, ἀλλ' ἔστιν ὅτε καὶ ἐναντίως ἀπὸ τῶν ἐπομένων ἐπὶ τὰ προηγούμενα, καὶ διὰ τοῦτο προηγητικοὶ λέγονται. καλεῖται δὲ ἡ τοιαύτη προήγησις καὶ ὑποποδισμός. |<sub>254v</sub>
- 115 <9> πάλιν δὲ τῶν ὑπολειπτικῶν δύο ἀστέρων, ἡλίου τε καὶ σελήνης, ὁ μὲν ἡλιος τὴν μεταξὺ τοῦ ζωδιακοῦ γραμμὴν δίεισιν, ἡ δὲ καὶ διὰ τοῦτο ἡλιακὴ καλεῖται· οὐ γὰρ ἔστιν ὁ ζωδιακός, ὡς προεῖρηται, κύκλος ὑπὸ μιᾶς γραμμῆς περιεχόμενος, ἀλλὰ πλάτος ἀξιόλογον ἔχει, ἀλλὰ τὸν μὲν μεσαίτατον [[πάλιν]] τούτου κύκλον, ὃς καὶ μέγιστός ἐστι καὶ εἰς δύο τέμνει τὴν σφαῖραν, ὁ ἡλιος δίεισιν. ἡ δὲ σελήνη κατὰ τὴν τάξιν
- 120 τῶν ἄλλων πέντε πλανήτων ποτὲ μὲν τὴν μέσην ταύτην γραμμὴν δίεισι ποτὲ δὲ βορειότερα ποτὲ δὲ νοτιωτέρα καθίσταται, καὶ ἦν ἂν καὶ αὕτη προηγητικὴ διὰ τὴν τοιαύτην ἀνωμαλίαν κατὰ τὴν τάξιν τῶν ἄλλων ἀστέρων· ἀλλ' ὅτι τὸ μέγεθος τοῦ κύκλου αὐτῆς ὡς προσγειοτάτης τῶν ἄλλων ἔστιν ἐλάχιστον, φθάνει ὑπολειπτικὴ τίς γινομένη, ἀλλ' οὐ προηγητικὴ. [[οὔτοι μὲν οὖν οἱ δύο κύκλοι καὶ τῇ θέσει καὶ τῷ μεγέθει δέ-
- 125 δονται· οὔτε γὰρ οἱ τόποι τῶν κύκλων μεταπίπτο]] οὔτοι οὖν πάντες οἱ τῶν πλανήτων κύκλοι τῇ θέσει μὲν δέδονται – ἀμετάπτωτοι γὰρ οἱ τόποι αὐτῶν – τῷ μεγέθει δὲ οὐ δέδονται· οὐ γὰρ ἔχομεν ἐκάστω αὐτῶν ἴσον πορίσασθαι.

<sup>17</sup> ἔστι s.l. corr. εἰσὶ

<sup>18</sup> corr. e προηγούμενα m.1