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# Conrad Heingarter's Treatise on Planetary Latitudes: An Introduction and Critical Edition

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# An Introduction and Critical Edition\*

## Eleonora Andriani, Camille Bui, Nicholas Jacobson

**DISCLAIMER: This document is a preliminary draft of the contribution, currently in its second proofs.**

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To the memory of  
Helena Avelar de Carvalho (1964–2021)

## Introduction

Sometime in the latter half of the fifteenth century, the Swiss astrologer and physician Conrad Heingarter composed a short treatise on planetary latitudes contained in a manuscript destined for his patron, Duke John II of Bourbon (1426–88), while in residence at Belleperche. The work is divided into two sections: a *theorica* and a *practica*. The *theorica* purports to describe the planetary models upon which the tables of planetary latitude were based. The *practica* is a set of canons, which presents instructions to be used with three different types of latitude table. The inclusion of the *practica* implies that the author had more than just a theoretical interest in the subject in mind. He intended for his readers to compute with the tables, and he offered a tutorial on how to do so.

In light of Heingarter's role at the Bourbon court and his career trajectories, his efforts in establishing a practical guide for calculating planetary latitude values may reveal a growing interest among astrologers and physicians — and not just mathematical astronomers — in this relatively advanced branch of astronomy. This shift in technical interests was itself likely spurred on, at least in part, by changes in the practice of medical astrology. Throughout the late-thirteenth and fourteenth centuries in Europe, a medical astrologer's primary tools of prognostication resided in the *figura caeli*, the tracking of the Moon through critical days, and the attribution of astral properties to different medicines. These tools were taken up, in turn, by practitioners of the late medieval and early modern periods.<sup>1</sup>

Paramount among these stood the *figura caeli*, or horoscope, in which the positions of the seven classical planets and the lunar nodes were depicted on a square representation of the zodiac. The nodes, and sometimes the Moon's latitude, were included to account for lunar and solar eclipses. The horoscope was then divided into 12 triangles, representing the houses, which

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\* This chapter has been written collectively. Eleonora Andriani wrote most of the pages 4-13, Camille Bui wrote most of the pages 14-15, and Nicholas Jacobson wrote most of the pages 1-3 and 16-22. The edition, translation, and glossary were established collectively.

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<sup>1</sup> For a subtle account of the interplay of different elements in medical astrology, and how they were inherited in the Renaissance and Early Modern period by such practitioners as Girolamo Cardano, see Anthony Grafton and Nancy Siraisi, 'Between the Election and My Hopes: Girolamo Cardano and Medical Astrology', in *Secrets of Nature: Astrology and Alchemy in Early Modern Europe*, ed. by Anthony Grafton, Jed Z. Buchwald, and William Newman (Cambridge: MIT Press, 2001), pp. 69–131, pp. 77–78.

surrounded a central square providing relevant information such as the time, place, and occasion for which the horoscope had been made. The *figura caeli* typically only included the seven planets' positions in the zodiac in terms of ecliptic longitude, neglecting the latitude values for all but the Moon.<sup>2</sup> With this primary tool, other crucial techniques of astrological practice could be performed, such as calculating directions and profections for the chart, determining planetary conjunctions and aspects, and establishing the date of conception for the native.<sup>3</sup> These latter calculations, however, relied upon the same planetary positions in longitude that a practitioner would find for the base horoscope.

By the late fifteenth century, several salient factors emerged that put pressure on physicians like Heingarter to re-evaluate the theoretical underpinnings of the practices developed for their profession. First, the influx of new texts and translations from the Greek language, especially in the decades leading up to the fall of Constantinople in 1453, had contributed to a concerted effort among scholars to uncover the original teachings of the ancients. From the perspective of the astral sciences, this humanistic impulse was directed towards the goal of finding the authentic doctrines of Ptolemy and the earliest Hellenistic practitioners of astrology.<sup>4</sup> Although there were some who used this search for original texts as an excuse to clear away what were considered to be accretions of later generations, there were others, like Heingarter, who instead sought to gather together and systematize the vast body of knowledge within a single framework.<sup>5</sup> As a consequence of the compiling efforts of this new generation of humanists in the major centres of learning in Western Europe, a greater variety of computing practices were made more widely available to aspiring medical and judicial astrologers that went well beyond planetary longitude and eclipse calculations.

At the same time, medical astrologers were facing a wave of sceptical criticism from those who would rid the arts and sciences of divinatory practices and fatalistic beliefs.<sup>6</sup> Heingarter's own fierce defence of the use of astronomy for medicine appears later in his career when such debates became more prevalent in scholarly circles.<sup>7</sup> In order to justify their craft, some astrologers sought a common ground with their critics by emphasizing the naturalistic foundation of their discipline. Direct causal connections between planetary motions and terrestrial effects were sought that could explain individual events on Earth in terms of specific physical changes in the heavens. Techniques involving planetary conjunctions, oppositions, and aspects were gathered together in astronomical canons, with others requiring an adept to pay close attention to the speed, direction, and nearness of a planet on its epicycle and eccentric in relation to the Earth. The latitudinal position of a planet held great significance within such

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<sup>2</sup> See Alexandre Tur, 'From Astronomical Computation to Astrological Interpretation: *Figurae Caeli* and "Astrological Squares" in Fifteenth-Century Annual Prognostications' in this volume.

<sup>3</sup> Directions and profections were both methods of forecasting by which a designated position in the horoscope was moved towards other significant points in the chart. We discuss the technique of directions in greater detail in the first section of this paper. Ptolemy concluded the *Quadripartitum* with a discussion of profections. See Ptolemy, *Tetrabiblos*, ed. and trans. by Frank E. Robbins (Cambridge, Mass.: Harvard University Press, 1940), pp. 447–57.

<sup>4</sup> See Dag Nikolaus Hasse, *Success and Suppression: Arabic Sciences and Philosophy in the Renaissance* (Cambridge, Mass.: Harvard University Press, 2016), pp. 248–92, (pp. 251–53, 268–69).

<sup>5</sup> For evidence of Heingarter's belonging to the latter category, see Nicolas Weill-Parot, *Les 'Images Astrologiques' au Moyen Âge et à la Renaissance: spéculations intellectuelles et pratiques magiques (XII<sup>e</sup>–XV<sup>e</sup> siècle)* (Paris: H. Champion, 2002), p. 805.

<sup>6</sup> Gian Mario Cao, 'Inter alias philosophorum gentium sectas, et humani, et mites: Gianfrancesco Pico and the Sceptics', in *Renaissance Scepticisms*, ed. by Gianni Paganini and José R. Maia Neto (Dordrecht: Springer, 2009), pp. 127–47; Cao, 'The Prehistory of Modern Scepticism: Sextus Empiricus in Fifteenth-Century Italy', *Journal of the Warburg and Courtauld Institutes* 64 (2001), 229–80 (pp. 259–60). It should be noted that recent scholarship has shown that Giovanni Pico della Mirandola's own critiques may have been motivated by an impulse to reform astrology rather than fully overturn it; see Dag Nikolaus Hasse in the note above.

<sup>7</sup> For a discussion of Heingarter's defence, see section 1 below.

a naturalistic system since it could account for the position of the physical body of the planet rather than its projection onto the ecliptic plane.<sup>8</sup> It also played an important role in determining the aspects between these physical bodies. Thus, authors treating techniques involving the so-called planetary accidents or passions often advised the most careful practitioners to take into account the planet's latitudinal position in their computations.<sup>9</sup>

Finally, the greater attention afforded to planetary passions also contributed to what was a broader movement among students, practitioners, and scholars alike to reform the curriculum available for learning astronomy in the university. During this period, the *Theorica planetarum communis*, which had served as the central text on planetary astronomy for university instruction, was routinely criticized for the inadequacy of its final three chapters that considered retrograde and direct motion, the use of planetary latitude tables and their theoretical underpinnings, and planetary aspects.<sup>10</sup> In addition to addressing new interests and concerns in the realm of medical astrology, Heingarter's treatise on latitudes also intervened in these debates over the curriculum of the Latin university system. Thus, because Heingarter's own career sat at the intersection of court politics, the medical profession, and the university, it is clear that he composed his treatise to address different audiences hailing from multiple contexts. The treatise served simultaneously as a humanistic gift of erudition to his patron at Belleperche, a boon to aspiring practitioners of the astral sciences, and was also presented as a commentary text that would aid the arts faculty of Paris in their efforts to expand their curriculum.

By way of introducing Heingarter's treatise and its significance, this article will highlight these three aspects of his career in turn. The first section will discuss his firm commitment to the integration of mathematical astronomy into his practice as a physician and counsellor in the face of sceptical forces within the profession. In addition to this, we will show that his efforts in gathering and commenting on what he considered to be the most authoritative texts in his field brought to the fore several techniques that focused on the importance of planetary accidents in medical and judicial astrology. We will limit ourselves to reviewing the features of these techniques that are relevant to planetary latitudes.

The second section will consider the humanistic impulse that spurred Heingarter to collect and preserve a wide body of textual material on planetary latitude. The many extant witnesses to his library reveal an abiding interest in the subject over the course of many years. Through the identification and analysis of several of these manuscripts, we will reconstruct features of Heingarter's research and collection practice that are relevant to understanding how he composed the treatise.

The third section discusses Heingarter's continued collaboration with masters at the University of Paris and his intention to augment the arts curriculum with his teachings on latitude theory and computation. This element of Heingarter's career has received relatively little attention in the current secondary literature, and we hope to present this text as a facet of

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<sup>8</sup> Understanding apparent planetary positions in the zodiac to be dependent upon the motions of real physical spheres had become a subject of lively debate among fifteenth-century astronomers, particularly at the University of Vienna. For a salient example of the relevance of latitude theory to these discussions, see Michael Shank, 'Regiomontanus versus George of Trebizond on Planetary Order, Distances, and Orbs (*Almagest* 9.1)', in *Ptolemy's Science of the Stars in the Middle Ages*, ed. by David Juste, Benno van Dalen, Dag Nikolaus Hasse and Charles Burnett (Turnhout: Brepols, 2020), pp. 305–86, (pp. 370–377).

<sup>9</sup> This was already the case with John of Saxony in his commentary on the *Introductorius* (*Commentum super textu Alchabitii*). See section 1 below.

<sup>10</sup> The *Theorica planetarum communis* is often referred to as the *Theorica planetarum Gerardi* in reference to Gerard of Cremona's alleged authorship of the work. Because this attribution is doubtful, we have opted to refer to this work as the *Theorica planetarum communis* throughout. See Claudia Kren 'Planetary Latitudes, the *Theorica Gerardi*, and Regiomontanus', *Isis*, 68 (1977), 194–205; Claudia Kren, 'A Medieval Objection to "Ptolemy,"' *The British Journal for the History of Science*, 4 (1969), 378–93.

Heingarter's larger project of guiding and training a new generation of students. In doing so, we will provide an overview and analysis of the treatise.

A critical edition and translation of Heingarter's treatise will appear at the end as an Appendix, together with a list of relevant vocabulary terms as a glossary.

## 1. Heingarter's Defence of Medical Astrology

Originally from Horgen near Zürich, Heingarter received his B.A. in 1454, his M.A. in 1455, and his licentiate in medicine at the University of Paris in March 1466. Perhaps as early as 1463 or 1464, Heingarter began his career in the service of John II, whom he served until the duke's death in 1488.<sup>11</sup> During his years of study in Paris, Heingarter had become an avid student of the quadrivium, as has been made readily apparent in the many extant manuscripts either belonging to him or that have transmitted his own original works. From those of his codices preserved at the Bibliothèque nationale de France in Paris, we are offered a unique window into the growth and development of his competencies in mathematical astronomy.<sup>12</sup>

Many of these witnesses contain mathematical texts that were gathered together by Heingarter when he was still a student at the University of Paris. In one such student manuscript, BnF, lat. 7197, introductory texts on arithmetic, geometry, and astronomy filled with Heingarter's annotations sit incongruously alongside Ciceronian orations and Hugh of St Victor's *De grammatica*. Manuscripts such as BnF, lat. 7197 constitute a series of exercises amounting to a corpus of juvenilia, but, even years after writing his youthful notes on the *Sphere* of John of Sacrobosco and the *Theorica planetarum communis*, Heingarter would return to these foundational works again and again for inspiration. He wrote no less than two marginal commentaries on the full text of the *Theorica*, and the planetary latitude treatise itself should be seen as a specialized version of a third such commentary focusing on the *Theorica*'s seventh chapter. He remained committed to the application of astronomy to his profession throughout his life.

A perusal of Heingarter's practice in the first decade or so of his career shows that his methods did not deviate drastically from those of his contemporaries. As a counsellor to the duke and his household, as well as a diplomat and advisor to King Louis XI (the brother of the duchess), Heingarter availed himself of the common astrological tools of his generation. In 1469, he prepared for the king an interpretation of the Saturn-Mars conjunction, although it is

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<sup>11</sup> It is beyond the scope of this article to provide an exhaustive account of the life and the work of Conrad Heingarter. We are therefore only mentioning a selection of contributions vital to an investigation into these topics. For more on Heingarter's life and work, see Lynn Thorndike, *A History of Magic and Experimental Sciences*, 8 vols (New York: Columbia University Press, 1934–1958), IV, pp. 357–73 and pp. 374–85; Maxime Préaud, *Les méthodes de travail d'un astrologue du xv<sup>e</sup> siècle, Conrad Heingarter*, unpublished thesis, Paris, École des chartes, 1969, pp. 143–49; Maxime Préaud, *Les astrologues à la fin du Moyen Âge* (Paris: J.-C. Lattès, 1984), particularly pp. 71–94, 97–100, 141–55, 177–86, 240–43; Jean-Patrice Boudet, *Le Recueil des plus célèbres astrologues de Simon de Phares*, 2 vols (Paris: H.Champion 1997–1999), I, pp. 585–87, 94a–94b; Weill-Parot, *Les 'Images Astrologiques'*, pp. 710–14 and pp. 901–03; Matthieu Husson, 'The Art of Astrological Computations: Conrad Heingarter and the Manuscript Paris, BnF latin 7295A', in *Exploring Written Artefacts: Objects, Methods, and Concepts*, ed. Jörg B. Quenzer, (Berlin: De Gruyter, 2021), pp. 513–32; Steven Vanden Broecke, 'Astrological Self-Government at the Fifteenth-Century Court of Bourbon', *Early Science and Medicine* 28 (2023): pp. 34–64.

<sup>12</sup> The Bibliothèque nationale de France preserves several manuscripts belonging to Heingarter or preserving his works, namely: lat. 7197, lat. 7295A, lat. 7305, lat. 7333, lat. 7432, lat. 7446, lat. 7450, and lat. 11232. Manuscripts of uncertain connection to Heingarter: lat. 7273, lat. 7447, and lat. 7314.

no longer extant.<sup>13</sup> BnF, lat. 7446 contains a nativity that Heingarter prepared for Jean de la Gutte, a favourite at the Bourbon court. In BnF, lat. 7447 there appears a *iudicium anni* for the duke attributed to Heingarter.<sup>14</sup> Likewise Heingarter prepared a *iudicium anni* for the year 1476 addressed to King Louis that is preserved in BnF, lat. 7450.<sup>15</sup> These judgments conform to the typical conventions of finding the degree of the ascension and midheaven, dividing the houses, and finding planetary longitudes for a horoscope.

Something appears to have happened later in Heingarter's career that caused him to become much more self-conscious about the methods of medical astrology. Beginning in the late 1470s and continuing throughout the 1480s, he began writing medical advice and public circulars in which he zealously defended his practice against critics. He wrote one of his most strident defences of the integration of astronomy into medicine to Duchess Jeanne of Bourbon in a work of medical advice dated to August 26, 1480. At the very beginning of this excursus, he included a long chapter, aptly entitled *On the Usefulness of the Science of the Stars and what is Profitable and Necessary to Physicians (De utilitate sciencie astrorum et quod sit medicis proficua et necessaria)*.<sup>16</sup> Written three years after Marsilius Ficino's *Disputatio contra iudicium astrologorum* and only six years before Pico della Mirandola's bombshell *900 Theses* were published in Rome, thereby challenging the very epistemic foundations of astrology, Heingarter's defence entered circulation at a moment of sceptical ferment within the medical profession.<sup>17</sup> The text offers an eclectic mix of justifications for astronomy's role in medicine, taking turns in appealing to traditional authorities and natural causation for proof of its efficacy.

It was an inescapable truth to Heingarter that the lower realm of the earth was ruled by celestial bodies and to prove this he called to his defense a host of authorities including Aristotle, Cicero, al-Rāzī, Bernard Gordon ('a modern medical man', cit.), Arnald of Villanova, Abū Ma'shar, Hippocrates, Ptolemy, and the *Speculum astronomie*, which he attributed to Albert the Great.<sup>18</sup> Making heavy weather of the fact that he had tradition on his side, Heingarter was offering a response to rivals who questioned the relevance of the astral sciences to their discipline. Such physicians, he anticipated, would have much to say against what he had written, even though it contained doctrines in agreement, as he himself explains, 'with none but authoritative sources'.<sup>19</sup>

Not satisfied with the invocation of authorities whom he anticipated his opponents would reject out of hand, Heingarter also made an appeal to the natural connections between the heavenly bodies and terrestrial occurrences. Summarizing his opponents' position, Heingarter explained that these physicians found it rash and superstitious for a doctor to consult the stars, since medicine was a science resting on principles of its own. Conceding that, from a methodological point of view, medicine was a discipline deriving its conclusions from its own principles, Heingarter, nevertheless, denied that this implied that medical knowledge

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<sup>13</sup> Though the judgment is no longer extant, Simon de Phares attests to its existence in *Le Receuil*; see Boudet, *Le Recueil*, vol. I, p. 586.

<sup>14</sup> On the attribution of this work to Conrad Heingarter, see Ernest Wickersheimer, *Dictionnaire biographique des médecins en France au Moyen Âge*, new ed. (Geneva: Droz 1979), p. 57.

<sup>15</sup> On the political profile of Heingarter's astrological activity, see Tur, 'From Astronomical Computation to Astrological Interpretation-in in this volume.

<sup>16</sup> The medical advice to the duchess can be found in Zürich, Zentralbibliothek MS C 131, an illuminated manuscript of 49 written folios. On this medical advice, see Lynn Thorndike, 'Conrad Heingarter in Zurich Manuscripts, Especially his Medical Advice to the Duchess of Bourbon', *Bulletin of the Institute of the History of Medicine*, 4 (1936), pp. 81–87. A text for the duke closely resembling that which was addressed to his wife can be found in BnF, lat. 11232.

<sup>17</sup> Cao, 'Inter alias philosophorum gentium sectas, et humani, et mites', pp. 127–47.

<sup>18</sup> See BnF, lat. 11232, ff. 3<sup>v</sup>, 4<sup>v</sup>–7<sup>r</sup> and 29<sup>r</sup>.

<sup>19</sup> 'Forsan multum contra hoc capitulum (quod nisi ex fontibus Sapientum hausimus) garrubulant...'. See BnF, lat. 11232, f. 6<sup>v</sup>.

could be gleaned without recourse to the mathematical and natural sciences. Instead, he likened the active principles of medicines, natural compounds, and celestial bodies to the virtues of moral philosophy. ‘Just as in ethics the virtues are connected’, he wrote, ‘so medicine cannot be separated from natural philosophy or astronomy’.<sup>20</sup> Thus, at least by the 1480s, Heingarter had made a point to explain the efficacy of the stars on the health of his patrons in terms of natural causation.

During these years, Heingarter had integrated himself into a circle of renowned medical astrologers, and he even found the time to mentor a budding new generation of scholars. While providing his services to the king, he joined the ranks of many other practitioners, such as Jean Coleman, Arnoul de La Palu, Pierre de Graville, Laurent Hutz, Jacques Lose, and Angelo Cato. More frequently, he would have interacted with his colleagues at the ducal court, including his sometime student Simon de Phares, as well as Jacques Sanglier, Antonio Chiapucin, and S. Belle.<sup>21</sup> In addition to teaching Simon de Phares, Heingarter also served as a mentor to Guillaume Cop and probably also Erhard Windsberger and Conrad Türst. These latter three were all physicians of Swiss origin.

It is from the young scholars whom Heingarter mentored that we find the clearest testimony of his commitment to defending astronomy’s role in medicine and his interest in reforming it when necessary. In this regard, an exceptionally revealing document is a letter addressed to Heingarter by Guillaume Cop — the future physician to Louis XII and Francis I, but a *magister artium* and a baccalaureate in medicine at the University of Paris at the time of its composition.<sup>22</sup> The letter, which is dated to 1493, can be found in the first four folios of Vatican, Biblioteca Apostolica Vaticana, Reg. lat. 1241, a paper manuscript of 178 folios of astronomical content.<sup>23</sup> From the opening lines, one learns that Heingarter served as Cop’s master and teacher (*dominus et preceptor*):

To the illustrious man Conrad Heingarter of the leafy garden of Zurich, professor of the sidereal science as well as medicine, most erudite physician of the most Christian king of France and the illustrious duke of Bourbon, Guillaume Cop of Basel, Master of Arts and bachelor of medicine, wishes as much health as possible to his master and preceptor, for he venerates him as one among the first rank.<sup>24</sup>

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<sup>20</sup> ‘Nolo negare propria medicine principia, sed volo dicere quemadmodum (ut in ethicis probatum est) quod virtutes sint connexe; pariformiter medicina nec a philosophia naturali nec ab astronomia subtrahi potest’. See BnF, lat. 11232, f. 6<sup>v</sup>; see also Thorndike, *A History of Magic*, vol. IV, p. 368.

<sup>21</sup> See Jean-Patrice Boudet, *Astrologie et politique entre Moyen Âge et Renaissance* (Florence: SISMEL — Edizioni del Galluzzo, 2020), pp. 297–98. On S. Belle, see Helena Avelar de Carvalho, *An Astrologer at Work in Late Medieval France: The Notebooks of S. Belle* (Leiden: Brill, 2021). On Conrad Heingarter’s relationship with Erhard Windsberger and Conrad Türst see: Alfred Schmid, *Conrad Türst’s Iatro-mathematisches Gesundheitsbüchlein für den Berner Schultheissen Rudolf von Erlach* (Bern: P. Haupt, 1947), particularly pp. 7–13, 21. See also Bernhard Milt, ‘Beitrag zur Kenntnis der mittelalterlichen Heilkunde am Bodensee und Oberrhein’, *Vierteljahrsschrift der Naturforschenden Gesellschaft in Zürich* 85 (1940), pp. 298–305.

<sup>22</sup> On the life and work of Guillaume Cop, see Wickersheimer, *Dictionnaire biographique des médecins*, 235–38; Marie-Louise Portmann, ‘Der Basler Humanisten-Arzt Wilhelm Copp (um 1460–1532)’, *Gesnerus* 15 (1958), 106–19; Stefania Fortuna, ‘Wilhelm Kopp Possessore dei Par. Gr. 2254 e 2555? Ricerche sulla traduzione del *De victus ratione in morbis acutis* di Ippocrate’, *Medicina nei Secoli. Arte e scienza*, 13 (2001), 47–57. Due to its rich content, a full edition, translation, and comment of this letter will be provided in a forthcoming publication by Eleonora Andriani and Nicholas Jacobson.

<sup>23</sup> ‘Iterum vale. Anno 1493, sexto Idus Iunias’. BAV, Reg. lat. 1241, f. 4<sup>v</sup>. The letter covers ff. 1<sup>r</sup>–4<sup>v</sup>. See David Juste, ‘MS Vatican, Biblioteca Apostolica Vaticana, Reg. lat. 1241’ (update: 21.02.2022), Ptolemaeus Arabus et Latinus. Manuscripts, accessed 8 April 2023: URL = <http://ptolemaeus.badw.de/ms/464>.

<sup>24</sup> ‘Clarissimo viro Conrado de viridariis Thuricensi, sideralis scientie medicineque professori, christianissimi regis Francie inclitique Borbonii ducis medico doctissimo. Domino et preceptoris suo in primis colendo, Guilhelmus Copp Basiliensis, arcium magister et medicine baccalaureus, salutem quam plurimam optat’. BAV, Reg. lat. 1241, f. 1<sup>r</sup>.

Cop went on to praise Heingarter for the effectiveness of his vigorous polemics against sceptics. Either alluding to his teacher's polemical *De utilitate sciencie astrorum* or to a later work called the *Defensio astronomie*, which, in 1488, he had written in Moulins for Louis Malet de Graville, admiral of France, he declared that Heingarter had effectively defended his abiding interest in the mathematical sciences:

And particularly in astronomy, against the detractors of which you wrote as rigorously as you did elegantly, so that anyone who would read through your 'edition', which you composed with great labour, are forced into silence, having lowered [their] head being unable to reply to it with anything.<sup>25</sup>

From Cop's testimony, we also learn of Heingarter's interest in modifying or clarifying techniques deemed necessary for the practice of the medical astrologer, known as directions. Adopting the rhetorical flourish of the new humanist style, Cop declared:

What could I say about the directions, which all the astrologers of our times have quite an aversion to? Having examined these, as if seeing the face of a Gorgon they would turn to stone and are deeply rendered speechless. You made all these things so clear and easy that to anyone even of little intelligence in a short amount of time those things would be accessible, which, formerly, even a sharp mind in a long amount of time could barely grasp.<sup>26</sup>

The practice of directing a planet in a horoscope had an ancient pedigree, with Ptolemy himself having described its astrological significance in the third book of the *Tetrabiblos*.<sup>27</sup> One planet was chosen from the chart to serve as the representative of the native's physical or spiritual well-being. It was called the significator, and the technique of directing this planet involved projecting it from the line of the ecliptic onto the celestial equator, and then imagining it to move to a place where another planet or aspect from the chart had also been projected onto the equator, this latter one called a promissor.<sup>28</sup> Each degree of movement on the celestial equator was thought to be equivalent to one year of the native's life. When a significator and a promissor met, it was believed that a significant event would occur to affect the native's physical or spiritual health — either for good or for ill.

Cop's assessment that Heingarter had worked on directions and sought to clarify their procedures is corroborated by the fact that one of the longest marginal notes in BnF, lat. 7432, the composition of which Heingarter had supervised for John II, is a paraphrase of John of Saxony's commentary on the influential *Introductorius* of Alcabitius ('Abd al-'Azīz al-Qabīṣī).<sup>29</sup> In this passage, Heingarter preserved a detailed set of procedures for calculating

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<sup>25</sup> 'Precipue astronomiam, in cuius emulos tam graviter tamque eleganter scripsisti, ut quicumque editionem tuam, quam pro eius defensione elucubrasti, perlegerint, demisso vultu nihil respondere potentes, tacere cogantur'. BAV, Reg. lat. 1241, f. 2<sup>r</sup>. The *Defensio* can be found in Zürich, Zentralbibliothek, B 244, ff. 1<sup>r</sup>–4<sup>r</sup>.

<sup>26</sup> 'Quid autem de directionibus loquar? Quas omnes ferme nostre tempestatis astrologi abhorrent. Ipsisque inspectis, tamquam Gorgonis viso capite in saxa mutantur penitusque obmutescunt. Has tu tam claras facilesque reddidisti, ut cuique eiam mediocris ingenii brevi temporis spacio patefiant que antea per longa temporum intervalla acutissimus intellectus vix capere poterat'. BAV, Reg. lat. 1241, f. 2<sup>v</sup>.

<sup>27</sup> The relevant passage can be found in the tenth chapter of the third book. For a modern translation, see Ptolemy, *Quadripartitum*, ed. and trans. by Robbins, pp. 270–305.

<sup>28</sup> Heingarter also refers to the significator as the 'hileg' from the Persian word *haylāj*, which means ruler of life. See Al-Battānī, *Opus astronomicum*, ed. by Carlo A. Nallino, 2 vols (Milan: Hoeplium, 1899–1907), I, pp. 313–14.

<sup>29</sup> The text is found in BnF, lat. 7432, ff. 160<sup>r</sup>–207<sup>v</sup>. For the critical edition of Alcabitius or Al-Qabīṣī's work in both Arabic and Latin together with a modern translation, see Alcabitius, *Introductorius*, in *Al-Qabīṣī (Alcabitius): The Introduction to Astrology: Editions of the Arabic and Latin Texts and an English Translation*, ed. by Charles Burnett, Keiji Yamamoto, and Michio Yano (London: The Warburg Institute, 2004).



planetary directions.<sup>30</sup> It is one of several such instances in Heingarter's annotated library in which he emphasized the importance of determining planetary latitudes for astrological judgments.

Following the basic instructions for finding directions, which only required the calculation of the planetary longitudes, Heingarter went on to include a section in which he discussed the importance of taking into account planetary latitudes in more carefully considered calculations. Quoting from John of Saxony's commentary, he informed the reader that this method is more difficult.<sup>31</sup> In these cases, the position of the planet projected onto the celestial equator must originate from the physical body of the planet in the zodiac rather than from its unadjusted longitudinal position on the ecliptic line.

Heingarter also detailed the use of an instrument, called a *directorium*, for directing planets with latitude.<sup>32</sup> Such an instrument is described in a text attributed to John of Lignères, which can be found with a crude diagram in BnF, lat. 7295.<sup>33</sup> The instrument is constructed in much the same manner as an astrolabe with a projection of the celestial sphere's climate circles, namely the tropics of Capricorn and Cancer, as well as the celestial equator. A projection of the ecliptic with nested circles of ecliptic latitude are then constructed in the same way that one produces the almucantars found on an astrolabe's climate plate. Furthermore, the rotating element of the *directorium* is not the ecliptic circle, but rather a moveable local horizon set to the terrestrial latitude of the user. This analogue to the rete of an astrolabe is comprised of two arms, one representing the horizon and the other the midheaven. In this way, the *directorium* can determine the points on the celestial equator that rise, set, and culminate with the true position of the planet in latitude to the north or south of the ecliptic plane.

Describing techniques of determining directions, which took into account the planetary latitude, was not the only area of medical astrology where Heingarter sought correctives to contemporary methods. In the same manuscript of BnF, lat. 7432, Heingarter included an excerpt from a work on medical astrology that he entitled the *Tractatus de pronosticis et componendis et ministrandis medicinis* taken from a work by the English Dominican friar, Robert of York (fl. 1313-1325), who was also known as *Perscrutator*.<sup>34</sup> In conclusion 8 of his *De impressionibus aeris*, in which the author treats the forecasting of plagues and pestilences, it is explained that planetary latitudes were to be taken into account when forecasting future onsets of plague. The text identified certain star positions in the zodiac that signified disease and mortality. In the event that a superior planet formed an aspect with one of these positions, it would portend the outbreak of pestilence. To determine these positions, moreover, the planet's latitude and its direction to the south or to the north of the ecliptic had to be found before the aspect between the star and the planet was established. Heingarter included two small tables containing the longitudinal and latitudinal positions of these stars together with their orientations to the north or south of the ecliptic.

The concern described in the *Tractatus de pronosticis* for a practitioner to find a planet's latitude before determining its aspect with certain stars in the zodiac is one case among a subset

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<sup>30</sup> BnF, lat. 7432, ff. 194<sup>r</sup>–198<sup>v</sup>. This same passage can be found in the 1503 printed edition of the work, which also contains John of Saxony's commentary to it. See *Alchabitius cum comento*, ed. by Bartholomäus Alten (Venice: Per Ioannem et Gregorium de Gregoriis fratres, 1503), ff. h6<sup>r</sup>–i2<sup>r</sup>.

<sup>31</sup> '... quando autem significatores habent latitudines difficilior est modus'. BnF, lat. 7432, f. 198<sup>r</sup>.

<sup>32</sup> 'Et propter hoc factum fuit instrumentum ad dirigendum planetas habentes latitudines et illud instrumentum vocatum fuit directorium'. BnF, lat. 7432, f. 198<sup>r</sup>.

<sup>33</sup> BnF, lat. 7295, ff. 78<sup>r</sup>–79<sup>v</sup>.

<sup>34</sup> See BnF, lat. 7432, f. 268<sup>r</sup>–268<sup>v</sup>. See Thorndike, *History of Magic*, vol. III, pp. 103–18 and 678–79; on the *De impressionibus aeris* see also Anne Lawrence-Mathers, *Medieval Meteorology: Forecasting the Weather from Aristotle to the Almanac* (Cambridge: Cambridge University Press, 2020), pp. 159–61. The identification was made on the basis of the text provided by Erfurt, Universitäts- und Forschungsbibliothek, Dep. Erf. CA 2<sup>o</sup> 395, ff. 104<sup>v</sup>–105<sup>r</sup>.

of general concerns about ensuring the coherence of astrological doctrine regarding the planetary conjunctions and their effects in the terrestrial realm. As John of Saxony described it in his commentary on the *Introductorius*, there was a difference between planetary aspects in longitude on the one hand, and planetary aspects in both longitude and latitude on the other.<sup>35</sup> If the vicissitudes of planetary rays were truly the cause of the various contingencies and changes on Earth, then planetary bodies surely had to be taken into account. These concerns about attending to the latitude of a planet became readily apparent to anyone who saw a planetary conjunction, for there were perceptible differences between a conjunction in longitude and a conjunction in longitude and latitude.

Finally, in his annotations on Pseudo-Ptolemy's *Centiloquium*, Heingarter duly noted the natural effects that a ruling planet could have on the bodily disposition of a native. In the 53<sup>rd</sup> aphorism, the text teaches the practitioner to calculate the ruling planet's latitude to determine the constitution of the individual for whom the birth chart had been drawn.<sup>36</sup> If the planet had no latitude, the native would be lean, and if the planet had a great latitude, the native would be large.

All of these careful notes that Heingarter arranged on the significance of latitudes were part of a much larger body of material that he collected on the importance of determining the velocity of the planets, identifying their stations, retrogradations, and directions, and finding the times when they were at apogee on the epicycles and eccentrics. The planetary latitudes seem to have taken pride of place in Heingarter's mind, and this may have been because ignoring them so starkly undermined any pretensions to a mathematically reliable medical astrology. Critics of the system were certainly aware of this. Deploying arguments that had been propounded earlier against practicing astrologers by such sceptics as Nicole Oresme and Henry of Langenstein, zealous opponents of medical and judicial astrology were quick to assail the insufficiencies of a practice that did not pay due attention to the latitudes of planets.<sup>37</sup> As Pico della Mirandola would so cuttingly observe in his posthumously published *Disputationes adversus astrologiam divinatricem*, even if most astrologers had mastered mathematical astronomy (a fact he was reluctant to accept), they had manifestly failed to apply it correctly. 'How great is their negligence', he wrote, that:

even among those who have an interest in calculating, which most of them lack, you will find few who do not resort to ephemerides to obtain the true position of the stars. [...] But those who do so necessarily make many false statements and omit many things, thereby invalidating the entire truthfulness of the predictions. For there is almost never a reference to the latitudes of the planets; but at what point will the astrologer not err, will he not lie, if he does not take this into account, if we suppose that the principles of this art are true?<sup>38</sup>

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<sup>35</sup> 'Coniunctio autem latitudinis est cum fuerint duo planete in uno signo coniuncti et fuerint equalis latitudinis ab ecliptica ...'. See *Alchabitius cum comento*, ff. g8<sup>v</sup>-h1<sup>r</sup>.

<sup>36</sup> BnF, lat. 7432, f. 140<sup>r</sup>.

<sup>37</sup> Stefano Rapisarda, 'Doubts and Criticism on Astrology in Western Traditions from Antique to Early Modern Literature', in *Prognostication in the Medieval World*, ed. by Matthias Heiduk, Klaus Herbers, and Hans-Christian Lehner (Berlin: De Gruyter, 2021), pp. 756-58; Michael Shank, 'Academic Consulting in Fifteenth-Century Vienna: The Case of Astrology', in *Texts and Contexts in Ancient and Medieval Science: Studies on the Occasion of John E. Murdoch's Seventieth Birthday*, ed. by Edith Sylla and Michael McVaugh (Leiden: Brill, 1997), p. 252; George W. Coopland, *Nicole Oresme and the Astrologers: A Study of His Livre de Divinacions* (Cambridge, Mass.: Harvard University Press, 1952).

<sup>38</sup> 'Iam vero indiligentia quanta paucos enim invenies etiam ex his qui supputandi habent rationem (qua tamen eorum maxima pars caret) qui ut veram positionem syderum assequantur ad ephemeridas non confugiant. [...] Hoc autem qui faciunt et perperam dicere et omittere multa est necessarium, unde omnis praedictionum veritas infirmetur, fere enim ibi nunquam de latitudine planetarum ulla significatio, qua ignorata ubi non errabit, ubi non mentietur astronomus, si vera istius artis decreta existimamus?' See Giovanni Pico della Mirandola, *Disputationes adversus astrologiam divinatricem*, in *Opera omnia Ioannis Pici Mirandulae Concordiaequae comitis* (Basel: Heinrich Petri, 1557), p. 445.

The treatise, which Heingarter finally prepared in order to establish the geometrical foundations of the latitude theory and the proper procedures for finding latitude values using the tables, appeared in the same manuscript where so many of these notes on the importance of planetary latitude for medical astrology can be found.

## 2. A Scrupulous Collector and Compiler

Given the content and form of the extant manuscript in which the text was preserved, it would appear that Heingarter's treatise on planetary latitude was also written to convey the erudition of an author worthy to serve under the auspices of a great lord. The treatise can be found as a single witness in the margins of BnF, lat. 7432, which is a codex consisting of 275 folios bearing dimensions of approximately 125 × 205 mm. The manuscript's rich array of marginal notes presented alongside a superbly decorated iconographic programme make it clear that it was meant to be a presentation copy for John II.<sup>39</sup> It exhibits a single neat hand and large margins to include commentaries throughout. Though there may have been several individuals collectively responsible for its creation, the production of the manuscript was carried out under Heingarter's supervision at the castle of Belleperche and is an expression of his public persona. The multi-faceted nature of the manuscript's production, moreover (the three dates of 1468, 1477, and 1485, which can be found in different notes and colophons throughout the manuscript, point to a processual and multi-year composition of the texts and annotations therein), also has the effect of creating conjunctures with other works, tables, stylistic habits, and annotations that are found elsewhere in Heingarter's corpus. What we shall see in this section is that the treatise and its accompanying canons and tables cannot be read independently of other codices contained in his library. The overall effect was that the reading and use of the latitude treatise was performed at the level of a unified library in which common topics of interest found in separate manuscripts emerged in conjunction with one another.

In addition, the types of texts that appear in these manuscripts were chosen strategically to showcase their compiler's status as a consummate humanist collector. The opening works of BnF, lat. 7432, a text on the life of Ptolemy (*De vita Ptholomei*) and another on the life of Hermes Trismegistus (*De Hermete*), were not original to Heingarter, but were rather excerpted from the thirteenth-century *Liber philosophorum moralium antiquorum* attributed to John of Procida (c. 1210–c. 1298).<sup>40</sup> Nevertheless, their presence at the beginning of the codex signal their compiler's interest in honouring these original adepts of his craft, and perhaps drawing

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<sup>39</sup> On this manuscript, see David Juste, *Les manuscrits astrologiques latins conservés à la Bibliothèque nationale de France* (Paris: CNRS, 2015), pp. 152–53; Matthieu Husson, 'Mathematical Astronomy and the Production of Multiple-Texts Manuscripts in Late Medieval Europe: A Comparison of BnF, lat. 7197 and BnF, lat. 7432', in *The Emergence of Multiple-Text Manuscripts*, ed. by Alessandro Bausi, Michael Friedrich, and Marilena Maniaci, (Berlin: De Gruyter, 2019), pp. 247–74.

<sup>40</sup> Lynn Thorndike, Colette Beaune, and Jean-Patrice Boudet have maintained Heingarter's authorship of these texts. Thorndike writes, 'These [texts] are evidently by Heingarter since they contain allusions to his favourite retreat, Belle-Perche, and to the "era of John, duke of Bourbon and Auvergne"'. See *A History of Magic*, IV, p. 362n31. See also, Colette Beaune, 'La notion d'Europe dans les livres d'astrologie du XV<sup>e</sup> siècle', in *La Conscience européenne au XV<sup>e</sup> et au XVI<sup>e</sup> siècle. Actes du Colloque international organisé à l'École Normale Supérieure de Jeunes Filles* (Paris: École normale supérieure de jeunes filles, 1982), p. 6n26; Boudet, *Le Recueil des plus célèbres astrologues*, vol. I, pp. 23n16 and 80–81n26. Relevant textual evidence can be found in John of Procida, *Liber philosophorum moralium antiquorum*, ed. Ezio Franceschini: 'Il *Liber philosophorum moralium antiquorum*', in *Atti del Reale Istituto Veneto di scienze, lettere ed arti* 91/2 (1932), 393–597 (pp. 402–03, 531–48). On the mistaken attribution of this work to John of Procida, see Sonia M. Medrano, 'Atribución y restitución: hermenéutica crítica de la autoría del *Liber philosophorum moralium antiquorum*', in *De Falsa et Vera Historia* 2, ed. by Mikel Labiano, (Madrid: Ediciones Clásicas, 2019), pp. 203–10.

affinities between them and himself. In this manner, he was also mirroring the posture of his own patron who styled himself a champion of the humanist movement and a great preserver of ancient knowledge. Indeed, Heingarter credited John II with a worldwide survey project on the knowledge of various peoples and praised him for having ordered the correction of some altered works of antiquity.<sup>41</sup> The duke, in Heingarter's estimation, had decided to build up a library after he saw how many volumes had been lost due to the fall of Constantinople in 1453. This led him to collect worthy books from all over the world, repairing and emending them as he deemed necessary.<sup>42</sup>

Insofar as Heingarter contributed to the library's expansion, he did so in ways that manifest conspicuous commonalities across the manuscripts he possessed. For example, Heingarter frequently adorned the manuscripts of his collection with a patina of the humanistic aesthetic in the form of Grecisms and transliterations of Latin text into Greek script. The last four folios of BnF, lat. 7432 contain Greek letters with their orthographic variants, a list of Greek diphthongs, and Christian prayers in Greek with an interlinear Latin translation (*Gloria patri* / Δόξα τῷ πατρὶ, *In nomine patris* / εἰς τὸ ὄνομα τοῦ Πατρὸς, *Ave gratia plena Maria* / Χαῖρε κεχαριτωμένη Μαρία, *Pater noster* / Πάτερ ἡ ὦν, etc.).<sup>43</sup>

His student Guillaume Cop characterized Heingarter as a voracious reader of Greek literature.<sup>44</sup> Witnesses to several works of mathematical astronomy that were Heingarter's bear the same features of transliterating or translating phrases into Greek. The final word of the fly leaf in BnF, lat. 7333 reads 'end', or τέλος,<sup>45</sup> to signal the termination of a contents list giving the title of the major works in the manuscript. And, again, the explicit to a treatise on arithmetic in BnF, lat. 7295A, concludes with a transliteration into Greek of the Latin phrase *Explicit seu finis per Konradum Heingarter*, thereby confirming that parts of this manuscript are indeed an autograph.<sup>46</sup>

These latter two sources are workaday codices, the second of which (BnF, lat. 7295A) has recently been aptly named a 'toolbox' manuscript due to the gradually accumulated sets of relevant computational techniques preserved within it.<sup>47</sup> The similarity between the contents of the works found in these two manuscripts, as well as others in Heingarter's library, and that of BnF, lat. 7432, however, go well beyond the presence of Greek text. They also contain facets of common astronomical problems taken from different perspectives or different genres that clearly relate to one another when read together. For instance, the treatise on planetary latitudes

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<sup>41</sup> 'Nam ipse est princeps qui, nostro tempore, fere solus in Europa scientias diligit, amat atque observat, et scientes honorat, qui, a finibus terre per mundi universa climata, omnium gentium et linguarum scientias perquirat, et libros de sapientum antiquorum sententiis perditos, inemendatos, restaurari emendarique iussit'. BnF, lat. 7432, f. 4<sup>r</sup>. See also Thorndike, *A History of Magic*, vol. IV, p. 363n32.

<sup>42</sup> '... ut enim Constantinopolitane cladi consideras qua nuper crudelis Turci sevitia tot optimarum litterarum volumina naufragio submersit, ex omnibus mundi partibus dignos quosque libros afferri iubes ut bene reparentur emendatioresque sint summopere curas'. BnF, lat. 7305, f. 4<sup>r</sup>. See also Thorndike, *A History of Magic*, vol. IV, p. 385.

<sup>43</sup> Heingarter also included, as part of the *Grammatica* by Hugh of Saint Victor, a full Hebrew and Greek alphabet in his student manuscript. See BnF, lat. 7197, f. 119<sup>r</sup>-119<sup>v</sup>.

<sup>44</sup> See Fortuna, 'Wilhelm Kopp Possessore', 48. 'Quantam autem in poetica, oratoria, grecaque litteratura operam consumpseris: si enarrare conabor, *ante diem clauso componet vesper olympo*'. Vatican, BAV, Reg. lat. 1241, f. 3<sup>r</sup>. The passage in italics is a quotation from Virgil's *Aeneid*, book I, v. 374; see Publius Vergilius Maro, *Aeneis*, rev. ed., trans. by Henry Rushton Fairclough and George P. Goold (Cambridge, Mass.: Harvard University Press, 1999), p. 288.

<sup>45</sup> BnF, lat. 7333, f. II. In reality, the word written at the end of the table seems to be γέλως (i.e. laughter) rather than τέλος. However, the cursive tau may resemble a gamma, and the confusion between omicron and omega could be rather frequent even among the most skilled Greek scribes.

<sup>46</sup> For more on this explicit included in BnF, lat. 7295A, see Eleonora Andriani, Samuel Gessner, and Nicholas Jacobson, 'A Note on the *Arabes maxime*: A testimony of Alfonsine astronomers' interest in the Toledan Tables', in this volume. See also BnF, lat. 7295A, f. 45<sup>r</sup>.

<sup>47</sup> See Husson, 'The Art of Astrological Computations' in *Exploring Written Artefacts*, pp. 513-16.

appears as a marginal commentary on folios 219<sup>r</sup>–222<sup>v</sup> of BnF, lat. 7432, mostly framing the last two chapters of the *Theorica planetarum communis*, which are entitled ‘On the Latitudes of the Six Planets and the Declination of the Sun’, and ‘On Finding the Aspects of the Planets’.<sup>48</sup> In like manner, we find two annotated texts in earlier manuscripts that were in Heingarter’s possession. In BnF, lat. 7333, Heingarter composed a complete marginal commentary of the *Theorica* (ff. 54<sup>v</sup>–63<sup>r</sup>). Earlier than this, likely during his days as a student at Paris, Heingarter had also extensively annotated another witness to the *Theorica*, which is preserved in BnF, lat. 7197 (ff. 51<sup>r</sup>–57<sup>v</sup>).

In his glosses and commentaries, we can see Heingarter’s interest in certain topics taking root, expanding, and developing over time. In the case of the latitudes, Heingarter’s first treatment, found in BnF, lat. 7197 (ff. 56<sup>r</sup>–57<sup>v</sup>), is rather sparse, containing three *nota* in Heingarter’s hand. In BnF, lat. 7333 (ff. 61<sup>v</sup>–63<sup>r</sup>), however, folios 62<sup>r</sup>–63<sup>r</sup> are filled with definitions and clarifications of the original text treating the latitudes. Furthermore, the introduction to this commentary, found on folio 54<sup>v</sup>, is reminiscent in many important ways of the more specialized marginal commentary found in BnF, lat. 7432. They both divide their subject matter neatly into a *theorica*, treating attributes of astronomy defined as theoretical, followed by a *practica*, treating those attributes of astronomy defined as practical.

Furthermore, the introduction to the BnF, lat. 7333 commentary already betrays Heingarter’s concerns to refine planetary calculations in order to identify the precise locations of planetary positions. He emphasizes the importance of understanding all the components of a planet’s position that together constitute its true motion. This includes identifying its position in both the eighth and ninth spheres, but also in attending to all of its accidental qualities or the planetary passions. And finally, Heingarter explains that calculating the planetary latitude in addition to the planetary longitude is necessary to find this true motion.<sup>49</sup>

In the same way, the accompanying canons, tables, and instrument texts relating to planetary latitudes that appear in BnF, lat. 7432 recur again in multiple volumes of Heingarter’s library. In BnF, lat. 7333 a table of contents in the hand of Heingarter points out the treatment of the stations and retrogradations of the planets together with their latitude, as part of the *Liber super totam astrologiam* by the late-thirteenth-century Franciscan Bernard of Verdun. As Claudia Kren has noted in her seminal article on the development of planetary latitude theory and practice in the late-medieval West, Bernard of Verdun’s was one of the very few pre-Alfonsine works that attempted to grapple with the confusions of latitude theory as it was inherited from the *Theorica planetarum communis* and the Toledan tradition.<sup>50</sup> On folio 43<sup>r</sup>, where the chapter *De stationibus et retrogradationibus atque planetarum latitudinibus* begins, a marginal note in Heingarter’s hand is provided, which reads *hic incipit tractatus nonus et habet distinctiones duas, quarum prima est de planetarum retrogradationibus et continet capitula tria (et distinctio secunda est de latitudinibus et earum annexis et continet capitula novem)*. Throughout the entire *Liber super totam astrologiam*, this note in the hand of Heingarter is by far the lengthiest among a set of marginal annotations that are otherwise rather short and sporadic.

In addition to the *Liber super totam astrologiam*, in BnF, lat. 7333 Heingarter also preserved a work by Bernard of Verdun dealing with an instrument called the *torquetum* (*truquetum* in the manuscript). This is followed by another text concerning the same instrument by Franco de Polonia (ff. 49<sup>r</sup>–52<sup>v</sup>), which Heingarter had earlier included in BnF, lat. 7197 (ff. 15<sup>r</sup>–16<sup>r</sup>). The *torquetum* may have been of some interest to Heingarter due to his personal proclivities for latitude theory, as the instrument can be used for coordinate measurement and

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<sup>48</sup> ‘Capitulum VII. De latitudinibus sex planetarum et declinatione solis’ (BnF, lat. 7432, ff. 219<sup>r</sup>–221<sup>v</sup>); ‘Capitulum VIII. De planetarum aspectibus inventionem’ (BnF, lat. 7432, ff. 221<sup>v</sup>–222<sup>r</sup>).

<sup>49</sup> BnF, lat. 7333, f. 54<sup>v</sup>.

<sup>50</sup> Claudia Kren, ‘Planetary Latitudes, the *Theorica Gerardi*, and Regiomontanus’, 194–205 (pp. 198–99).

conversion, and the determination of a heavenly body's position using either ecliptic or equatorial coordinates.<sup>51</sup>

The commonalities of texts and topics across manuscripts sometimes are also indicated by the scribal marks of Heingarter's editing, which may be evidence of the direct transfer of certain works from one manuscript to another. On folio 176<sup>r</sup>–176<sup>v</sup> of BnF, lat. 7295A, for instance, we find the chapters of the *Priores astrologi* treating planetary latitude.<sup>52</sup> It is possible here to detect traces of Heingarter's careful reading of the latitude canons as he applied a scribal technique of adding red slashes to the chapters. On the same folio there are also marginal notes written in his hand, corresponding to these same chapters.

These notes and scribal marks were either added to aid Heingarter in his reading of the chapters, or, more likely, to edit parts that would be used in his final treatise. For these same chapters on planetary latitude would be paraphrased in the *practica* of his treatise in BnF, lat. 7432, as well as being appended to his version of John of Saxony's canon set (incipit: *Tempus est mensura motus*) in the same presentation manuscript. Indeed, from folios 224<sup>r</sup>–236<sup>v</sup> in BnF, lat. 7432, Heingarter decided to add supplemental canons to his set of the *Tempus est mensura motus* canons. To this end, we find three canons from the set of John of Lignères (incipit: *Priores astrologi*) following John of Saxony's canons, together with four canons excerpted from the Cb canons of the Toledan Tables, and a canon for equating the houses of unknown provenance. The canons excerpted from the Toledan canons had already been preserved by Heingarter in a comparative gloss of Alfonsine and Toledan astronomy found in BnF, lat. 7295A bearing the incipit *Arabes maxime*, and those annotated canons of the *Priores astrologi* found in BnF, lat. 7295A may similarly be the source of their equivalent texts accompanying *Tempus est mensura motus* in BnF, lat. 7432.<sup>53</sup> Thus, earlier texts studied and annotated in his toolbox manuscripts were apparently repurposed and rewritten in his presentation copy to the duke.

That the notes contained in BnF, lat. 7295A would serve as the groundwork of significant parts of Heingarter's later *practica* is also corroborated by clear connections that

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<sup>51</sup> On this instrument, see Emmanuel Poulle, 'Bernard de Verdun et le turquet', *Isis*, 55 (1964), 200–08, and Richard Kremer, 'How Did the *Turketum* (or *Torquetum*) Get its Name?', in *Scientific Instruments between East and West*, ed. by Neil Brown, Silke Ackermann, and Feza Günergün (Leiden: Brill, 2019), pp. 80–107.

<sup>52</sup> These are part of a nearly complete set of the *Priores astrologi* found from ff. 174<sup>r</sup>–180<sup>v</sup>. The set lacks five canons, which Heingarter does not fail to notice, writing in the lower margin of f. 180<sup>v</sup>: 'Hic deficient canones quinque scilicet 41us, 42us, 43us, 44us et quadragesimus quintus'. See BnF, lat. 7295A, f. 180<sup>v</sup>.

<sup>53</sup> The first text on f. 237<sup>r</sup> (heading: *De stacione planetarum et retrogradatione*) corresponds to Cb 152–59; see Fritz S. Pedersen, *The Toledan Tables: A Review of the Manuscripts and the Textual Versions with an Edition* (Copenhagen: C.A. Reitzels Forlag, 2002), p. 442. The second text on f. 237<sup>r</sup> (heading: *De motu arumentii*) corresponds to Cb 160; see Pedersen, *The Toledan Tables*, pp. 442 and 444. The third text on f. 237<sup>r</sup> (heading: *De declinatione solis*) corresponds to Cb 161–62; see *The Toledan Tables*, p. 444. The fourth text (heading: *De latitudine lune*) on f. 237<sup>r</sup> corresponds to Cb pp. 163–64; see Pedersen, *The Toledan Tables*, p. 444. The fifth text covering f. 237<sup>r</sup>–237<sup>v</sup> (heading: *De latitudine trium superiorum*) corresponds to Cb 165; see Pedersen, *The Toledan Tables*, pp. 444 and 446. On f. 237<sup>v</sup> there is also a text (heading: *De latitudine Veneris et Mercurii*) corresponding to Cb 166; see Pedersen, *The Toledan Tables*, p. 446. The following text on f. 237<sup>v</sup> (heading: *Alius modus ad sciendum latitudines quinque planetarum secundum tabulas de Ligneris*) corresponds to Canon 21 of John of Lignères' *Priores astrologi*; see Marie-Madeleine Saby, *Les Canons de Jean de Lignères sur les tables astronomiques de 1321: Édition critique, traduction et étude*, 3 vols (unpublished thesis: École nationale des Chartes, 1987), I, pp. 206–07. The following text on ff. 237<sup>v</sup>–238<sup>r</sup> (heading: *De latitudine Veneris*) corresponds to *Priores astrologi*, Canon 22; see Saby, *Les canons de Jean de Lignères*, I, pp. 207–09. The following text on f. 238<sup>r</sup> (heading: *De latitudine Mercurii*) corresponds to Canon 23; see Saby, *Les canons de Jean de Lignères*, I, pp. 210–11. We could not identify the last text on f. 238<sup>r</sup> (heading: *De equatione duodecim domorum*; starting with 'Quere ascensiones tuas habitas ex parte gradus solis ex parte horarum simul iunctarum inter ascensiones circuli recti'). Interestingly, John of Lignères' *Cuiuslibet arcus* includes a canon about the equation of the houses (i.e. Canon 37: *Duodecim domos adequare*), but it does not correspond to this text on f. 238<sup>r</sup>. See Saby, *Les canons de Jean de Lignères*, I, pp. 153–55.

one can find between his descriptions of the latitude tables associated with the treatise in BnF, lat. 7432 and the presence of these same tables and their descriptions in BnF, lat. 7295A. In BnF, lat. 7295A, f. 127<sup>v</sup> and f. 164<sup>v</sup>, one finds latitude tables, one of which appears to have been directly incorporated into BnF, lat. 7432. These two tables in BnF, lat. 7295A, which we shall label A and B, contain numerical values deriving from the Ptolemaic tradition, which had been adapted by John of Lignères from the Toledan Tables and the *zīj* of al-Battānī.

Despite many similarities between the two tables contained in BnF, lat. 7295A, it seems that Heingarter privileged Table A. Copied in his own hand, it was added to the eleventh quire of the manuscript alongside the equation tables of the Parisian Alfonsine Tables, and a close reading of its title and column headings show that it was adapted and integrated into BnF, lat. 7432 to be used in conjunction with the *practica* of his treatise. Table A is found on folio 255<sup>v</sup> of BnF, lat. 7432 bearing the title *Tabula latitudinum quinque planetarum que est distancia eorum a via solis*, which differs from the title of Table B.<sup>54</sup> Furthermore, there are subtle alterations to the vocabulary of the columns containing latitude values for the inferior planets. For instance, instead of using the more common term *reflexio* for the second angle of inclination on the epicycle, which is referred to as ‘slant’ in modern commentaries, Heingarter opted for the slightly modified term *reflexus*. This word is repeated in the table contained on folio 255<sup>v</sup> of BnF, lat. 7432.

Table A also corrects for what is most probably a copying error found in the upper part of the column for the northern latitude of Saturn in table B. Indeed, in the 24° entry, the corresponding value in table B is 2;8 instead of 2;7. 2;8 normally corresponds to the value for the next entry 30°. From 24° to 84°, the values are therefore shifted by one line. To fill the gap created by a misalignment of the values, Heingarter repeats the value of 2;30 at 84° and 90°. One final distinguishing feature of Table A is the presence of a third column for the proportional minutes (*minuta proportionalia*), which is not found in Table B, and was not common to this kind of latitude table.<sup>55</sup>

These differences between Tables A and B amount to only very slight alterations on the part of Heingarter. Nevertheless, he deemed them significant enough to make note of them in his treatise. In the *practica*, he associated the third method for finding latitudes discussed therein with a latitude table he claimed to have altered from the original set of John of Lignères, writing:

And there is another, a third, way in which you will truly find the latitude of the five planets according to the following method using a table composed by John de Lignères, which we have made easier and clearer.<sup>56</sup>

He then goes on to paraphrase the latitude canons from the *Priores astrologi* to be used with his table in BnF, lat. 7432 adapted for this purpose. Whatever reasons inspired Heingarter to copy out his own latitude table — whether it was to correct the copyist’s errors in Table B or whether it was to add his own values of proportional minutes — the links between Table A in BnF, lat. 7295A and the canons of BnF, lat. 7432 are drawn fairly explicitly in Heingarter’s treatise.

In addition to these tables taken from the *zīj* of al-Battānī, Heingarter would later include the tables from the *zīj* of al-Khwārizmī in his presentation copy to the duke as well.

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<sup>54</sup> Table B is called the *Tabula latitudinis 5 planetarum quae est longitudo a via solis in circulo signorum* and is a part of the set of tables of John of Lignères. See José Chabás and Marie-Madeleine Saby, *The Tables of 1322 by John of Lignères, an Edition with Commentary*, (Turnhout: Brepols, 2022) 76–9.

<sup>55</sup> Also referred to as the *partes latitudinis planetarum*. These numbers do not provide a higher level of precision to the original value of the proportional minutes, as it does not fit any re-computation scenario for this particular case. One may wonder if it is an independent table or an auxiliary table that could help in performing interpolations.

<sup>56</sup> BnF, lat. 7432, f. 222<sup>v</sup>. See Appendix, 53–54.

They appear in the manuscript following the treatise in BnF, lat. 7432 on f. 222<sup>r</sup> and 255<sup>v</sup>–258<sup>r</sup>. His inclusion of these tables similarly reveals connections between BnF, lat. 7295A and BnF, lat. 7432. Following Heingarter’s treatise in the latter manuscript are found the two tables of the Indian tradition. The first of these tables, the *Tabula quadripartialis ad sciendum latitudines quinque planetarum*, starts at folio 256<sup>v</sup> and ends with folio 257<sup>r</sup>.<sup>57</sup> These are followed by the *Tabula bipartialis* from folios 257<sup>v</sup>–258<sup>r</sup>.<sup>58</sup> Much of the *practica* is devoted to the explication of these tables, and the methods of calculation that one applies to use them.

Manuscript 7295A, though it does not contain the tables themselves, ends with the *Arabes maxime* (already mentioned above), which is a comparative exposition of canons to the Alfonsine Tables and the Cb canons of the Toledan Tables. This work includes five chapters on planetary latitude from folios 189<sup>rb</sup>–190<sup>rb</sup> drawn from the Toledan canons.<sup>59</sup> The instructions found in the *Arabes maxime* explain how to calculate a latitude using the *bipartialis* and *quadripartialis* tables. Furthermore, as we discuss more fully in the next section, just as Heingarter relied upon the *De scientia astrorum* by Alfraganus (al-Farghānī) to explicate the canons and tables in his treatise, so too does the *Arabes maxime* invoke this text frequently in order to gloss the Toledan canons. Heingarter’s decision to make use of an unusual vocabulary found in Alfraganus to describe different aspects of the planetary latitude model, which we will discuss below, becomes less surprising if one has already read the chapters on latitude in the *Arabes maxime* that developed the same terminology. Thus, even though the *bipartialis* and *quadripartialis* tables are not found in BnF, lat. 7295A, the *practica* and tables of BnF, lat. 7432 can still be considered a continuation of the same project as that one being developed by the *Arabes maxime*.

One final set of latitude tables described in the treatise, the so-called Oxford Tables, which had been computed by Englishman William Batecombe in 1348, offers the starkest example of the manner in which BnF, lat. 7432 relies upon BnF, lat. 7295A for coherency.<sup>60</sup> In the *practica* of his treatise, Heingarter described their format and how to use them, writing:

The first [kind of latitude table] is that in which [the table] is entered with the mean centre in the descending line, and with the mean argument in the transversal line; and what is taken is that which is in the convergence of the [two] lines; and that will be the latitude of the planet; and this method is easy.<sup>61</sup>

No such tables exist in BnF, lat. 7432, however, and Heingarter’s only copy of them appears in the thirteenth quire of BnF, lat. 7295A.<sup>62</sup>

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<sup>57</sup> This table is called *quadripartialis* because the argument folds into four columns (from 1° to 90°, 179° to 90°, 181° to 270°, and 359° to 270°). For details on the origins of this table format and those of the *bipartialis* (see note below), see Kren, ‘Planetary Latitudes, the *Theorica Gerardi*, and Regiomontanus’, 194–205 (pp. 195–96n8).

<sup>58</sup> The argument for this table is folded in two, hence the name *bipartialis*. Another table dealing with retrogradations and stations, the *Tabula retrogradationum and stationum planetarum* was placed between these two parts of the latitude tables in the manuscript. After these tables, one can find the *Tabula de exitu planetarum* (See Chabás and Saby, *The tables of 1322*, 92).

<sup>59</sup> On this work starting with the *Arabes maxime*, see Andriani, Gessner, and Jacobson, ‘A Note on the *Arabes maxime*’, in this volume.

<sup>60</sup> This third set of tables Heingarter acquired had proven successful during the century since they had been composed, as they had enjoyed wide circulation throughout the major centres of learning in Europe. See John D. North, ‘The Alfonsine Tables in England’, in *Prismata, Naturwissenschaftsgeschichtliche Studien*, ed. by Yasukatsu Maeyama and Walter G. Saltzer, (Wiesbaden: Steiner, 1977), pp. 269–301 (Reprinted in J. D. North, *The Universal Frame: Historical Essays in Astronomy, Natural Philosophy, and Scientific Method* [London: The Hambledon Press, 1989], 327–59).

<sup>61</sup> BnF, lat. 7432, f. 222<sup>r</sup>. See Appendix, 51–52.

<sup>62</sup> This copy of the Oxford Tables is partial, and only includes the part on latitudes. Heingarter’s interest in this part of Batecombe’s set is likely due to their novel composition, which applied a double argument format and was relatively straightforward, thereby allowing for latitudes to be obtained with a minimal amount of calculation.



These connections between BnF, lat. 7432, BnF, lat. 7295A, and BnF, lat. 7333 reveal a fascinating practice on the part of Heingarter to not only order related works within a single manuscript, but also to arrange them across multiple manuscripts within a single library.<sup>63</sup> Some of the texts in question may have been composed when Heingarter was still a student; others were written at a time when Heingarter had begun his career as a medical professional following his licentiate. However, the mutually interrelated topics found across all of these texts suggest a tendency to cross-reference, augment, and edit topics of interest in such a way that no single codex was self-sufficient. The coherent application of computational techniques found in 7432, then, could only be achieved with recourse to multiple volumes of the library.

### 3. The Planetary Latitude Treatise and the Arts Curriculum at Paris

The latitude treatise, together with the compiled texts, tables, and annotations stored in the volumes detailed above, might rightly be understood as a research agenda, and the questions they raised probably animated Heingarter's mind over many years of his life. They also suggest that Heingarter's interest in these topics belonged to a more communal practice in which multiple actors were involved. In this way, the content and concern of the treatise was of more than just a personal nature. The treatise was likely intended to serve as a touchstone for the study of latitude theory and calculation.

The general pitch of the dedicatory introduction would suggest this, as it is presented in the form of a letter to Michael Roscher, Master of Arts at the University of Paris. Roscher was procurator of the nations of England and Germany when Heingarter was still at the university, and the two seem to have developed a rapport. In 1466, Roscher had worked together with Heingarter, who, on behalf of Jean Rosée, dean of the medical faculty, had petitioned to secure funding for students pursuing the doctoral degree in medicine.<sup>64</sup> The opening lines of the letter reproduce, almost verbatim, the beginning of the prologue to Boethius' *De institutione arithmetica*, a reference that would hardly escape the attention of a university master. Indeed, the division of the mathematical sciences into arithmetic, music, geometry, and astronomy displayed in *De institutione arithmetica* was widely assumed to be the basis of the medieval curriculum. Equally worthy of note is the fact that the parallel construction of Boethius and Heingarter's introductions are mirrored by the circumstances under which they both appear to have been composed. For Boethius also intended his scholarly

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They start at folio 145<sup>r</sup> and finish at folio 152<sup>r</sup>. A full latitude table for each planet takes three pages (i.e. 1 ½ folios each).

<sup>63</sup> A final manuscript worthy of comment is BnF, lat. 7314, which bears many affinities with 7432 in terms of its astrological point of view. For instance, it includes the *Introductorius maius* by Albumasar (Abū Ma'shar). In this work, Albumasar is concerned to take into account planetary latitudes when discussing 'the planets' occultation of one another and the eclipse of the two luminaries' (*Great Introduction*, I.2.3b). He also defines the 'application of the planets to each other in latitude by conjunction' to be a circumstance when 'two planets [are] conjoining', and 'their latitude is the same <and> in the same direction'. When this is the case, 'one of them eclipses the other' (*Great Introduction*, VII.5.8a). We are very grateful to Charles Burnett for pointing out these accounts. See Albumasar (Abū Ma'shar), *Liber introductorius*, in *The Great Introduction to Astrology by Abū Ma'shar*, ed. by Yamamoto Keiji, Charles Burnett, and David Pingree, (Leiden: Brill, 2019), pp. 53 and 769.

<sup>64</sup> '[...] supplicavit magister Conradus Heingarter, in medicina licenciatus, quod natio fide iuberet decano facultatis medicine pro summa triginta quatuor scutorum pro bursis ad doctoratum'. As quoted in *Liber procuratorum nationis anglicanae (alemanniae)*, ed. by Charles Samaran, Émile van Moé, and Susanna Vitte, 3 vols (Paris: Didier, 1935), III, p. 5.

efforts to serve the purpose of a gift to a patron and friend. In his case, the treatise was addressed to the Roman senator, Symmachus, who was also his father-in-law.<sup>65</sup>

The relevant connection between the arts faculty and Heingarter's production of the treatise is further confirmed by his explicit statement that students were the intended recipients of the work. He explained:

I have brought to you (Michael Roscher, Master of Arts) the not so lazy load of works, for which nothing is more ready for action than when <a thirst> for acquisition has been kindled; but I have sent these, which, taken from the wealth of the wise, we have gathered for the utility of students. And because in the previous books we have thoroughly gone through the motion of the stars and planets according to longitude with however much of theory and practice as suffices, I set out to compose this treatise on the motion of the planets according to latitude, which I shall divide into two chapters: the first of these explains the theory; the second explains the practice and the method of finding [the planets'] latitude with their *genzahar*<sup>66</sup> for the era of the Illustrious John, duke of Bourbon and Auvergne.<sup>67</sup>

The dedication of the text, not only to Roscher, but also to students of astronomy, reveals a third dimension to Heingarter's interest in latitude, quite different from the defence of his profession and the contributions to a humanistic library at Belleperche. He was also offering an authoritative text to be used in the context of formal instruction.<sup>68</sup>

Heingarter continued to foster a relationship with the university even after he had departed for Belleperche. In 1471, there was something of a power struggle between the king of France and duke of Bourbon on the one hand and the corporate authorities of the University of Paris on the other. The university had appointed a certain Anthony de Busco as acting scribe of the conservator (*scriba conservationis*), who, for reasons that remain unclear, was deemed unacceptable by the king. In response to the king's displeasure, the duke sent letters to the faculty requesting that Anthony de Busco be removed from office. In his place, John II suggested Heingarter should fill the post for the rest of the former scribe's tenure.<sup>69</sup>

Heingarter ultimately did not replace Anthony de Busco as *scriba conservationis*, but the fact that his name was raised as a possible replacement shows that both he and his patron continued to take a great interest in the affairs of the university.<sup>70</sup> This included not only a desire to guide the school's administrative affairs, but also an apparent interest in determining the curriculum for lectures in astronomy. Heingarter's curriculum was memorialized in the words of Guillaume Cop, who, in his above-mentioned 1493 letter, states that it is hard to tell whether it is Heingarter who is indebted to the quadrivial curriculum, or if it is not rather the contrary that is the case. Moreover, in Cop's words, Heingarter is the one who restored these

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<sup>65</sup> See Boethius, *De arithmetica*, in *Corpus Christianorum, Series Latina 94a*, ed. by H. Oosthout and J. Schilling, (Turnhout: Brepols, 1999), pp. 3–5; for an English translation, see *Boethian Number Theory: A Translation of the 'De institutione arithmetica'*, trans. with introduction and notes by Michael Masi (Amsterdam: Rodopi, 1983), pp. 66–68.

<sup>66</sup> That is, the planetary nodes.

<sup>67</sup> BnF, lat. 7432, f. 219<sup>r</sup>. See Appendix, 42.

<sup>68</sup> Given that he intended to adjust the planetary nodes to the date of Duke John's birth, he must have dedicated his efforts to the university at a time after he had accepted patronage at Belleperche.

<sup>69</sup> 'Anno quo supra, die decima Marcii, congregata fuit alma Parisiensis Universitas apud Sanctum Maturinum super duobus articulis. Primus fuit ad audiendum lecturam quarundam licentiarum supremi domini nostri domini regis et domini ducis Borbonie, in quibus continebatur quod non placebat supremo domino nostro regi quod magister Anthonius de Busco amplius officium scribe conservacionis exerceret'. See *Liber procuratorum nationis anglicanae (alemanniae)*, ed. by Samaran, van Moé, Susanna Vitte, III, p. 171.

<sup>70</sup> 'Totum negotium erat de remotione personae non gratae magistri Anthonii de Busco. Dux Borbonii commendaverat Universitati 'suum medicum, licet astrologum, videlicet magister Corardum'. Illi tamen non annuit Universitas et cum consensu domini conservatoris, scilicet episcopi Meldensis, magister Robertum Mazengarbe, iam scribam conservationis, designavit ad exercendum simul duos scribatus'. See *Liber procuratorum nationis anglicanae (alemanniae)*, Samaran, van Moé, Susanna Vitte, III, pp. 171–72n1.

mathematical sciences to light — particularly astronomy — to which Heingarter contributed greatly with the works he wrote.<sup>71</sup>

Cop would go on in the letter to lay out the curriculum of astronomical texts, tables, and instruments that Heingarter introduced to him for mastery of the discipline.<sup>72</sup> Cop presents the *Theorica planetarum communis* as the introductory work of Heingarter’s teaching regimen.<sup>73</sup> Neither as thorough nor as coherent as its earlier chapters treating planetary longitudes, the quality of the seventh chapter on latitude had already been challenged by Henry of Langenstein, whose *De reprobatione ecentricorum et epiciclorum* (1364) would gain currency at the University of Vienna after he moved there in the late fourteenth century.<sup>74</sup> By the time of Heingarter’s writing, the *Theorica planetarum* was generally agreed to be inadequate. A still more devastating attack than Langenstein’s would be published at about the same time as Heingarter’s latitude treatise when Johannes Regiomontanus held it up to bitter scrutiny in the *Disputationes contra deliramenta cremonensia* (1475).<sup>75</sup> Because the *Theorica planetarum communis* continued to play such an integral role in university instruction of astronomy even after such broadsides had been levelled, it makes sense that masters of arts at Paris would call upon someone to clarify the text and correct it where necessary.

In Heingarter’s efforts to do so, we see that he offered two rather different strategies in his *theorica* and his *practica*, respectively. In the *theorica*, he sought to establish what one might call an authoritative and univocal account of planetary motion in latitude. He does not present two models, one to be associated with the *zīj* of al-Khwārizmī and the other with the *zīj* of al-Battānī. Instead, the planetary motions described in Heingarter’s *theorica* are unambiguously associated with the models established by Ptolemy in the thirteenth book of the *Almagest* and transmitted by the *zīj* of al-Battānī.<sup>76</sup>

In the *theorica* of the treatise, Heingarter differentiates, just as Ptolemy had done, between two categories of latitudinal motion, one that pertains to the superior planets and the other to the inferior. In the case of the superior planets, both the deferent and the epicycle of the simple longitudinal model are brought out of the plane of the ecliptic to account for the planet’s latitude. He explains that in the case of the inclination of the planet’s deferent, the angle is fixed. The circles of the deferent and the ecliptic intersect at two points called nodes or *genzahar*, and a straight line between these two points forms the nodal line, dividing the circle of the deferent into two unequal parts, where the larger part is the north and the smaller

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<sup>71</sup> ‘In mathematicis autem disciplinis ita profecisti, ut an tu musis ipsis quadrivialibus, an ipse tibi plus debeant: haud facile conicere possim. Cum enim iam quasi perditae extinctaeque essent, tu ipsas in lucem reducis. Praecipue astronomiam in cuius emulos tam graviter tamque eleganter scripsisti...’. BAV, Reg. lat. 1241, f. 2<sup>r</sup>. The arts of the quadrivium are here embodied by the muses, which is consistent with the humanistic and erudite tone of the letter.

<sup>72</sup> BAV, Reg. lat. 1241, ff. 3<sup>v</sup>–4<sup>v</sup>. The question of Heingarter’s preparatory curriculum in mathematical astronomy will be treated more fully by Eleonora Andriani and Nicholas Jacobson in a future article. See note 22.

<sup>73</sup> It should not be forgotten that the latitude treatise is, in fact, a commentary on the seventh chapter of the same work. See BAV, Reg. lat. 1241, f. 4<sup>r</sup>.

<sup>74</sup> BnF, Lat. 16401, f. 62<sup>r</sup>. See Kren, ‘A Medieval Objection to “Ptolemy”’, 378–93; Michael Shank, ‘Regiomontanus and Astronomical Controversy in the Background of Copernicus’, in *Before Copernicus: The Cultures and Contexts of Scientific Learning in the Fifteenth Century*, ed. by Rivka Feldhay and F. Jamil Ragep (Montreal: McGill-Queen’s University Press, 2017), p. 84.

<sup>75</sup> The seventh chapter of the *Theorica planetarum communis* has been edited by Francis Carmody. See *Theorica planetarum Gerardi*, ed. by Carmody (Berkeley: 1942), pp. 41–43. For an in-depth discussion of Johannes Regiomontanus’ 1475 *Disputationes contra deliramenta cremonensia*, see Kren, ‘Planetary Latitudes, the *Theorica Gerardi*, and Regiomontanus’, 194–205.

<sup>76</sup> Although Ptolemy revised what he had done in his later works through the *Handy Tables* and the *Planetary Hypotheses*, it was the more complex version of the *Almagest* that was to be found in the Toledan Tables. See Noel Swerdlow, ‘Ptolemy’s Theories of the Latitude of the Planets in the *Almagest*, *Handy Tables*, and *Planetary Hypotheses*’, in *Wrong for the Right Reasons*, ed. by Jed Z. Buchwald and Allan Franklin (Dordrecht: Springer, 2005), pp. 41–71.

south.<sup>77</sup> The second inclination is that between the epicycle and the deferent. As opposed to the inclination of the deferent, the epicycle's inclination varies over time with its axis of rotation always parallel to the nodal line.<sup>78</sup> When the epicycle is at the nodes, it is in the plane of the ecliptic, but the inclination reaches its maximum when the epicycle centre reaches its highest point on the deferent.<sup>79</sup>

As for the inferior planets, Heingarter explains that their motion in latitude has three components. Like the superior planets, their deferents incline from the ecliptic plane, but this time the angle of the tilt varies over time. When the centre of the epicycle is at the nodes, the deferent is in the ecliptic plane, but when it is at the top of the deferent, the inclination reaches its maximum.<sup>80</sup> Heingarter goes on to say that, like the superior planets, the inferior planets also have an inclination of the epicycle rotating about the diameter of the epicycle that runs parallel to the nodal line, except that, in the case of the inferior planets, this inclination varies such that the epicycle is in plane when the epicycle centre is at the top of the deferent and the inclination is maximum when the epicycle centre is at the nodes.<sup>81</sup> In addition to this, a third inclination must be added, with an axis of rotation about the diameter of the epicycle that is perpendicular to that of the first epicyclic inclination. This inclination varies such that the epicycle is in plane when the epicycle centre is at the nodes.<sup>82</sup> It is at its maximum when the epicycle centre is the top of the deferent.<sup>83</sup>

Despite Heingarter's self-described attempt to thoroughly treat planetary latitude theory just as previous authors had done for planetary longitudes, his efforts to offer this unequivocal exposition were hindered by a general lack of standardization in the terminology, procedural methodology, and mathematical models he inherited from previous source material. The heterogeneity of latitude terminology stands in stark contrast with the terminology developed for planetary longitudes. As Olaf Pedersen observed in his seminal article, 'The Origins of the *Theorica planetarum*', the *Theorica planetarum communis* had effectively championed the models of Ptolemaic astronomy against other alternatives by consistently establishing a vocabulary that could be applied to the canonical procedures and the numerical values of the tables available to the practitioner. Pedersen wrote that the author of the *Theorica planetarum communis*

successfully trie[d] to overcome the terminological ambiguity in Ptolemy by introducing separate Latin terms for separate concepts, for instance by creating a variety of terms for all the variables that are called 'anomaly' in the *Almagest*. This is not to say that he knew Greek, or even a Latin translation of the *Almagest*, but only that he was aware of the need for a consistent and unequivocal vocabulary in planetary theory. [...] Historically speaking there is no doubt that these five chapters were instrumental in acquainting students with the principal features of the various kinematical models of the *Almagest*, and thus in strengthening the position of Ptolemaic astronomy against attacks from teachers who, following al-Bitruji, tried to introduce other models.<sup>84</sup>

Heingarter did not enjoy the benefit of having inherited a similarly unified vocabulary for his *theorica* on latitudes. As if to confirm the dearth of contemporary fifteenth-century texts

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<sup>77</sup> BnF, lat. 7432, f. 219<sup>v</sup>.

<sup>78</sup> BnF, lat. 7432, f. 220<sup>r</sup>.

<sup>79</sup> BnF, lat. 7432, f. 220<sup>r</sup>.

<sup>80</sup> See Glen Van Brummelen, *Mathematical Tables in Ptolemy's Almagest*, PhD Thesis (Simon Fraser University, 1993), p. 358.

<sup>81</sup> BnF, lat. 7432, f. 221<sup>r</sup>.

<sup>82</sup> Again, the top of the deferent is always southerly for Mercury and always northerly for Venus. See Van Brummelen, *Mathematical Tables in Ptolemy's Almagest*, p. 358.

<sup>83</sup> BnF, lat. 7432, f. 221<sup>r</sup>.

<sup>84</sup> Olaf Pedersen, 'The Origins of the "Theorica Planetarum"', *Journal for the History of Astronomy*, 12 (1981), 113–23 (p. 116).

containing a consistent and conventional idiom, in the first chapter of the treatise Heingarter leans heavily upon the older (and largely outmoded) terminology found in the eighteenth chapter of John of Seville's translation of Alfraganus' *Science of the Stars*.<sup>85</sup> Written in the twelfth century, the text contains a vocabulary that is not consistent with that of the more conventional lexicon of astronomical terms that had taken root in the university in subsequent centuries. Even astronomical objects that are ubiquitous to the Ptolemaic models, like that of the eccentric circle (*circulus egressae cuspidis* in Alfraganus, but more typically rendered as *circulus ecentrici*) or the epicycle (*circulus brevis* in Alfraganus, but more typically rendered as *epiciclus*), diverge from the standard vocabulary. This is to say nothing of the more specialized terminology of latitude theory like the inclination of the deferent, which is often translated as 'deviation' in modern commentaries, but that Heingarter calls the *declinatio ecentrici ab ecliptica* in the *theorica*. Heingarter's descriptive phrase expresses the spatial relations between the deferent and the ecliptic nicely, but it differs from the more common term *deviatio*, which could be found in the canons and is employed by Heingarter in his *practica*. Similarly, the second angle of inclination on the epicycles of the inferior planets, often translated as 'slant' in modern commentaries, is given the much more unusual name *involutio* in the *theorica*. This differs from most other Latin sources on the subject, including the Toledan and Alfonsine canons, which refer to this same angle as the *reflexio* — a term that Heingarter again reverts to in the *practica*.<sup>86</sup>

Heingarter's introduction of novel terminology in the *theorica* may have undermined his unifying efforts in some cases, but there are other instances in which he can be seen updating outdated modes of expression by either silently changing the terms in his compilation or by including the vocabulary that one would find in canon texts taught in the university alongside the older term. For example, when referring to the epicycle centre, he often calls it the *cuspidis seu centrum epicicli*. He also attempted to reinterpret passages from the *Theorica planetarum communis* that did not conform with the Ptolemaic model of planetary latitude detailed by Alfraganus in the *Science of the Stars*. For example, Heingarter quotes a passage from the *Theorica planetarum communis*' seventh chapter verbatim when explaining how the epicycle of a superior planet inclines from its deferent plane, writing:

The epicycle, moreover, is inclined from the eccentric such that the planet will always be between the ecliptic and the centre of the epicycle, except when the centre of the epicycle is at the head or tail; then, the epicycle is right on the eccentric.<sup>87</sup>

This passage is not coherent with the planetary models described by Ptolemy, however, since it is not the planet that will always be between the ecliptic and the epicycle centre due to the epicycle's inclination, but rather the epicycle's apogee. Heingarter glosses this passage in a way that agrees with the description found in Alfraganus, however, by explaining that

... the inclination of the lower half of the epicycle from the plane of the deferent is always in that direction toward which that half of the deferent — in which is the centre of the epicycle — declines from the plane of the ecliptic. And, therefore, when the centre of the epicycle is outside

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<sup>85</sup> For a modern edition of work of Alfraganus, see Alfraganus (al-Farghānī), *Differentie in quibusdam collectis scientie astrorum*, trans. by John of Seville, ed. by F.J. Carmody (Berkeley: University of California Press, 1943). We follow Charles Burnett in giving John of Seville's translation of Alfraganus the title *Science of the Stars*. This is in spite of the fact that the work has been given a wide variety of different names over the years. On this topic, see the third Appendix to Charles Burnett's 'From *Astronomica* to *Exotica*: Jacob Golius' Edition of Alfraganus' *On the Science of the Stars* in Comparison with the Earlier Versions', in *Scholarship Between Europe and the Levant: Essays in Honour of Alastair Hamilton*, ed. by Jan Loop and Jill Kraye (Leiden: Brill, 2020), pp. 85–86.

<sup>86</sup> For a more detailed account of the variations in terminology to be found in the treatise, see the appendices in this article, including the glossary.

<sup>87</sup> BnF, lat. 7432, f. 220<sup>r</sup>. See Appendix, 47.

of the nodes, the planet on the upper part of the epicycle is between two planes, namely that of the ecliptic and its deferent.<sup>88</sup>

That is to say, the epicycle's perigee is always further from the plane of the ecliptic than is the centre of the epicycle. Thus, when the planet is on the part of the epicycle closer to the apogee, it will fall between the planes of the ecliptic and the deferent. This statement is in agreement with the Ptolemaic model, though it contradicts the passage taken from the *Theorica planetarum communis*, to which it serves as a gloss.<sup>89</sup>

This latter example of Heingarter's efforts to bring some order and consistency to the many sources that he integrated into his treatise serves to show that, more serious than the terminological variability of the latitude theory, was the multiplicity of descriptions of the models lying behind these terms and the procedures involved in their calculation.

Such ambiguities became more apparent in Heingarter's *practica*, where multiple canons are provided for using different tables to find latitude values. As opposed to his approach in the *theorica*, Heingarter decided to leave the multiple methods alongside one another in the *practica* with no attempt to reconcile them to one another. Instead, he provides one set of instructions for using tables ultimately derived from al-Battānī's *zīj*, which require the user to find two angles of inclination for the superior planets and three angles of inclination for the inferior planets. These values are then combined to obtain the final latitudinal position of the planet. This is the method that one would find in the canons written by John of Lignères and paraphrased in Heingarter's *practica*.<sup>90</sup>

When drawing upon the Toledan canons, Heingarter provided a different set of instructions, which preserved the procedures designed for the Indian model as found in the *zīj* of al-Khwārizmī. These procedures required simultaneous use of the *bipartialis* and *quadripartialis* tables, the format of which is described in the previous section. For these tables, he provided two canons: one for the superior planets, the other for the inferior.<sup>91</sup>

That the canon instructions, the tables, and, by implication, the models discussed in the treatise's second chapter are demonstrably divergent from each other was apparently not Heingarter's chief concern in the *practica*. Instead, he appears to have cared most of all about offering workable and clear instructions for students, instructing them in how to use each table set regardless of whether the table set in question was linked to the model described in the first chapter. He was aware that these tabular methods were different and likely knew they yielded different numerical results. Nevertheless, by giving these different methods as a *practica*, Heingarter did not necessarily wish to resolve all the ambiguities implied in the tables.

## Conclusion

It remains to be seen if Heingarter ever applied the procedural instructions of his latitude treatise in any systematic way to his horoscope charts later in life. Indeed, since the extant artefacts of Heingarter's career date from the 1460s to the early 1480s and very possibly predate the writing of the treatise, we may not be able to say with any degree of certainty if he changed

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<sup>88</sup> BnF, lat. 7432, f. 220<sup>r</sup>. See Appendix, 46.

<sup>89</sup> This is an error in the *Theorica planetarum communis* that Regiomontanus attacked vociferously in the *Disputationes*. See Kren, 'Planetary Latitudes, the *Theorica Gerardi*, and Regiomontanus', 194–205 (p. 199).

<sup>90</sup> For a description of the tabular procedures for planetary latitudes found in John of Lignères' canons, see José Chabás and Bernard R. Goldstein, *A Survey of European Astronomical Tables in the Late Middle Ages* (Leiden: Brill, 2012), pp. 106–10.

<sup>91</sup> For a succinct explanation of the canon methods using the *bipartialis* and *quadripartialis* tables, see Kren, 'Planetary Latitudes, the *Theorica Gerardi*, and Regiomontanus', 194–205 (pp. 196–97n9).

his practices in discernible ways later in his career.<sup>92</sup> Given what we know of the other arenas of Heingarter's life — gathering a manuscript collection at the court and developing a curriculum for students at the University of Paris — it is also possible that the latitude treatise could have served other purposes as well. In some instances, Heingarter's insistence on precisely calculating planetary latitudes for medical astrology may have been directed more at those who would attack a medical astrologer's practice than those who would actually do the calculations in emulation of it. Thus, there was probably at least an element of his research agenda that was much more rhetorical than practical and that intended to answer the questions of sceptics or tyros as much as to expand the repertoire of the seasoned calculator.

What is undeniable, however, is that Heingarter was a part of a new generation of practitioner in the late fifteenth century that had become profoundly interested in problems of planetary latitude, and he sought to gather as much material on the topic as possible. Furthermore, the importance of accounting for latitude in astrological procedures, as Heingarter explored in the annotations of BnF, lat. 7432, would garner more and more advocates as the discipline of medical astrology came under increasing critical scrutiny in the decades following Heingarter's composition of the treatise. This was particularly the case for the technique of finding planetary directions. Giovanni Bianchini and Johannes Regiomontanus both computed canons and tables for planetary directions with provisions that would allow a user to include planetary latitude values.<sup>93</sup> Later still, late-sixteenth- and early-seventeenth-century horoscopes, such as those drawn up by Girolamo Cardano and Galileo Galilei, would contain planetary latitudes for use in directing the significator of a nativity.<sup>94</sup> Similarly, Giovanni Antonio Magini would compute direction tables for planets with different latitudes in his posthumous *De directionibus*.<sup>95</sup> Such calculations had become a convention by the time Jean-Baptiste Morin treated the subject in his encyclopaedic *Astrologia Gallica*.<sup>96</sup>

For the quotidian calculations of the practicing medical astrologer, these procedures would have been simplified by the printed ephemerides that would increasingly include planetary latitude positions as well as longitude. Evidence to this effect would include some of the most widely circulating ephemerides of eminent authors such as Regiomontanus, Cardano, Johann Stöffler, Jacob Pflaum, Philipp Imsser, Luca Gauricus, Giovanni Battista Carello, Johann Stadius, and Cyprian Leowitz.<sup>97</sup> In short, Heingarter's concerns about latitudes can be

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<sup>92</sup> Although the horoscopes of Heingarter that we investigated do not include planetary latitude values, it is worth mentioning that he did take into account planetary latitude positions in some of his own prognostications. See for instance, BnF, lat. 7447, f. 9<sup>r</sup>.

<sup>93</sup> Giovanni Bianchini, *Tabulae astronomicae et canones in eas*, ed. by Augustin Olomoucký (Venice: Simone Bevilacqua, 1495); See Johannes de Regiomontanus, *Tabulae directionum projectionumque*, ed. by Johannes Angelus (Augsburg: Erhard Ratdolt, 1490), pp. b5<sup>a</sup>–b6<sup>a</sup>, c1<sup>a</sup>–c3<sup>a</sup>.

<sup>94</sup> See Girolamo Cardano, *De astrorum iudiciis, tomus quintus quo continentur astronomica, astrologica, onirocritica*, ed. by Jean-Antoine Huguetan and Marc-Antoine Ravaud (Lyon: Huguetan and Ravaud, 1663), p. 221; Galileo Galilei, *Astrologica nonnulla* in *Le opere di Galileo Galilei*, ed. by Antonio Favaro, 20 vols (Florence: G. Barbèra, 1890), XIX, pp. 205–20.

<sup>95</sup> Magini describes what he considers to be the conventional techniques for finding planetary aspects and directions, both requiring the latitude position of the planet in question. He does so in two extended passages in his work, which was published posthumously. See Giovanni Antonio Magini in Alfonso Zoboli, *De directionibus* (Venice: apud Franciscum Grossum, 1620), pp. 2–6, 13.

<sup>96</sup> See Jean-Baptiste Morin, *Astrologia Gallica principis et rationibus propriis stabilita atque in XXVI libros distributa* (The Hague: Adriaan Vlacq, 1661), pp. 354–62 and 545–58. For an English translation of these passages, see Jean-Baptiste Morin, *Astrologia Gallica: Book Sixteen, The Rays and Aspects of the Planets* (Tempe: American Federation of Astrologers, 2008), pp. 3–54; *Astrologia Gallica: Book Twenty-two, Directions*, trans. by James Herschel Holden (Tempe: American Federation of Astrologers, 1994), pp. 31–48.

<sup>97</sup> We thank Rich Kremer for informing us of this tendency in fifteenth- and sixteenth-century printed ephemerides. See Girolamo Cardano, *Libelli quinque* (Nuremberg: Johann Petreius, 1547); Johannes Regiomontanus, *Ephemerides* [1475–1506] (Nuremberg: Regiomontanus, 1474); Johannes Stöffler and Jacob Pflaum, *Almanach nova plurimis annis venturis inservientia* [1499–1531] (Ulm: Joannis Reger, 1499); Philipp

understood in terms of many broader trends in the practice of astronomy that were developing at the end of the fifteenth century.

## Appendix

### 1. Editorial Principles

#### 1.1 The Text

The following critical edition represents the first edition of the treatise on planetary latitude by Conrad Heinarter found in Paris, BnF, lat. 7432 on ff. 219<sup>r</sup>–222<sup>v</sup>. We attempted to reproduce this text as faithfully as possible, retaining its orthography almost in all instances. However, we have standardised the alterations of the consonant spelling of ‘ci/ti’ (e.g. opulencia>opulentia declinacio>declinatio, inclinacio>inclination...), as it does not seem possible to assess the prevalence of one spelling habit over the other throughout the text. Moreover, we opted for the capitalisation of proper names (e.g. iohannes>Iohannes, avernia>Avernia, alfraganus>Alfraganus) and planets (mercurius>Mercurius, mars>Mars, venus>Venus), although they are found in lower case in the manuscript witness.<sup>98</sup>

To mark syntactic units, we have applied a modern system of punctuation. In the process of editing the text, we have made a concerted effort to remain true to the apparent division of the text. Nonetheless, it is important to acknowledge that capital letters are frequently utilised to indicate information considered significant by the author and may not always signal the beginning of new sentences or paragraphs.

To improve the readability of the text, we have taken the liberty of creating new paragraphs where necessary, even if not explicitly indicated in the manuscript. This decision was made after careful consideration and a deep understanding of the intended meaning and sense of the text. Our primary objective is to present an accurate and comprehensible edition of the text, and we believe that our approach will enable readers to gain a more profound appreciation of the author’s intent and meaning.

Within the text at hand, numerical expressions are restricted only to the sexagesimal values. Conversely, adverbs such as "primo, secundo, tertio," and so forth, are spelled out in full despite the fact that their abbreviated form employs a numeral. Moreover, ordinal numbers are also spelled out in their alphabetic form (e.g. 3<sup>a</sup> latitudo > tertia latitudo).

The edited text is accompanied by an *apparatus criticus* and an *apparatus fontium*: (1) the first apparatus records few conjectures and scribal errors; (2) the second apparatus includes

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Imsser, *Ephemeridum opus Ioannis Stoeffleri Iustingensis mathematici praeclarissimi a capite anni Redemptoris Christi 1532 in alios 20 proxime subsequentes ad veterum imitationem accuratissimo calculo elaboratum* [1532–1551] (Tübingen: Ulrich Morhart, 1531); Luca Gaurico, *Ephemerides recognitae et ad unguem castigatae. Schemata et praedictiones ad annum usque virginiei partus 1552* [1534–1551] (Venice: Lucantonio Ginti, 1533); Giovanni Battista Carello, *Le Efemeridi volgari per anni 17, al meridiano dell’inclita città di Vinigia* [1555–71] (Venice: Nicolo Bevilacqua, 1555); Johannes Stadius, *Ephemerides novae et exactae Ioannis Stadii Leonnouthesi ab anno 1554 ad annum 1570* (Cologne: Birekmann, 1556); Cyprian Leowitz, *Ephemeridum novum atque insigne opus ab A.D. 1556 usque in 1606 accuratissime supputatum* (Augsburg: Philipp Ulhard, 1557).

<sup>98</sup> For clarity and consistency the words provided as examples in parenthesis are expressed in nominative case, although some of these words never occur in the nominative within the text.



the sources of the text. Only on the first page of the edition a footnote is added to clarify the integration of a word in angular brackets.

In this edition, the page change is noted in the right margin and within the text by a vertical bar. Finally, the edition was conducted on the basis of a single manuscript, and therefore, to avoid unnecessary repetition, we have not included its *siglum* in the apparatus.

## 1.2 The Translation

The translation we provide hereafter is intended to help the reader through the understanding of the treatise and offer a handy context of reference for the contribution preceding this Appendix. We attempted to translate the text as literally as possible, inserting words in square brackets only when we considered it suitable for its readability.

The very nature of Latin syntax allows for long compound sentences whereas English syntax does not. Hence, in a few instances we have altered the syntax of the text, by breaking a long sentence into two or more separate shorter sentences. In order to preserve the connection between the text and its translation, the reference to the page change is noted in the right margin and within the text by a vertical bar.

## List of Abbreviations

**ante corr.** = *ante correctionem* = ‘before correction’

**cf.** = *confer* = ‘compare/ consider’

**coni.** = *coniecimus* = ‘we conjectured’

**Angular brackets** (<...>) enclose words, etc. that we have added as deemed necessary for the reconstructed text

**Square brackets** ([...]) enclose words that we have added in the translation to enhance clarity

## Glossary of Terms

Conrad Heingarter’s theoretical chapter on planetary latitudes relied heavily upon John of Seville’s Latin translation of Alfraganus’ *Science of the Stars*, while his practical chapter drew mainly from the canons to John of Lignères’ tables (bearing the incipit *Priores astrologi*) and the version of the canons to the Toledan Tables, which Fritz Pedersen has designated by the letters Cb. The technical vocabulary used by Alfraganus to describe the models for planetary latitudes differs significantly from that of the canons to the Alfonsine and Toledan Tables. Despite his occasional updating of John of Seville’s terms for epicycle and eccentric, however, Heingarter chose not to standardize the lexicon of terms that he had at his disposal to describe the various angles of motion involved in finding planetary latitudes. For this reason, we have deemed a glossary of terms to be a useful addition to the edited text and translation provided above. Each entry consists of a single-word term. Phrases, which incorporate a word but signify a distinct concept, are included in bold within the definition of each entry. Each entry word is presented in its nominative and genitive form with its gender signified in italics alongside it.

**abscisio, abscisionis, f.:** intersection; in its verbal form, the term is used to describe the point where a planet's eccentric plane cuts the ecliptic plane; when used in the phrase **locus abscisionis**, the term refers to a planetary node. See also, **caput et cauda draconis**, **genzahar**, **intersectio**, and **nodus**.

**arcus, arcus, m.:** arc; the term **arcus circuli inter stellam et equinoxialem** is used to define the declination of a star or a planet from the celestial equator. See also, **declinatio**.

**argumentum, argumenti, n.:** argument; the term is used in two senses in the text: first as the elongation of the true position of the Moon from the true position of the northern lunar node, the **argumentum latitudinis lune**; second, the term is used to refer to a planet's true elongation from the apogee of its epicycle, or the **argumentum equatum planete**.

**aux, augis, f.:** aux, apogee; referred to simply as the "aux" in the translation above, this term refers to the point on the epicycle where the planet will have reached its furthest distance from the Earth, which is the **aux epicycli**; on the eccentric circle, the term is used to designate the furthest point of the centre of the epicycle from the Earth, which is the **aux ecentrici**.

**axis, axis, m.:** axis; Heingarter uses the term to indicate the movement of a body about a fixed point of rotation. To this end, he refers to the axis of the celestial equator (**axis circuli equinoxialis**), the axis of the ecliptic (**axis circuli signorum**), and the axis of the eccentric circles (**axis ecentricorum**) of specific planets; he also describes the motion of planetary epicycles and eccentrics in terms of axial rotation (e.g. **axis qui transit per ambo puncta longitudinum mediarum epicycli**).

**caput, capitis, n.:** head; in reference to the "head and tail of the dragon" (**caput et cauda draconis**), namely the nodes of lunar latitude, in which the head signifies the point from which the Moon ascends northward above the ecliptic plane.

**cauda, caudae, f.:** tail; the "tail of the dragon" (**cauda draconis**) signifies the point from which the Moon descends southward below the ecliptic plane.

**centrum, centri, n.:** centre; the centre is the elongation of the mean planet from its apogee on the eccentric circle; because the Ptolemaic theory of planetary latitude requires an adjustment of the planet's centre to or away from the planet's eccentric apogee, Heingarter distinguishes between the planet's centre before adjusting for the nodes (**simplex centrum**) and after (**centrum cum suo addito**); the centre of an epicycle (**centrum seu cuspis epicycli**) refers to the mean motion of a planet.

**circulus, circuli, m.:** circle; the term designates several periodic and regular motions used to calculate planetary positions; Heingarter chooses to maintain certain outmoded terms for planetary motion, such as the use of the term **circulus brevis** for an epicycle (**epicyclus**), the term *circulus egressse cuspi* in reference to an eccentric (**circulus ecentrici**); the term is also deployed frequently as a synonym for the celestial equator (**circulus equinoxialis**) and the ecliptic (**circulus signorum**).

**declinatio, declinationis, f.:** declination; although generally used to describe the angle of inclination from the celestial equator to the body of a star or planet (**declinatio planete ab circulo equinoxiali**), in Heingarter's theoretical chapter it takes on a variety of meanings: it can be used to describe a planet's latitude (**declinatio planete ab ecliptica**); it also is used interchangeably with **inclinatio** (see below) to describe the tilt of a planets' epicycle at the points of apogee and perigee (**declinatio epicycli**); it can be

used to describe the angle of deviation (see below) found in the canons, which is defined by the tilt of the eccentric plane from the ecliptic (**declinatio ecentrici ab ecliptica**); finally it is used interchangeably with the term **involutio** (see below) to describe the rotation of the two mean longitudes of an epicycle (**declinatio utrarum-que longitudinum epicycli mediarum**), otherwise known as “reflection” or “slant” in contemporary literature (see **reflexio** below).

**deferens, deferentis**<sup>99</sup>: deferent; a rarer term in Heingarter used as a synonym for the eccentric circle on which the centre of the epicycle rides.

**deviatio, deviationis, f.**: deviation; used only in the canons, this term is used to describe the angle of inclination formed between the plane of a planet’s eccentric circle and the plane of the ecliptic; in the theoretical chapter, the deviation is referred to as the “declination of the eccentric from the ecliptic” (**declinatio ecentrici ab ecliptica**). See **declinatio** above.

**directus, directi**: direct; this term is used to describe the manner in which the epicycle circle aligns with the ecliptic plane at the planetary nodes; it is also a term used to describe values found in planetary tables at a place opposite (**in directo**) to the values of the argument of the table.

**dyiameter, dyametri**, as *sub. m.* or *n.*: diameter; Heingarter uses the term to highlight two epicycle diameters of particular significance in the latitude models: the first of these is the diameter that passes through the apogee and perigee of the epicycle reaching the Earth’s centre, and this is called the **dyiameter que est ab auge vera epicycli usque in oppositum augis**; the other is the diameter that goes through the two mean longitudes of the epicycle, and is called the **dyiameter que vadit super utrasque longitudines medias**.

**ecliptica, eclipticae, f.**: ecliptic; the Sun’s apparent annual motion through the fixed stars of the zodiac; in Heingarter’s treatise, the ecliptic is more frequently referred to as the “circle of the signs” (**circulus signorum**). See **circulus** above.

**genzahar (or geuzahar; undeclinable)**: genzahar; from the Arabic *jawzahar* and the Persian *gawzahar*, the genzahar refer to the planetary nodes. See also, **abscissio, caput et cauda draconis, intersectio**, and **nodus**.

**inclinatio, inclinationis, f.**: inclination; the angle that cuts through the plane of eccentric circle when a planets’ epicycle tilts (**inclinatio epicycli**) northward or southward at the points of apogee and perigee (aka **declinatio epicycli**). See **declinatio** above.

**intersectio, intersectionis, f.**: intersection; another word used by Heingarter to refer to the planetary nodes. See also, **abscissio, caput et cauda draconis, genzahar**, and **nodus**.

**involutio, involutionis, f.**: involution; the term in Heingarter’s theoretical chapter used to describe the rotation of the two mean longitudes of an epicycle (**declinatio utrarum-que longitudinum epicycli mediarum**), otherwise known as “reflection” or “slant” in contemporary literature. See **reflexio** below.

**latitudo, latitudinis, f.**: latitude; generally the width or breadth of a thing, but specifically used to describe the angle of inclination from the ecliptic to the body of a star or planet; see also Heingarter’s use of the phrase **declinatio planete ab ecliptica** under **declinatio** above.

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<sup>99</sup> One termination participle.

**longitudo, longitudinis, f.:** longitude; generally the length or elongation between two bodies with astronomical significance, but specifically the position of a planet in the plane of the ecliptic as measured from the head of Aries; the terms “further longitude” (**longitudo longior**) or “nearer longitude” (**longitudo propior**) make reference to the points on an eccentric where the epicycle centre is at its furthest or nearest position with respect to the Earth (in the translation we simply render these terms as “apogee” and “perigee”); the positions on a planet’s epicycle where the body of the planet is at its furthest or nearest point is also called the **longitudo longior** and the **longitudo propior** respectively; Heingarter refers to the positions of apogee and perigee together as the **longitudines diversas**, and calls the positions at right angles to these the **longitudines mediae**.

**locus, loci, m.:** place, position.

**motus, moti, m.:** motion, position.; **motus declinationis vel inclinationis epicycli**

**nodus, nodi, m.:** node; another word used by Heingarter to refer to the planetary nodes. See also, **abscissio, caput et cauda draconis, genzahar, and intersectio**.

**oppositus, oppositus, m.:** opposite, opposed; used as an adjective to describe the position on the eccentric or epicycle circle that is directly opposite the apogee (**oppositum augis**), which is, namely the perigee.

**pars, partis, f.:** part, side, direction; a term used frequently to establish the orientation of a planet in latitude, whether to the north or to the south of the ecliptic plane; the term can also be used to describe the ascending or descending position of an epicycle or eccentric circle; the word is also used to describe the fourth term in a proportional relation — the **pars proporcionalis** — that is guided by the rule of three as a kind of linear interpolation.

**reflexio, reflexionis, f.:** reflection; the term in the canons that describes the rotation of the two mean longitudes of the epicycle of one of the inferior planets (**declinatio utrarum-que longitudinum epicycli mediarum**), otherwise known as the **involutio** in Heingarter’s theoretical chapter. See **involutio** above.

**signum, signi, n.:** sign; Heingarter uses the term explicitly to refer, not to the 12 zodiacal signs of 30° each, but rather the 6 “physical” signs (**signa physica**) of 60° each.

1 <I>n dandis accipiendisq[ue] muneribus, ita recte officia (inter eos 219<sup>r</sup>  
precipue, qui se amant colunt atq[ue] observant) estimantur, si liquido  
constabit nec ob hoc aliud quod liberalius offerret inventum esse, nec ab  
illo unquam quod iocundius benivolentia complecteretur acceptum. Hec  
5 ipse considerans attuli tibi (Michael Roscher artium magister) non ignava  
operum pondera quibus ad facinus nihil instructius est, cum habendi  
<sitis><sup>a</sup> incanduit, sed ea attuli que ex sapientum opulentia in studentium  
utilitatem sumpta conveximus. Et quia superioribus libris motum  
stellarum et planetarum secundum longitudinem quantum theorice et  
10 practice sufficit peregrimus, hunc vero de planetarum motu secundum  
latitudinem tractatum componere intendens, quem per duo dividam  
capitula: quorum primum theoreticam, secundum practicam et modum  
inventionis latitudinis cum eorum genzahar ad eram illustrissimi Iohannis<sup>b</sup>  
Borbonii atq[ue] Arvernie ducis ostendit.

15 <Capitulum primum>

Est autem latitudo planete declinatio eorum ab ecliptica circuli signorum  
in utrisque partibus septentrionalis scilicet et meridiei. Et si  
consideravimus circulum exeuntem per axem circuli signorum et per  
stellas et gradus earum ex circulo signorum: erit arcus eius circuli inter  
20 stellam et eius gradum eadem quantitas latitudinis eius a circulo. Describit  
autem nobis sol circulum signorum per cursum suum ab occidente in  
orientem, eo quod superficies eius circuli ecentrici in qua movetur sit  
inseperabilis a superficie circuli signorum non declinans ab ea. Ceteri  
autem planete preter solem sunt quemadmodum narrabo ex dictis  
25 ALFRAGANI.

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1 In dandis . . . 8 sumpta conveximus] Cf. SEVERINUS BOETHIUS, *De arithmetica*, prolog.; ed. SCHILLING – OOSTHOUT, p. 3 16 Est autem latitudo . . . 53 longitudinibus mediis fere] Cf. ALFRAGANUS, *Differentie*, c. 18.1–9; ed. CARMODY, p. 31–32.

a) The passage found in ll. 1–8 exhibits a close parallel to the first lines of Boethius' *De arithmetica*. The integration of 'sitis' in angular brackets was deemed necessary to restore the passage from corruption. Because Heingarter has followed the language of the *De arithmetica* so closely here, we have decided to use the exact word found in this source.

Motus nanque omnium stellarum fixarum versus orientem est super  
utrosque polos axis circuli signorum. Et ideo quicquid ex eis fuerit in  
superficie circuli signorum, non declinabit ab eo, quicquid vero fuerit ex  
eis extra superficiem circuli signorum versus septentrionem vel meridiem,  
30 erit motus eius inseparabilis a quantitate longitudinis que est inter ipsam  
et circulum signorum in latitudine, nec unquam removebitur ab hoc. Patet  
itaque quod unaqueque stellarum fixarum vel non habet latitudinem a  
circulo signorum, vel eius latitudo semper sit quantitatis unius.

In luna autem vel quinque planetis erraticis erit e contrario, quia motus  
35 eorum non est semper super polos axis circuli signorum, sed sunt super  
eentricorum axes, qui abscindunt superficiem | circuli signorum super  
dyametrum circuli signorum et declinant ab eo versus septentrionem vel  
meridiem. Ideoque latitudo eorum fit diversa a circulo signorum.

Superficies enim circuli lune eentrici abscindit superficiem circuli  
40 signorum super punctos utrosque capitis scilicet et caude, et declinat ab eo  
versus septentrionem et meridiem, eius quoque declinatio est fixa super  
unam quantitatem nec removetur ab hoc. Et superficies eius circuli brevis  
est inseparabilis a superficie circuli eentrici, nec declinans ab ea. Ideoque  
fit ei una diversitas in latitudine propter declinationem eentrici a circulo  
45 signorum.

Diversitas vero quinque planetarum erraticorum in latitudine non est una,  
quia circuli eorum eentricorum declinant a circulo signorum et circuli  
epiclorum declinant a circulis etiam eentricorum. Circuli enim eentrici  
abscindunt circulum signorum super dyametrum eius, et declinant ab eo  
50 versus septentrionem et meridiem. Et loca abscisionis horum quinque  
planetarum sunt ista: locus abscisionis Saturni est in medio inter  
longitudinem mediam et ustrasque longitudes diversas. In reliquis autem  
quatuor planetis sunt in utrisque longitudinibus mediis fere. Et dico  
notantur fere, quia intersectiones eorum non sunt precise in medio  
55 longitudinis medie, ut postea patebit.

Et nota quod semper illa intersectio per quam planeta movetur ab ecliptica  
septentrionem versus dicitur caput draconis vel genzahar. Et alia  
intersectio per quam planeta ab ecliptica mutatur ad meridiem dicitur

219<sup>v</sup>

cauda draconis. Moventur autem intersectiones lune ab oriente in  
 60 occidentem omni die tribus minutis fere.  
 Declinatio autem longitudinum longiorum ecentricorum defferentium  
 trium superiorum est versus septentrionem a circulo signorum et  
 longitudinum propiorum versus meridiem fixe sempiternaeque  
 65 immobilitatis quemadmodum est in luna. Sed intersectiones due  
 ecentricorum trium superiorum cum ecliptica, non moventur, nisi motu  
 octave spere.  
 Et nota quod locus genzahar Saturni, distat a loco opposito augis deferentis  
 secundum signorum successionem per 40 gradus, alii ponunt 45. Et eius  
 alia intersectio que cauda dicitur distat a loco augis ecentrici secundum  
 70 successionem signorum per 40, alii 45, gradus similiter. Erit igitur locus  
 partis deferentis maxime declinantis ad septentrionem distans a loco augis  
 deferentis contra successionem signorum per 50 gradus et locus partis  
 deferentis declinans ad meridiem distat etiam a loco oppositi augis | per 220<sup>r</sup>  
 50 gradus; alii ponunt 45 contra signorum successionem.  
 75 Et semper locus maxime declinationis est ille qui equaliter distat ab  
 utraque sectione. Et isti qui ponunt 45 gradus magis concordant cum  
 ALFRAGANO. Et locus genzahar Iovis distat a loco augis sue deferentis per  
 70 gradus contra successionem signorum; quare locus partis deferentis sui  
 maxime declinans ad septentrionem erit distans a loco augis secundum  
 80 successionem signorum per 20 gradus. Et locus Martis distat ab auge sui  
 ecentrici per 90 gradus contra signorum successionem. Erit igitur locus  
 partis sui deferentis que maxime declinat ad septentrionem in loco augis  
 sui deferentis. Et latitudines horum trium planetarum scripte in eorum  
 85 deferentis qui maxime declinat ad septentrionem vel meridiem.  
 Est et unus alius motus in istis tribus superioribus secundum quem  
 movetur medietas superior epicycli et inferior declinando a superficie  
 deferentis ex utraque parte septentrionis et meridiei. Et dicitur motus

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61 longiorum] *coni.*; longiarum 72 50] *coni.*; *scr.* 55 *sed* 50 *ante corr.* 74 50] *coni.*; *scr.* 55

61 Declinatio autem . . . 64 quemadmodum est in luna] Cf. ALFRAGANUS, *Differentie*, c. 18.9; ed. CARMODY, p. 32

declinationis vel inclinationis epicicli. Est autem iste motus super axem  
90 qui transit per ambo puncta longitudinum mediarum epicicli, que quidem  
puncta distant per 90 gradus ab auge vera epicicli. Et dyameter que est ab  
auge vera epicicli usque in oppositum augis semper est equedistans  
superficie ecliptice, nisi cum fuerit centrum epicicli in nodis  
intersectionum. Nam tunc ipsa erit in superficie ecliptice, tunc enim nulla  
95 erit inclinatio.

Sed maxima est hec inclinatio cum centrum epicicli fuerit in locis  
intermediis. Et est inclinatio medietatis inferioris epicicli semper a  
superficie deferentis ad partem illam ad quam declinat a superficie  
ecliptice ipsa medietas deferentis, in qua est centrum epicicli. Et ideo  
100 quando centrum epicicli fuerit extra nodos, planeta existens in superiori  
parte epicicli est inter duas superficies, scilicet ecliptice et sui deferentis.  
Inclinatur autem epiciclus ab ecentrico, ita quod semper erit planeta inter  
eclipticam et centrum epicicli, nisi cum centrum epicicli est in capite vel  
cauda; tunc est epiciclus directus in ecentrico.

105 Declinatio vero ecentricorum Veneris et Mercurii non est fixa, sed  
movetur super dyameterum circuli signorum et vadit super utrosque nodos  
motu modico versus septentrionem et meridiem, et revertitur ad locum  
inceptionis in anno semel quemadmodum revertitur motus longitudinis; et  
erit medietas longitudinis longioris ecentrici sex mensibus versus  
110 septentrionem a circulo signorum et sex mensibus versus meridiem. Et 220<sup>v</sup>  
similiter mutatur medietas propior versus septentrionem et meridiem.  
Supponiturque superficies ecentrici superficie circuli signorum in anno  
bis et erit hoc cum fuerit cuspis circuli brevis in utrisque nodis.

Cumque fuerit cuspis circuli brevis Veneris in aliquo nodorum, erit  
115 inceptio declinationis medietatis ecentrici que succedit ipsi nodo versus  
septentrionem, et alia medietas versus meridiem. In Mercurio vero est e  
contrario, quia cum fuerit cuspis eius circuli brevis in unoque nodorum,  
erit initium declinationis medietatis eius que succedit ipsi nodo versus  
meridiem, et alia medietas versus septentrionem.

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**102** Inclinator . . . **104** in ecentrico] Cf. *Theorica planetarum Gerardi*; Paris, Bibliothèque nationale de France, lat. 7432, f. 219<sup>v</sup> **105** Declinatio vero . . . **181** coherentes superficie ecentrici] Cf. ALFRAGANUS, *Differentie*, c. 18.10–26; ed. CARMODY, p. 32–33



120 Fit itaque necessario ut sit cuspis vel centrum epicycli unius cuiusque  
 horum planetarum, vel in superficie circuli signorum cum fuerit apud  
 utrosque nodos, vel in una parte circuli signorum et numquam declinat ad  
 aliam partem. Erit enim centrum epicycli Veneris a circulo signorum  
 versus septentrionem semper, et Mercurii versus meridiem semper. Et  
 125 patet quod perfectio circularum declinationum ecentricorum Veneris et  
 Mercurii a circulo signorum versus septentrionem et meridiem est.  
 Cum fuerit cuspis seu centrum epicycli in longitudine longiori ecentrici vel  
 propiori, declinatio autem epicyclorum quinque planetarum movetur atque  
 mutatur; et erit reversio eius ad locum inceptions in anno semel, ut  
 130 reversio motus longitudinis. Sed motus epicycli in tribus superioribus est  
 super dyametrum que vadit super utrasque longitudes medias. Fitque  
 longitudo epicycli longior versus septentrionem a circulo ecentrico sex  
 mensibus, et versus meridiem sex mensibus, et erit motus dyametri que  
 vadit super utrasque longitudes medias in directo superficiei circuli  
 135 signorum.  
 Eritque superficies epicycli, abscindens superficiem ecentrici et non  
 supponitur ei, sed supponitur superficiei circuli signorum in anno bis. Hoc  
 est cum fuerit motus cuspidis seu centri eius in utrisque locis nodorum. Et  
 inceptio huius declinationis, que est longitudinis longioris epicycli et eius  
 140 longitudinis propioris ab ecentrico, est ex utrisque locis nodorum.  
 Perfectio vero eius est apud longitudinem longiorem, et longitudinem  
 propiorem.  
 Partes quoque declinationis sic distinguuntur: longitudes epicycli  
 propiores declinant ab ecentricis in partem declinationis circularum  
 145 ecentricorum a circulo signorum; longitudes vero longiores e contrario.  
 Eritque declinatio longitudinum epicyclorum propiorum, cum fuerit in  
 medietatibus ecentricorum septentrionalibus, versus septentrionem. Et 221<sup>f</sup>  
 cum fuerit in medietatibus meridianis, versus meridiem.  
 Veneri autem et Mercurio in declinatione epicycli sunt duo motus quorum  
 150 unus assimilatur motui trium superiorum, qui est ex parte longitudinis  
 longioris et longitudinis propioris epicycli ab ecentrico. Et alter est ex parte  
 declinationis utrarumque longitudinum epicycli mediarum. Et vocatur hec  
 declinatio involutio.

Eritque inceptio declinationis longitudinis longioris et longitudinis  
155 propioris epicycli ab ecentrico ex longitudine longiori et longitudine  
propiori ecentricis, et perfectio eius est apud utrosque nodos et tunc  
supponitur superficiei ecentrici superficies epicycli. Inceptio vero  
declinationis utrarumque epicycli longitudinum mediarum ab ecentrico est  
ex utrisque nodis, et eius perfectio est apud longitudinem longiorem et  
160 propiorem ecentrici, et tunc erit perfectio declinationis ecentrici a circulo  
signorum. Patet itaque quod unaqueque illarum declinationum epicycli  
cum fuerit in perfectione sua, non erit ex declinatione alia aliquid omnino,  
quia inceptio uniuscuiusque earum est ex perfectione alterius.

Partes autem declinationis sunt ita: cum fuerit centrum epicycli in  
165 medietate que incipit a longitudine longiori ecentrici, erit declinatio  
longitudinis longioris epicycli Veneris ab ecentrico versus septentrionem.  
Eritque longitudo propior e contrario longitudini epicycli. Et cum fuerit  
cuspis seu centrum in alia medietate ecentrici et e contrario huic quod iam  
narravimus; patet igitur ex dictis in aliis planetis tribus quod plurima pars  
170 huius declinationis fit apud nodos, et tunc fuerit utreque longitudes  
epicyclorum horum duorum planetarum medie adherentes superficiei  
ecentrici et circuli signorum ab invicem suppositorum.

De parte vero declinationis involutionis, cum fuit centrum epicycli in  
longitudine ecentrici longiori, erit declinatio longitudinis medie epicycli  
175 orientalis ab ecentrico in Venere versus septentrionem et in Mercurio  
versus meridiem. Longitudo vero media occidentalis e contrario parti  
orientali, et cum fuerit centrum in medietate ecentrici propiori, erit e  
contrario huic quod diximus de medietate longiori, et patet quod plurima  
pars huius inclinationis fit apud longitudinem longiorem et propiorem  
180 ecentrici et tunc fiunt utreque longitudes epicycli longior, scilicet et  
propior coherentes superficiei ecentrici. Loca autem intersectionum in  
Venere et Mercurio ab ecliptica in suis deferentibus.

Tamen communitas astronomorum sic verificant genzahar planetarum.  
Nam ab auge Saturni subtrahunt 140 gradus, ab auge Iovis 70, a Martis  
185 90, ab auge Veneris nihil, nam genzahar suum semper est | in loco sue 221<sup>v</sup>  
augis. Ab auge Mercurii minuunt 180 gradus, quibus factis remanebunt

vera loca genzahar quinque planetarum. Quantitates autem harum  
latitudinum in septentrionem et meridiem a circulo signorum sunt ita.  
Latitudo lune est quinque graduum ex gradibus circuli signorum. In  
190 planetis vero quinque narremus breviter illud quod colligitur de latitudine  
universorum motuum ipsorum in septentrionem et meridiem. Saturni  
quidem latitudo est trium graduum, Iovis duorum, Martis vero in  
septentrionem quatuor graduum et 3<sup>e</sup> unius et quarte unius et in meridie  
septem; Veneris sex graduum et 3<sup>e</sup> unius, ut patet in *Almagesti*, et extra  
195 *Almagesti* novem, et Mercurii quatuor graduum.  
Et sic peregrinus universorum motuum latitudines, in hoc finiendo  
capitulum primum Deo auxiliante.

### Capitulum secundum de practica inveniendi latitudines planetarum

<E>st autem differentia inter declinationem et latitudinem planetarum.  
200 Declinatio quidem proprie dicta sumitur a circulo equinoxiali, ita quod  
declinatio planete vel stelle est distantia seu quantitas arcus circuli inter  
stellam et equinoxialem. Circuli dico exeuntis per axem circuli  
equinoxialis et per stellam et gradum circuli equinoxialis.  
Latitudo vero planete superius capitulo primo declarata est. Ad habendum  
205 vero latitudines lune sic procedendum est. Locum genzahar equatum de  
loco lune equato minue vel medium cursum genzahar loco lune equato  
adiunge et habebis argumentum latitudinis lune, cum quo lineas numeri  
equationis lune ingredi et latitudinem lune in directo illius positam  
summe que erit septentrionalis ascendens, si fuerit eius argumentum ab  
210 uno gradu in 90. Si autem a 90 usque 180, tunc erit septentrionalis  
descendens. Si autem latitudo fuerit a 180 usque ad 270, erit meridionalis  
descendens. Et a 270 usque ad 360, erit meridionalis ascendens.  
Declinationem autem solis et stellarum reperies eodem modo, intrando  
cum gradu solis in tabulam declinationis, et illud quod in directo fuerit,

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207 argumentum latitudinis] *coni.*; *scr.* arcum

187 Quantitates . . . 197 Deo auxiliante] Cf. ALFRAGANUS, *Differentie*, c. 18.27–28; ed. CARMODY, p. 33b  
194 ut patet in *Almagesti*] CLAUDIUS PTOLEMAEUS, *Almagestum*, XIII, c. 3 205 Locum genzahar . . . 212  
meridionalis ascendens] cf. *Canones Azarchelis*, Cb163–64; ed. PEDERSEN, p. 444

215 erit vera solis declinatio, que erit ascendens in septentrionem vel  
descendens in meridiem, eo modo quo de luna diximus. In sex vero  
planetis preter solem declinatio alio modo invenitur. Nam si latitudo fuerit  
septentrionalis oportet eam addere ad declinationem repertam per gradum  
220 declinatio a circulo equinoxiali.

Ad inveniendum autem latitudines quinque planetarum posite sunt tabule  
trium manerierum: prima est in qua intratur cum centro medio in linea  
descendente et cum argumento medio in linea tamen transversali et capitur  
id quod est in con|cursu linearum et illud erit latitudo planete et ille modus 222<sup>f</sup>  
225 facilis est. Est et alius modus per tabulas bipartiales et quadripartiales. Et  
dicuntur bipartiales, quia ostendunt latitudinem proveniente[m] ex parte  
epicicli; ideo intratur in eas cum argumento equato. Sed quadripartiales  
ostendunt latitudinem proveniente[m] ex parte eccentrici; ideo intratur in eas  
cum centro equato.

230 Ad habendum autem argumenta latitudinum quinque planetarum: oportet  
scire eorum intersectiones, id est genzahar cum ecliptica que fuerunt in  
principio ere Arabum, sicut patet in tabula sequenti et in principio ere  
illustrissimi Iohannis Borbonii atque Arvernii ducis, sicut in tabula  
subsequente per quam nostro tempore, hoc est anno Domini 1425  
235 operabimur, et tempore futuro addemus supra genzahar cuiuslibet quinque  
planetarum, id quod ponitur in tabula continuationis motuum eorum.

### De latitudine trium superiorum

Si autem per tabulam bipartialem trium superiorum planetarum invenire  
desideras, cum cuiusvis eorum argumento equato lineas numeri tabularum  
240 bipartialis intra, et quod in directo eius fuerit in tabula planete illius scribe  
ad partem et erit radix latitudinis. Depost genzahar planete eiusdem de  
loco eius examinato deme vel medium cursum genzahar eiusdem planete  
loco eius vero adde et habebis argumentum latitudinis, cum quo lineas  
numeri tabule quadripartialis ingredi et quod ibi inveneris in tabula

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238 Si autem . . . 262 planetarum latitudines] Cf. *Canones Azarchelis*, Cb165–66 ; ed. PEDERSEN, p. 444–46

245 planete summe et illud divide per radicem latitudinis superius inventam.  
Et quod provenerit ex divisione est latitudo planete. Quod si non posses  
dividere, frange in minutias subtiliores et postea divide sicut fit in  
fractionibus horarum.

Et si argumentum latitudinis cum quo intrasti fuerit ab uno gradu in 90,  
250 erit ipsa latitudo septentrionalis ascendens, eo modo quo superius de luna  
declaravimus. Alii tamen cum secundam latitudinem non possunt dividere  
per primam, faciunt e contrario et tunc latitudinem computant a limbo  
zodiaci versus eclipticam.]

Veneris autem et Mercurii latitudinis sic habetur scientia. Intramus cum 222<sup>v</sup>  
255 argumento eorum equato tabulas bipartialis numeri et facimus ut dictum  
est in aliis. Argumentum autem latitudinis sic colligimus: argumentum  
eorum equatum addimus medio cursui solis et quod colligitur ex eo,  
minuimus genzahar eorum vel addimus medium cursum genzahar eorum  
eodem numero collecto, et sic invenimus argumentum latitudinis eorum,  
260 cum quo intramus lineas quadripartialis numeri et facimus per omnia sicut  
fecimus in tribus superioribus planetis, et sic invenimus horum duorum  
planetarum latitudines vel ab ecliptica vel a limbo zodiaci computando; et  
hec de secunda manerie inventionis latitudinum planetarum sufficiant.  
Est et alia maneries tertia per tabulam compositam a DE LINERIIS, quam  
265 tabulam faciliorem et clariorem fecimus in qua veraciter latitudines  
quinque planetarum per hunc modum subscriptum reperies.

### De latitudine Saturni, Iovis et Martis

Primo centrum atque argumentum equatum cuiuslibet eorum scribatur  
per se. Secundo centro equato Saturni adde gradus 50, a centro vero Iovis  
270 gradus 20 minuuntur, de centro Martis nihil mutatur. Tertio cum centro  
cuiusvis eorum accipe minuta proportionalia. Quarto cum argumento vero  
cuiusvis planete accipe latitudinem taliter, cum enim centrum verum cum  
suo addito vel minuto vel invariato fuerit repertum in parte superiori  
tabule, tunc accipe latitudinem septentrionalem. Sin autem meridionalem.

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268 Primo centrum atque . . . 276 erit planete latitudo] Cf. IOHANNES DE LINERIIS, *Priores astrologi*, c. 21; ed. SABY, p. 206

275 Quinto de illa latitudine accipe partem proportionalem secundum  
proportionem ad 60 et illa pars proportionalis erit planete latitudo.

### De latitudine Veneris

Primo centrum cum argumento equato quodlibet per se scribatur.  
Secundo cum argumento equato cape quod est in directo tabule  
280 declinationis et reflexionis et extra scribatur. Tertio centro adde 60 gradus  
cum quibus summe minuta proportionalia. Quarto accipe partem  
proportionalem declinationis servate secundum proportionem ad 60, que  
pars proportionalis erit latitudo epicycli; conserva eam, et si centrum cum suo  
addito et argumentum verum fuerit in eadem parte tabule sive superiori  
285 sive inferiori, tunc latitudo erit meridionalis. Si autem fuerit in diversis  
tabulis, tunc latitudo erit septentrionalis; scribe ergo nomen sue partis.  
Quinto cum simplici centro Veneris prius servato, accipe minuta  
proportionalia et scribantur ad partem et similiter cape ibidem sextam  
partem minorum proportionalium que est tertia latitudo que provenit ex  
290 deviatione deferentis ab ecliptica et est semper septentrionalis, et cum  
minutis proportionalibus servatis ad partem, accipe partem  
proportionalem ex reflexione servata secundum proportionem ad 60, et  
hec erit reflexio secundo examinata; scribe eam.

Tunc si centrum simplex Veneris fuerit in medietate superiori et  
295 argumentum verum planete minus tribus signis phisicis, reflexio erit  
septentrionalis. Si argumentum fuerit plus, tunc erit meridionalis. Sed si  
centrum fuerit in medietate inferiori et argumentum minus tribus signis,  
tunc reflexio erit meridionalis. Si argumentum fuerit plus tribus signis, erit  
septentrionalis et est latitudo secundo examinata que provenit ex  
300 declinatione epicycli; conserva eam et scribe nomen sue partis.

Ultimo illas tres latitudines collige similiter et subtrahe minus a maiori, si  
non fuerit eiusdem partis et a maiori denominabitur latitudo. Si vero fuerit  
eiusdem partis, totum in simul collige et erit latitudo Veneris.

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278 Primo centrum cum . . . 303 erit latitudo Veneris] Cf. IOHANNES DE LINERIIS, *Priores astrologi*, c. 22, ed. SABA, p. 207–09

## De latitudine Mercurii

305 Primo centrum verum et argumentum verum quodlibet per se scribatur.  
Secundo cum argumento vero accipe id quod in directo tabule  
declinationis et reflexionis reperies et quodlibet per se scribatur; cape  
similiter ibidem decimam partem reflexionis quam minue ex reflexione si  
centrum verum fuerit repertum in superiori parte tabule. Sin autem illam  
310 decimam partem reflexionis super reflexionem adde, eam conserva prima  
deleta. Tertio cum centro vero Mercurii quatuor signa phisica et 30 gradus  
adde cum quibus summe minuta proportionalia et de declinatione prius  
servata accipe partem proportionalem secundum proportionem ad 60 et  
proveniet latitudo primo examinata proveniens ex declinatione epicicli;  
315 conserva eam. Et si centrum cum suo addito et argumentum verum fuerint in  
eadem parte tabule, tunc latitudo erit meridionalis. Si in diversis, erit  
septentrionalis; scribe nomen partis sue. Quarto centro vero Mercurii tria  
signa phisica adde cum quibus accipe minuta proportionalia, similiter  
accipe quarta partem cum semis quarte et erit latitudo Mercurii tertia que  
320 semper est meridionalis, quam scribe ad partem, et cum minutis  
proportionalibus et reflexione prius servata, accipe partem proportionalem  
secundum proportionem ad 60, et erit reflexio examinata quam conserva.  
Quod si centrum verum Mercurii cum suo addito cum quo minuta  
proportionalia ultimo sumpsisti fuerit in medietate superiori et  
325 argumentum verum planete minus tribus signis, reflexio erit  
septentrionalis, et si plus, meridionalis. Sed si centrum cum suo addito  
fuerit in medietate inferiori et argumentum minus tribus signis, tunc  
reflexio erit meridionalis; si autem argumentum fuerit plus tribus signis,  
erit septentrionalis, et est latitudo secundo examinata que provenit ex  
330 declinatione epicicli; conserva eam et scribe nomen sue partis. Demum illas  
latitudines tres ad invicem collige si fuerint unius partis et habebis  
latitudinem Mercurii. Si autem fuerint diversarum partium, tunc subtrahe  
minorem de maiori et remanebit vera Mercurii latitudo computata a via  
solis.

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305 Primo centrum verum . . . 332 latitudinem Mercurii] Cf. IOHANNES DE LINERIIS, *Priores astrologi*, c. 23; ed. SABA, p. 210–11

335 Hec autem, mi Michael, que de planetarum et stellarum latitudinibus breviter quo ad eorum theoreticam et practicam composuimus ex dictis Sapientum. Vale.



In giving and receiving gifts, such kindnesses are rightly esteemed 219<sup>r</sup> (especially among those who love, honor and respect one another) if it will be clearly agreed that, on account of this, there is neither anything to be found which one should offer more freely, nor is there ever anything to be received which one should take from another more delightfully, than benevolence. Considering this, I have brought to you (Michael Roscher, master of arts) the not so lazy load of works, for which nothing is more ready for action than when <a thirst> for acquisition has been kindled; but I have sent these, which, taken from the wealth of the wise, we have gathered for the utility of students. And because in the previous books we have thoroughly gone through the motion of the stars and planets according to longitude with however much of theory and practice as suffices, I set out to compose this treatise on the motion of the planets according to latitude, which I shall divide into two chapters: The first of these explains the theory; the second explains the practice and the method of finding [the planets'] latitude with their *genzahar*<sup>1</sup> for the era of the Illustrious John<sup>2</sup>, duke of Bourbon and Auvergne.

### <The First Chapter>

Now the latitude of a planet is their declination from the ecliptic of the circle of the signs<sup>3</sup> in both directions, namely of the north and of the south. And if we consider a circle passing through the axis of the circle of the signs and through the stars and their degrees from the circle of the signs, the arc of that circle between the star and its degree will be the same as the

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<sup>1</sup> Heingarter deploys a number of different Latin terms to describe the planetary nodes, including *genzahar*, *nodus*, *abscisio*, and *intersectio*. We render Heingarter's terminology into English by keeping *genzahar* unchanged, and translating *abscisio* and *intersectio* as 'instersection'. We only ever refer to planetary nodes as such when the word *nodus* is employed.

<sup>2</sup> John II, Duke of Bourbon and Auvergne (1426–1488).

<sup>3</sup> With only nine exceptions, Heingarter follows Alfraganus in calling the ecliptic the 'circle of the signs'. Here in the beginning of the text he equates the two terms by introducing the phrase *ecliptica circuli signorum*. We preserve Heingarter's wording, and only refer to the ecliptic as such when it is so indicated in the text.

distance of its latitude from the circle.<sup>4</sup> By its course from west to east, the Sun will describe for us the circle of the signs because the plane of that eccentric<sup>5</sup> circle in which it moves is inseparable from the plane of the circle of the signs, not declining from it. I shall describe the remaining planets besides the Sun from what was said by ALFRAGANUS.

Indeed the motion of all the fixed stars toward the east is [centered] on both poles of the axis of the circle of the signs. And, therefore, whichever from among these is on the plane of the circle of the signs, it will not decline from it; moreover, whichever among these is outside the plane of the circle of the signs, toward the north or south, its motion will be inseparable from the quantity of the distance which is between that [star] and the circle of the signs in latitude, nor will it ever move from this [position]. It is, therefore, clear that each of the fixed stars either has no latitude from the circle of the signs, or its latitude is always of one quantity.

This will be quite the contrary for the Moon or the five wandering planets, because their motion is not always [centered] on the poles of the axis of the circle of the signs, but are on the axes of the eccentrics, which cut the plane | of the circle of the signs on the diameter of the circle of the signs, 219<sup>v</sup> and decline from it toward the north or south. And therefore, their latitude appears different from the circle of the signs.

Indeed, the plane of the eccentric circle of the Moon cuts the plane of the circle of the signs on both points, that is, of the head and tail, and declines from it to the north or south. Its declination is also fixed at one quantity, and does not move from this. And the plane of its small circle is inseparable from the plane of the eccentric circle, and it does not decline

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<sup>4</sup> In this sentence, Heingarter invites the reader to imagine a great circle drawn through the pole of the ecliptic, passing through the body of the star and touching the ecliptic. The latitude is then defined as the arc of that circle spanning the distance between the ecliptic and the body of the star.

<sup>5</sup> Here and throughout the treatise, Heingarter has silently changed the term for eccentric found in John of Seville's original rendering of Alfraganus, namely the *circulus egressse cuspis*, to the more familiar *circulus ecentrici*.

from it. And therefore, it has a single difference in latitude on account of the declination of the eccentric from the circle of the signs.

In the latitude of the five wandering planets, however, there is not just one difference, because the circles of their eccentrics decline from the circle of the signs, and the circles of the epicycles also decline from the eccentric circles. In fact, the eccentric circles cut the circle of the signs on its diameter, and they decline from it to the north and south. And the places of intersection of these five planets are these<sup>6</sup>: the place of the intersection of Saturn is in the middle between the mean longitude and both divergent longitudes.<sup>7</sup> In the remaining four planets, however, they are nearly at both mean longitudes. I mean they are nearly observed [there], because their intersections are not precisely in the middle of mean longitude as shall be made clear hereafter.

And note that that intersection by which the planet moves away from the ecliptic toward the north is always called the head of the dragon or the genzahar. And the other intersection by which the planet moves away from the ecliptic to the south is called the tail of the dragon. The Moon's intersections move from the east to the west by about three minutes every day.

The declination<sup>8</sup> of the eccentric deferents of the three superior planets is to the north of the circle of the signs for the apogees<sup>9</sup>, to the south for the

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<sup>6</sup> The word 'these' translates *ista* (f. 219<sup>v</sup>, line 51) in the text. The passage seems to follow *verbatim* John of Seville's version of Alfraganus' *On the Science of the Stars*, found on p. 32 of Carmody's edition (Note that Carmody refers to Alfraganus' work as the *Differentie*, however, the text goes by several titles according to different traditions.). On this topic, see the third appendix to Charles Burnett's 'From *Astronomica* to *Exotica*: Jacob Golius' Edition of al-Farghānī's *On the Science of the Stars* in Comparison with the Earlier Versions', in *Scholarship Between Europe and the Levant: Essays in Honour of Alastair Hamilton*, eds. Jan Loop and Jill Kraye (Leiden: Brill, 2020), pp. 85–86. Interestingly, Gerard of Cremona's translation in this place presents the same variant as Heingarter, namely *ita*, rather than John of Seville's *ista*. However, *ita* and *ista* represent equally fair variants; on the basis of this single variant, one cannot conclude that Heingarter borrowed from Gerard of Cremona rather than John of Seville.

<sup>7</sup> Here Heingarter is referring to the apogee and the perigee.

<sup>8</sup> The 'declination ... of the planets' eccentric deferents' (*declinatio ... ecentricorum defferentium trium superiorum*) introduced here, is equivalent to the term 'deviation of the deferent from the ecliptic' (*deviatio deferentis ab ecliptica*) employed in the canon texts, which Heingarter used for the second chapter of the treatise below. In this case, Heingarter has chosen not to standardize the terminology of his treatise, even though he has done so for other terms elsewhere (see nxx, xx, xx, and xx).

<sup>9</sup> Here, and whenever this term is used, we have chosen to translate *longitudo longior* as 'apogee'. Although it is referring to the same position on an epicycle or an eccentric that we translate as 'aux' when the Latin term *aux* is

perigees, [and is] fixed and eternally immobile, just as it is for the Moon. But the two intersections of the three superior planets' eccentrics with the ecliptic do not move except by the motion of the eighth sphere.

And note that the place of Saturn's genzahar is 40 degrees away from the place opposite of the aux of the deferent following the order of the signs; others put it at 45. And its other intersection, which is called the tail, is, in like manner, 40 (some say 45) degrees away from the place of the aux of the eccentric following the order of the signs. Therefore, the place of the part of the deferent declining most to the north is 50 degrees away from the place of the aux of the deferent against the order of the signs. And the place of the part of the deferent declining [most] to the south is also 50 degrees away from the place opposite of the aux |; others put it at 45 220<sup>r</sup> degrees against the order of the signs.

And indeed the place of greatest declination is always that which is equally distant from either intersection. And those who posit 45 degrees agree more with ALFRAGANUS. And the place of the genzahar of Jupiter is 70 degrees away from the place of its deferent's aux against the order of the signs; therefore, the position of the side of its deferent declining most toward the north will be 20 degrees away from the place of the aux following the order of the signs. And the place of Mars' [genzahar] is 90 degrees away from the aux of its eccentric against the order of the signs. Therefore, the place of the side of its deferent that declines most to the north will be at the place of the deferent's aux. And the latitudes of these three planets written in their tables are positioned as if the center of the

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found in the text, we maintain a distinction between 'apogee' and 'aux' to signal to the reader when *longitudo longior* is used, as opposed to *aux*. The same can be said for the terms *longitudo propior* and *oppositio augis*, which are translated as 'perigee' and 'place opposite of the aux' respectively. In considering these two pairs of terms to be equivalent, we follow chapter 12.6 of Alfraganus' *Differentie* where it reads: 'Unusquisque autem circularum egressae cuspidis vocatur circulus egressae cuspidis, et hii sunt in quibus movetur planeta in medio cursu suo equali ab occidente in orientem. Fitque de hoc quod diximus necessario ut sint in unaquaque sperarum duo loca opposita, unus scilicet in ultima longitudine spere a terra et alius in propiori longitudine. Unus autem istorum locorum qui est longitudo longior vocatur augis [*sic*] planete et alter qui est longitudo propinquior vocatur oppositio augis'. See Carmody, *Differentie*, p. 23.

epicycle were always in that place of the deferent, which declines most to the north or the south.

And there is one other motion in these three superior planets according to which the upper half and lower half of the epicycle move by declining from the plane of the deferent from both the north and south's side. And this is called the motion of the epicycle's declination or inclination. This motion, moreover, is about the axis that crosses through both points of the mean longitudes of the epicycle, which points, indeed, are 90 degrees away from the true aux of the epicycle. And the diameter, which is from the true aux of the epicycle up to the point opposite of the aux, is always parallel to the plane of the ecliptic, except when the center of the epicycle is on the nodes of the intersections.<sup>10</sup> For then that [diameter] will be on the plane of the ecliptic<sup>11</sup>, and then, indeed, there will be no inclination.

But this inclination is greatest when the center of the epicycle is in the intermediate places.<sup>12</sup> And the inclination of the lower half of the epicycle from the plane of the deferent is always in that direction toward which that half of the deferent – in which is the center of the epicycle – declines from the plane of the ecliptic.<sup>13</sup> And, therefore, when the center of the epicycle is outside of the nodes, the planet on the upper part of the epicycle is between two planes, namely that of the ecliptic and its deferent.

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<sup>10</sup> In this sentence and the sentence before, Heingarter introduces the two diameters that Ptolemy uses to define motion in latitude on the planetary epicycles. In the first instance, Heingarter describes what is effectively the first diameter, or the line through the center of the epicycle connecting the perigee and the apogee. He does so, however, by defining the movement of the apogee and the perigee in terms of the axial rotation of the second diameter, which joins the mean points of longitude through the epicycle center (the 'motion ... about the axis that crosses through both points of the mean longitudes of the epicycle ...'). In the second instance, one would expect Heingarter to describe the second diameter, which could be defined as the line through the center of the epicycle connecting the mean longitudes, however, he instead defines it in terms of the first diameter ('the diameter ... from the true aux of the epicycle up to the point opposite of the aux ...'). We believe this may have been a slip of the pen, as the rest of the sentence clearly refers to the second, rather than the first, diameter of the epicycle, which remains always parallel to the ecliptic in the Ptolemaic model.

<sup>11</sup> The *Theorica planetarum Gerardi* asserts that when the epicycle is at the nodes, it will be in the plane of the deferent, but Heingarter has corrected this to the plane of the ecliptic. For a discussion of the error in the *Theorica planetarum Gerardi*, see Claudia Kren, 'Planetary Latitudes, the *Theorica Gerardi*, and Regiomontanus', in *Isis* 68/2 (1977), 199–200.

<sup>12</sup> That is, at the top and bottom of the deferent rather than the nodes.

<sup>13</sup> Heingarter means to say that the epicycle's perigee is always further from the plane of the ecliptic than is the center of the epicycle. This statement is in agreement with the Ptolemaic model, though it contradicts the passage taken from the *Theorica planetarum Gerardi*, which is found in the following paragraph. See nxx below.

The epicycle, moreover, is inclined from the eccentric such that the planet will always be between the ecliptic and the center of the epicycle, except when the center of the epicycle is at the head or tail; then the epicycle is right on the eccentric.<sup>14</sup>

The declination of the eccentrics of Venus and Mercury, however, is not fixed, but moves on the diameter of the circle of the signs, and goes about both nodes with a small motion toward the north and the south; and it returns back to its starting place once in a year, just as the motion of longitude returns; and the apogee's<sup>15</sup> half of the eccentric will be to the north of the circle of the signs for six months, and to the south for six months. And, similarly, the perigee's half moves toward the north and south. And the plane of the eccentric is set under the plane of the circle of the signs twice in a year, and this will be when the cusp of the small circle<sup>16</sup> is in both nodes. 220<sup>v</sup>

And when the cusp of the small circle of Venus is in one of the nodes, it will be the beginning of the declination of the half of the eccentric that is entering that node to the north; and the other half of the eccentric toward the south. But in Mercury the contrary is the case, because, when the cusp of the small circle is on one of the nodes, it will be the beginning of the declination of that half that enters that node towards the south; and the other half toward the north.

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<sup>14</sup> This sentence comes directly from the *Theorica planetarum Gerardi*, which Heingarter's treatise is commenting upon. It is also a quote from the work that has gained some notoriety, as Johannes Regiomontanus directly attacked this part of *Theorica planetarum* for being erroneous. It falsely claims that the planet's position must always lie somewhere between the epicycle center and the plane of the ecliptic, when it is rather the epicycle's apogee that must be found there (see nxx) above. This statement is contradicted by Heingarter's own commentary in the passage before it. Whether this was meant as an explicit correction of the original text or not remains unsaid. For a discussion of Regiomontanus' criticism of this passage, see Kren, 'Planetary Latitudes, the *Theorica Gerardi*, and Regiomontanus', 199–200.

<sup>15</sup> The text reads *medietas longitudinis longioris ecentrici*, which we have translated as 'apogee's half of the eccentric'. Likewise, just below, the text reads *medietas propior*, which we have translated as the 'perigee's half'.

<sup>16</sup> Here and throughout much of the text, Heingarter preserves the terminology of Alfraganus's *Differentie*, calling the center of the epicycle the 'cusp of the small circle' (*cusps circuli brevis*). Elsewhere Heingarter will supplement al-Alfraganus's terminology with the more conventional vocabulary of the university, such as when he refers to the *cusps vel centrum epicycli*; see nxx below.

Therefore, it necessarily happens that the cusp or center of the epicycle<sup>17</sup> of each one of these planets is either in the plane of the circle of the signs when it is at both nodes, or to one side of the circle of the signs, and never declines to the other side. Indeed the center of the epicycle of Venus will always be to the north of the circle of the signs, and Mercury's always to the south. And it is clear that the completion of the declination circles of Venus and Mercury's eccentrics are to the north and south of the circle of the signs.

When the cusp or center of the epicycle is at the apogee or perigee of the eccentric, moreover, the declination of the five planets' epicycles moves and changes; its return to its beginning position will be once a year, just as is the return of the motion of longitude. But the motion of the epicycle in the three superior planets is on the diameter that goes through both mean longitudes. The apogee of the epicycle is away from the eccentric circle toward the north for six months, and toward the south for six months; and the motion of the diameter that goes through both mean longitudes will be right on the plane of the circle of the signs.

And this will be the plane of the epicycle, cutting the plane of the eccentric, and it is not set under it [i.e. the eccentric]; but it is set under the plane of the circle of the signs twice in a year. That is, when the motion of the cusp or its center is at both positions of the nodes. And the beginning of this declination, which is of the apogee of the epicycle and its perigee from the eccentric, happens at both positions of the nodes. Indeed its completion is at its apogee and perigee.

The directions of the declination are also distinguished thus: the perigees of the epicycle decline from the eccentrics in the direction of the eccentric circles' declination from the circle of the signs; the apogees are the opposite. And the declination of the perigees of the epicycles will be

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<sup>17</sup> Heingarter supplements John of Seville's *cusps epicycli* with the more familiar *centrum epicycli*, and in the next instance leaves off *cusps epicycli* entirely.

toward the north, when it is on the northern halves of the eccentrics. And 221<sup>r</sup>  
it will be toward the south, when it is on southern halves.

Venus and Mercury have two motions in the declination of the epicycle, one of which is like the motion of the three superior planets, which is from the eccentric on the part of the epicycle's apogee and perigee.<sup>18</sup> And the other [motion] is from the direction of the declination of both of the epicycle's mean longitudes. And this declination is called involution.<sup>19</sup> And the beginning of the declination of the epicycle's apogee and perigee away from the eccentric will be on the apogee and perigee in the eccentrics; and its completion is at both nodes, and then the plane of the epicycle is set under on the plane of the eccentric. The beginning of the declination of both mean longitudes of the epicycle from the eccentric is on both nodes, and its completion is at the apogee and perigee of the eccentric; and then there will be a completion of the declination of the eccentric from the circle of the signs. It is clear, therefore, that when each of these declinations of the epicycle is at its completion, there will be no effect in any way from the other declination, because the beginning of one of them happens at the completion of the other.

The directions of the declination are thus: when the center of the epicycle is on the half which begins from the apogee of the eccentric, the declination of the apogee of the epicycle of Venus will be from the eccentric to the north. And the perigee will be contrary to this for the longitude of the epicycle. And when the cusp or center is on the other half of the eccentric, it will be contrary to that which we have just described; it is, therefore, clear from what has been said about the other three planets that the greatest part of this declination happens at the nodes, and then both mean longitudes of the epicycles of these two planets are attached to

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<sup>18</sup> The 'declination of the epicycle', so defined, refers to the same angle, called by the same name, in the canons on the inferior planets in the second chapter of the treatise below.

<sup>19</sup> The term, originally found in John of Seville's translation is *involutio*, which comes from the Arabic term *iltiwā'* used in Alfraganus' original text. It refers to the same motion in the planetary model that contemporary scholars call 'slant'. The canons below and the headings to the tables do not render *iltiwā'* into Latin as *involutio*, but rather as *reflexio*, which is another possible translation for the same Arabic word.



the plane of the eccentric and the circle of the signs, each set under the other.

As for the direction of the declination of involution, when the center of the epicycle is at the apogee of the eccentric, the declination of the eastern mean longitude of the epicycle from the eccentric will be northerly for Venus, and southerly for Mercury; but the western mean longitude will be contrary for the eastern part. And when the center is on the perigee's half of the eccentric, it will be contrary to what we said about the apogee's half; and it is clear that the greatest part of this inclination occurs at the apogee and perigee of the eccentric; and then it happens that both the apogee and perigee of the epicycle cohere to the plane of the eccentric. The places of the intersections for Venus and Mercury, however, are away from the ecliptic in their deferents.

But the community of astronomers verify the *genzahar* of the planets in this way. For 140 degrees are subtracted from the aux of Saturn, 70 degrees from the aux of Jupiter, 90 degrees from Mars, nothing from the aux of Venus, for its node is always | in the place of its aux. 180 degrees are subtracted from the aux of Mercury; and having done this, the true places of the *genzahar* of the five planets will remain. The quantities of these latitudes in the north and south from the circle of the signs are thus. The latitude of the Moon is five degrees from the degrees of the circle of the signs. But for the five planets, let us describe briefly that which is gathered from the latitude of all of those motions in the north and the south. Indeed the latitude of Saturn is three degrees; Jupiter is two; Mars is four degrees and a third and a fourth in the north and seven degrees in the south; Venus is six degrees and a third, as is made clear in the *Almagest*, and, outside the *Almagest*, nine; Mercury is four degrees.<sup>20</sup>

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And thus we have completed the latitudes of all the motions, thereby finishing the first chapter with God's help.

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<sup>20</sup> Heingarter is relying on Alfraganus in stating that Venus has a latitude of 6 degrees and a third, but in Alfraganus it is actually 6 degrees and a fourth. See *On the Science of the Stars* 18.27, p. 33b.

## **The Second Chapter On the Practice of Finding the Latitudes of the Planets**

There is, moreover, a difference between the declination and latitude of planets. Indeed the declination, properly called, is taken from the equinoctial circle such that the declination of the planet or star is the distance or the quantity of the arc of the circle between the star and the equinoctial [circle]. I am speaking of the circle going through the axis of the equinoctial circle, the star and the degree of the equinoctial circle.

But the latitude of the planet is explained above in the first chapter. Indeed, one should proceed thus in order to obtain the latitudes of the Moon. Subtract the equated place of the genzahar from the equated place of the Moon, or add the mean motion of the genzahar to the equated place of the Moon, and you will have the arc of the Moon; and with this, enter the lines of number of the equation of the Moon, and take the latitude of the Moon that is placed opposite of it; this will be northern ascending if its argument is from one degree to 90. If, however, [it is] from 90 to 180, then it will be northern descending. If, moreover, it is from 180 to 270, it will be southern descending. And [if it is] from 270 to 360, it will be southern ascending.

And you will find the declination of the Sun and the stars in the same way by entering with the degree of the Sun into the table of declination; and that which is opposite it will be the true declination of the Sun, which is ascending in the north or descending in the south, in that way in which we said about the Moon. But in the six planets apart from the Sun, the declination is found in another way. For, if the latitude is northern, it is necessary to add it to the declination found for the degree of the planet, or – if it is southern – [it is necessary] to subtract it; and what remains will be the planet's declination from the equinoctial circle.

To find the latitudes of the five planets, moreover, tables of three kinds are arranged: the first [kind] is that in which [the table] is entered with the mean center in the descending line, and with the mean argument in the

transversal line; and that which is taken is that which is in the con| 222<sup>r</sup>  
vergence of the [two] lines; and that will be the latitude of the planet; and  
that method is easy.<sup>21</sup> And there is another way by means of two-part  
number and four-part number tables.<sup>22</sup> They are called two-part as they  
show the latitude resulting from the epicycle's part; therefore, one enters  
into them with the equated argument. But the four-part show the latitude  
resulting from the part of the eccentric; therefore, one enters into them  
with the equated center.

Moreover, to get the arguments of the latitudes of the five planets: it is  
necessary to know their intersections, that is, the *genzahar* with the ecliptic  
which were at the beginning of the era of the Arabs, as is made clear in  
the following table and at the beginning of the era of the Illustrious John,  
duke of Bourbon and Auvergne, as [is is shown] in the following table by  
which we will operate in our own time, that is, in the year of our Lord  
1425; and for a future time we will add to the *genzahar* of any of the five  
planets that which is placed in the table of the continuation of their  
motions.<sup>23</sup>

### **On the Latitude of the Three Superior Planets**

Moreover, if you wish to find [the latitude] through the two-part number  
table of the three upper planets, enter the lines of number of the two-part  
tables with the equated argument of whichever you wish, and write apart  
what is opposite of it in the table of that planet; and this will be the root of  
the latitude. Next, subtract the *genzahar* of that same planet from its  
corrected place, or add the mean motion of the same planet's *genzahar* to  
its corrected place, and you will have the argument of latitude; and with

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<sup>21</sup> This canon instructs the reader in the use of a double argument table, likely that of the Oxford Tables, which are contained in a manuscript owned by Heingarter, namely BnF Lat. 7295A.

<sup>22</sup> Heingarter is describing the method for finding latitudes using tables drawn from the Indian tradition. The canons detailing how to use these tables immediately follow this introduction.

<sup>23</sup> On folio 222<sup>r</sup> there is a table that give the values of the nodes or *genzahar* of the planets set to the *era Arabum* and which is taken from the Toledan Tables. Heingarter then includes a table of the same nodes set to the *era illustrissimi Iohannis Borbonii atque Arvernie*, although this table remains incomplete in the manuscript witness. There is also a partially complete *tabula continuationis motuum eorum* that is divided between years, months, and days.

this, enter the lines of number of the four-part table, and take what you have found in table of the planet; and divide that by the root of latitude that was found above. And what results from the division is the latitude of the planet. In case you cannot divide, break it into smaller parts and then divide as happens with fractions of hours.

And if the argument of latitude, with which you entered, is from one degree to 90, this latitude will be northern ascending, in that way in which we have declared above about the Moon. Nevertheless, others, when they could not divide the second latitude by the first, do this conversely, and then compute the latitude from the limb of the zodiac toward the ecliptic.<sup>24</sup>

And so is had, moreover, knowledge of the latitude of Venus and Mercury.

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We enter the two-part number tables with their equated argument, and we operate as has been said about the others. Moreover, we compute the argument of latitude thus: we add their equated argument to the mean motion of the Sun, and, from what is added, we subtract their *genzahar* or we add the mean motion of their *genzahar* to the same summed number; and thus we find the argument of their latitude; and with this, we enter the lines of the four-part number tables and we operate for everything as we did in the case of the three upper planets; and thus we shall find the latitudes of these two planets by computing from the ecliptic or from the limb of the zodiac; and this suffices concerning the second way for finding the latitude of the planets.

And there is another, a third, way<sup>25</sup> in which you will truly find the latitudes of the five planets according to the following method using a

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<sup>24</sup> Heingarter assumes an arithmetic procedure for finding the latitude, which would be a conversion of the method of division described in the Toledan canons. He borrows this line of thinking from the original text he is commenting upon where the *Theorica planetarum Gerardi* reads: 'Compositor autem tabularum ad ostensionem sui magisterii noluit ponere verso numeros praedictarum latitudinum in quibus unus subtrahitur ab altero semper, sed posuit numeros equipollentes in quibus si unus dividitur per alterum idem proveniret'. It is noteworthy that he describes this arithmetic procedure as being performed from the 'limb of the zodiac' (*a limbo zodiaci*), thereby employing a vocabulary that is most often found in instrument texts. For further discussion of this passage see Kren, 'Planetary Latitudes, the *Theorica Gerardi*, and Regiomontanus', 200–02.

<sup>25</sup> In describing his 'third way', Heingarter has recourse to the canons of John of Lignères' *Priores astrologi*, although he presents them as a paraphrase.

table composed by [JOHN] OF LIGNÈRES, which we have made easier and clearer.

### **On the Latitude of Saturn, Jupiter and Mars**

First, the center and the equated argument of any of them should be written by themselves. Second, add 50 degrees to the equated center of Saturn; 20 degrees should be subtracted from the true center of Jupiter and from the center of Mars nothing should be changed. Third, with the center of any of these [planets] take the minutes of proportion. Fourth, with the true argument of any planet take the latitude such that, when indeed the true center, with its added, subtracted, or unchanged [value], is found on the upper part of the table, then you take a northern latitude. If not, then [you take a] southern [latitude]. Fifth, from that latitude take the proportional part according to the proportion to 60 and this proportional part will be the latitude of the planet.

### **On the Latitude of Venus**

First, let any center be written down with the equated center by itself. Second, with the equated argument take what is opposite of it in the table of declination<sup>26</sup> and reflection<sup>27</sup>, and let it be written aside. Third, add 60 degrees to the center and with those take the minutes of proportion. Fourth, take the proportional part of the saved declination according to the proportion to 60, and that proportional part will be the latitude of the epicycle; save it, and if the center, with its added [value], and the true argument are in the same part of the table, whether in the upper or the lower, then the latitude will be southern. If, however, they are in different tables, then the latitude will be northern; therefore, write down the name of its direction. Fifth, with the simple center of Venus previously saved, take the minutes of proportion and let them be written down separately

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<sup>26</sup> Heingarter's use of the term 'declination' is coherent with his terminology in the first chapter; see nxx.

<sup>27</sup> Again, his terminology matches the first chapter; see nxx.

and similarly take again the sixth part of the minutes of proportion, and that is the third latitude that results from the deviation<sup>28</sup> of the deferent from the ecliptic, and is always northern; and with the minutes of proportion that have been saved apart, take the proportional part from the reflection that has been saved according to the proportion to 60; and this will be the reflection examined for a second time; write it down.

Then, if the simple center of Venus is on the upper half and the true argument of the planet is less than 3 physical signs, the reflection will be northern. If the argument is more [than 3 physical signs], then it will be southern. But, if the center is on the lower half [of the table] and the argument [is] less than three signs, then the reflection will be southern. If the argument is more than three signs, it will be northern; and this is the second examined latitude, that results from the declination of the epicycle; save it, and write down the name of its direction.

Finally, combine together these three latitudes in like manner, and subtract the lesser from the greater if [the latitude] is not in the same direction. And the latitude will be denominated from the greater. But if all are in the same direction, add them all together at once, and this will be the latitude of Venus.

### **On the Latitude of Mercury**

First, let any true center and true argument be written down by themselves. Second, with the true argument take what you find opposite to it in the table of declination and reflection and let it be written by itself; in like manner, take again the tenth part of the reflection which you will subtract from the reflection if the true center is found on the upper part of the table. If not, however, add that tenth part of the reflection to the reflection; keep it, having deleted the first value. Third, with the true center of Mercury add 4 physical signs and 30 degrees and with these take the minutes of proportion. Take the proportional part from the declination already saved

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<sup>28</sup> In the first chapter, the 'deviation' is referred to as the 'declination ... of the planets' eccentric deferents'; see nxx.

according to the proportion to 60; and what results will be the latitude examined for the first time, resulting from the declination of the epicycle; keep this. And if the center with its added [value] and the true argument are in the same part of the table, then the latitude will be southern. If they are in different [parts of the table], then [the latitude] will be northern; write down the name of its direction. Fourth, add three physical signs to the true center of Mercury with which you get the minutes of proportion; in like manner, take the fourth part with half a fourth. And this will be the third latitude of Mercury which is always southern; write this apart, and with the minutes of proportion and the reflection previously saved, take the proportional part according to a proportion to 60 and this will be the examined reflection, which you will save.

Now if the true center of Mercury, with its added [value], together with its minutes of proportion that you have finally taken, is on the upper half [of the table], and the true argument of the planet is less than three signs, then the reflection will be northern. But if [the true argument] is more than three signs, then [the reflection] will be southern. But, if the center with its added [value] is on the lower half and the argument is less than three signs, then the reflexion will be southern; if the argument is more than three signs, then it will be northern; this is the latitude examined for a second time which results from the declination of the epicycle; save it, and write the name of its direction. Finally, add these three latitudes together, if they were in the same direction, and you will have the latitude of Mercury. If, however, they were in different directions, then subtract the lesser from the greater, and what remains will be the true latitude of Mercury computed from the path of the Sun.

Now this, my Michael, is what we have briefly composed from the sayings of the Wise on the latitudes of planets and stars with respect to theory and practice. Farewell.

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