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Astronomical Shoptalk in Paris, ca 1246: An Edition and Translation of John of London's Letter to R. de Guedingue

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Article abstract

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Astronomical Shoptalk in Paris, *ca* 1246

An Edition and Translation of John of London's Letter to R. de Guedingue

by

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Abstract

A unique source on the practical aspects of the *scientia astrorum* (astronomy and astrology) in medieval Europe has come down to us in the shape of a letter written shortly after 1246 by John of London, an astronomer based in Paris. John used the letter to answer eight questions on technical problems posed to him by his addressee, a certain R. de Guedingue, with subject matters ranging from the rate of precession to the dates of the so-called Dog Days. The article makes this source available *via* a critical edition (based upon three manuscripts) and an accompanying English translation. An introduction discusses the background and transmission of John's letter as well as the identities of the letter writer and addressee. The edition and translation are followed by commentaries elucidating the background to each of the eight questions and John's answers to them.

About the Author

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Keywords medieval astronomy, astrology, horoscopes, thirteenth century, John of London, University of Paris

Introduction

Even though the Latin Middle Ages have left us with thousands of manuscripts containing texts, tables, and diagrams pertinent to the so-called *scientia astrorum*, which typically comprised both mathematical astronomy and astrology, very few sources from this period truly allow us to peer into the thought processes and conversations that the study of such material could engender. A surviving document that casts some precious light on precisely this subject is a letter written soon after 1246 by a Parisian scholar by the name of John of London. Its full text is extant in two copies:

P MS Paris, Bibliothèque nationale de France, lat. 7413/II, ff. 19va–21ra (s. XIII^{ex}).[1]

V MS Vatican City, Biblioteca Apostolica Vaticana, Pal. lat. 1340, ff. 84rb–85rb (s. XV$^{2/2}$ [1458/1459]).[2]

In addition, the end of the letter has been preserved in

O MS Oxford, Bodleian Library, Digby 168, f. 67ra (s. XIV [before 1372]),[3]

where the remainder is absent owing to the loss of the preceding folia.

John's letter answers eight technical questions that had been posed to him by his addressee, a certain "R. de Guedingue, his most beloved master" [§1 *Amatissimo magistro suo R. de Guedingue*]. They revolve around

(i) the rate of precession,
(ii) the planetary hours,
(iii) the projection of rays,
(iv) domification,
(v) the prime meridian used in recording geographic longitudes,
(vi) the quality of certain astrological texts,

[1] Described in Juste 2021a.

[2] Described in Juste 2021c.

[3] Described in Juste 2021b.

(vii) the reference frame used for the coordinates of stars on an astrolabe's rete, and

(viii) the calendrical beginnings of the four seasons as well as the beginning and end of the so-called Dog Days.

Issues (i) to (vii) could all be understood to have at least some bearing on the casting and interpretation of horoscopes, which suggests that John and his correspondent were both especially preoccupied with this side of the "science of the stars". They would have shared this interest with their northern French contemporary Richard de Fournival (1201–1260), who had cast his own birth horoscope before 22 October 1239.[4]

While the letter itself has drawn rather little attention from historians of astronomy, its author, John of London, enjoys a modicum of fame for a tabular list containing the ecliptic coordinates of 40 astrolabe stars.[5] From John's answer to question 7 [§42], it is known that a copy of this star table was originally appended to the letter that he addressed to R. de Guedingue, even though this attachment is absent from the three manuscripts mentioned above. The star table instead survives in at least 18 stand-alone copies, some of which modify its content.

Since no up-to-date list of these copies seems to be available at present, it may be worth inserting one here. Manuscripts not mentioned in the previous literature will be marked with an asterisk:

(1) Bergamo, Biblioteca Civica Angelo Mai, MA 388 (Sigma II 2), f. 122v (s. XV$^{2/2}$; *Tabula stellarum fixarum verificata Parisius per instrumentum armillarum* etc.).*

(2) Edinburgh, Royal Observatory, Crawford Collection, Cr. 2.5, f. 73r (s. XIII^{med}; *Tabula ad inveniendum loca stellarum fixarum magis famosarum*).

(3) Erfurt, Universitätsbibliothek, Dep. Erf. CA 4^{o} 366, ff. 50v–51r (s. XIV^{med}; *Tabula stellarum fixarum que ponuntur in astrolabio verificata Parysius per instrumentum armillarum anno Christi 1246*…).

(4) Groningen, Universiteitsbibliotheek, 102, f. 88r (s. XIII^{ex}; *Tabula stellarum fixarum que ponuntur in astrolabio*).

[4] On Richard's horoscope, see Boudet and Lucken 2018.

[5] For a discussion and edition of John's star list, see Kunitzsch 1966, 39–46 (type VI). The list was edited again, this time more reliably, in FPedersen 2002, 4.1502–1504 (LA15). See also Thorndike 1959, 161.

(5) London, British Library, Sloane 2479, f. 5r–v (s. XIV; *Tabula stellarum fixarum que ponuntur in astrolabio verificato* [*sic*] *Parisius per armillas anno domini 1246…*).

(6) Madrid, Biblioteca nacional de España, 9271, f. 116v (s. $XIV^{1/2}$; *Tabula stellarum fixarum verificata per instrumentum armillarum in civitate Parisius…*).

(7) Madrid, Biblioteca nacional de España, 10053, f. 16v (s. $XIII^{2/2}$; *Tabula stellarum fixarum verificata per instrumentum armillarum in civitate Parisius…*).

(8) Metz, Bibliothèque municipale, 1223, f. 16v (s. $XIII^{ex}$; *Tabula sequens est tabula stellarum fixarum que verificata fuit per instrumentum armillarum in civitate Parisius anno domini 1246…*; no table follows).

(9) Naples, Biblioteca nazionale Vittorio Emanuele III, VIII.C.49, f. 82r (s. $XIII^{2/2}$; *Tabula stellarum fixarum que ponuntur in astrolabio verificata Parisius per armillas anno 1246…*).*

(10) New Haven (Conn.), Harvey Cushing/John Hay Whitney Medical Library, Medical Historical Library, 11, f. 173v (s. XIV^{in}; *Tabula stellarum fixarum verificata per instrumentum armillarum in civitate Parisius*).*

(11) Oxford, Bodleian Library, Ashmole 191, f. 39v (s. XV; *Tabula stellarum fixarum que ponuntur in astrolabio verificata Parisius per instrumentum armillarum anno gratie 1246…*).

(12) Paris, Bibliothèque nationale de France, lat. 7411(B), f. 57v (s. $XIII^{ex}$; *Tabula stellarum fixarum verificata per instrumentum armillarum in civitate Parisius…*).*

(13) Paris, Bibliothèque nationale de France, lat. 7413/II, f. 36r (s. $XIII^{ex}$; *Tabula stellarum fixarum que ponuntur in astrolabio verificata Parisius per instrumentum armillarum anno domini 1246…*).

(14) Vatican City, Biblioteca Apostolica Vaticana, Pal. lat. 1414, f. 25r (s. $XIII^{2/2}$; 31 stars; *Stelle fixe posite in hac tabula verificate sunt per instrumentum armillarum in civitate Parisiensi*).*

(15) Vatican City, Biblioteca Apostolica Vaticana, Vat. lat. 3127, fol. 38v (s. XIV; *Tabula stellarum fixarum rectificatarum per instrumentum armillarum Parisius anno domini 1246…*).*

(16) Vienna, Österreichische Nationalbibliothek, 5311, f. 130v (s. $XIV^{2/2}$; *Tabula stellarum fixarum que ponuntur in astrolabio verificata Parisius per magistrum Iohannem de Londoniis per instrumentum armillarum anno domini 1246….*).

(17) Vienna, Österreichische Nationalbibliothek, 5412, ff. 159v–160v (s. XV; two different versions).
(18) Vienna, Österreichische Nationalbibliothek, 5442, f. 133v (s. XV; 42 stars; *Hec est tabula stellarum fixarum que ponuntur in astrolabio verificata per instrumentum armillarum anno Christi 1242*...).

As can be seen, the headings to most of these copies inform us that the coordinates on display were "verified" (*verificata*) in Paris using an armillary instrument, the year being 1246. This is fully congruent with the information that John provides in his letter, which mentions 1246 as the year in which he carried out an examination concerning the precession of the fixed stars [§10]. John also expressly claims to have verified (*verificavi*) the star table with the help of *armillae* [§42], although the precise nature of this verification remains opaque. For one thing, it is fairly evident that the coordinates in John's table were not derived in any straightforward manner from the star catalog contained in books 7 and 8 of Ptolemy's *Almagest*.[6] Not only do the longitudes in this list differ nonuniformly from Ptolemy's, there are also discrepancies in the values for the ecliptic latitudes, despite the fact that latitudes are unaffected by precessional shifts. While such discrepancies may in principle lend support to the idea that John's star table is a record of observed positions, the average increase of his ecliptic longitudes relative to the Ptolemaic ones is only around 15;20°, which would be a better match for the mid to the late 12th century than for 1246. Elly Dekker [2000, 191–194, 214–215], in the most thorough analysis of this star table published to date, argues that its star names and positions may have rather been copied from an existing astrolabe or from an earlier list drawn up by an Arabic astronomer. Of course, as Dekker herself concedes, this does not wholly negate the possibility that John made some adjustments based on his own observations.[7]

Whatever its precise origin, the vivid reception of John's star table in the later Middle Ages ensured that it became the Latin source behind several of the Arabic star names still in use today [Kunitzsch 1986 and 1987]. This process was due in large part to the treatise beginning *Scito quod astrolabium est nomen grecum* ... and often falsely attributed to Māshā'allāh, which became

[6] On this catalog, see most recently Marx 2021.

[7] See also the previous discussions of John's list in Poulle 1956, 313–315 and Poulle 1964b, 191–193.

the most popular medieval Latin text on astrolabe construction.[8] A reduced version of John's table with only 31 entries often appears in chapter 22 of this text,[9] while another star table in the same work draws on its nomenclature.[10] The full table also appears in Pierre de Maricourt's *Nova compositio astrolabii particularis*, which dates from around 1263/1264.[11] As a consequence of this wide diffusion, the star list originally drawn up by John of London became a frequently used template for the construction of the retes of physical astrolabes, as suggested by at least a dozen surviving specimens from the 14th and 15th centuries.[12]

In addition to all the different versions noted thus far, John's table was also subjected to a substantial revision at the hands of a certain Roger of Lincoln, who in 1250 added mediations and declinations to the original ecliptic coordinates. This revised table of 35 stars has come down to us in two copies, the headings of which note in unison that Roger based himself on an instrument—presumably another armillary instrument—that he constructed "according to the teaching" (*secundum doctrinam*) of his master, John of London:

- Erfurt, Universitätsbibliothek, Dep. Erf. CA 4^{o} 369, f. 217r (s. $\mathrm{XIV}^{1/2}$; *Tabula stellarum fixarum que in astrolabio poni solent verificata per instrumentum considerationis anno domini 1246, deinde post annos 4 examinata ad concordiam instrumenti quod fecit Rogerus Lincon<iensis> secundum doctrinam magistri Io. de London<iis> famosi astronomi, cuius nempe R. fuit discipulus*).[13]
- Vatican City, Biblioteca Apostolica Vaticana, Pal. lat. 1389, ff. 174v–175r (s. $\mathrm{XIV}^{2/2}$; ecliptic coordinates only; *Tabula stellarum fixarum*

[8] On this text, see Kunitzsch 1981, 42–48 and 1982, 499–501; Samsó 2020, 417–431. See also Poulle 1954, 84–86, which suggests that chapters 17 to 22 of this text may be a later addition authored by John of London.

[9] See Kunitzsch 1966, 47–50 (type VII); FPedersen 2002, 4.1504 (LA15a); Thomson 2019, 26–41 (tabula 2).

[10] See Kunitzsch 1966, 51–66 (types VIII–X); FPedersen 2002, 4.1507 (LA22); Thomson 2019, 2–25 (tabula 1).

[11] Pierre de Maricourt, *Nova comp.* c. 15 [Sturlese and Thomson 1995, 150–153].

[12] See Stautz 1997a, 145–150; 1997b, 88–92, 95–97, 115: Dekker 2000, 188–190, 209–213: Davis 2017, 8–14.

[13] The mediations and declinations of the Erfurt copy are incorporated into the edition in Kunitzsch 1966, 41–43.

> *que in astrolabio poni solent verificata per instrumentum consideratio-nis anno domini 1246^{o}, deinde post annos 4 examinata ad concordiam instrumenti quod fecit Rogerus Lincolniensis secundum doctrinam magistri Iohannis de Londoniis famosi astronomi, cuius idem R. discipulus fuit*).

Both copies refer to John of London as a *famosus astronomus*, thereby indicating that he was a scholar of some repute and standing. Following a suggestion already made in Fontès 1897, 385–386, one may consider the possibility that the astronomer John of London was identical to the scholar of the same name whom Roger Bacon, in his *Opus tertium* (1267/1269), counted among the only two “perfect mathematicians” of the present age.[14] This passage was further scrutinized in an article published in 1990 by Wilbur Knorr (1945–1997), who argued in favor of identifying John of London as the geometer John of Tynemouth [Knorr 1990], although this is a position he later abandoned [Knorr 2004a and 2004b].

Knorr also developed a hypothesis about the identity of R. de Guedingue, the mysterious addressee of John’s letter. In an unpublished article “On Robert Grosseteste’s Birthplace”, drafted in 1989, Knorr argued that Guedingue was a French scribe’s way of spelling the name of the village Gedding in Suffolk and that the individual whom John of London addresses by this name was none other than Robert Grosseteste.[15] While the suggestion of Gedding as the place behind the toponym used in John’s letter is not wholly implausible, Knorr’s conclusion that John sent this letter to Grosseteste is far too doubtful to deserve further consideration. Internal evidence to the contrary comes from John’s answer to the eighth and final question, which deals with a subject Grosseteste had addressed in his *Compotus* written in the 1220s, namely, the climatic beginnings of the four seasons. Since it appears that John used this same *Compotus* as a source of information in answering R. de Guedingue’s question [see p. 31 below], one can probably rule out that he was addressing its author.

A suggestion might instead be made to identify R. de Guedingue with the Master Richard of G. who authored the fractional algorithm or *Ars minutiarum* (“Cum minor quantitas aliquotiens sumpta maiorem componit...”)

[14] Roger Bacon, *Opus tertium* c. 11 [Egel 2020, 70]. The *Opus tertium* is dated to 1268–1269 in Hackett 2016, 128.

[15] For three drafts of this article and supplementary material, see Stanford University Libraries, Department of Special Collections, Wilbur Knorr Papers, SC 933, Box 27.

in MS Oxford, Bodleian Library, Ashmole 341, ff. 129r–142v (s. XIII^{ex}).[16] The full name is illegible here owing to some trimming of the upper page margin, but the remaining traces of the letter seem consistent with reading "exposita a magistro Ricardo de Geddinge".[17] A Richard of Gedding is attested as a fellow of Merton College, Oxford, and rector of Stapleford Tawney (Essex) in the late 13th century. He went abroad to study in Paris in 1288, which puts him too late to be a plausible candidate for the "magister" addressed by John's letter [see Emden 1958, 752].

As for John of London, the evidence currently at hand does not allow us to attribute to him works other than the letter and star table, or students other than the aforementioned Roger of Lincoln. Information of questionable authenticity is furnished by Simon de Phares' catalog of famous astrologers written in 1494–1498, which claims that John had many students, among them Gilbert de Provence and Mathieu de Sabloniere. It also makes John the author of three works on astronomical instruments, none of which is actually by him:[18]

(1) A book on the *saphea* (universal astrolabe) translated from Hebrew into Latin. Inc.: *Quia in mundi spera est motus*.... The claim of a Hebrew to Latin translation may have been inspired by the Latin rendering of Azarquiel's *saphea* treatise carried out in 1263 by Profatius Judaeus and John of Brescia.[19] However, the incipit instead

[16] See the entry for Richard de Keddigge in Sharpe 1997, 484.

[17] Anonymous copies of the same text appear in MSS London, British Library, Harley 531, ff. 33r–47v; Montpellier, Bibliothèque Interuniversitaire, Section de Médecine H 323, ff. 263ra–276va; Paris, Bibliothèque de la Sorbonne, 1037, ff. 201r–214v; Vatican City, Biblioteca Apostolica Vaticana, Ott. lat. 309, ff. 120ra–127vb; and Vienna, Österreichische Nationalbibliothek, 5311, ff. 73va–80va.

[18] Simon de Phares, *Recueil des plus celebres astrologues*, VIII.57 [Boudet 1997, 410–411]:

> Maistre Jehan de Londres florit en ce temps a Paris, grant astrologien, lequel translata de ebrieu en latin le livre de la *Saphee* qui commance: "*Quia in mundi spera est motus*, etc."; item composa ung autre t[r]aicté sur le *Quart de l'astrolabe* qui se commance: "*Nostra presens intentio est artem dicere*". Commenta semblablement sur le *Quadran antique* et en fist traictié qui se commence: "*Geometrie due sunt species*". Cestui fut <moult> speculatif et first plusieurs experiences de jugemens, dont il fut moult loé des clercs. Il eut plusieurs disciples et, entre autres, eut Gilbert de Provence et Mathieu de Sabloniere, qui furent grans hommes aprés lui et moult renommez en France et autre part.

[19] Edited in Millás Vallicrosa 1933, 114–152. See the commentary in Boudet 1997, 411.

points to the pseudo-Ptolemaic *Liber de compositione universalis astrolabii*, which the manuscripts report to be an Arabic to Latin translation made by Robert of Chester in London in 1147.[20] Some copies commence with the final paragraph of the prologue, which begins *Quoniam in mundi spera est motus*....[21]

(2) A treatise on the astrolabe quadrant (*quart de l'astrolabe*). Inc.: *Nostra presens intentio est artem dicere*.... This incipit belongs to the aforementioned *Nova compositio astrolabii particularis* by Pierre de Maricourt. Simon de Phares may have inferred John of London's authorship from the presence of his star table in this work.

(3) A treatise on the universal horary quadrant, or *quadrans vetus*. Inc.: *Geometrie due sunt species*.... Simon here probably refers to a very widely copied text starting "Geometrie due sunt partes", which appears to have originated in Montpellier in the 1260s.[22] Its manuscript witnesses are split on whether to attribute the work to Robert the Englishman or John the Englishman. The latter name was easily conflated with John of London, which may explain the ascription in Simon's catalog.

Whatever the background of its author, John of London's letter offers us an intriguing snapshot of a private scholarly exchange on astronomy and astrology in mid-13th-century Paris, at a time when this French city was one of relatively few centers in Latin Europe where the science of the stars was being cultivated at a serious level.[23] Earlier in the century, the teaching of elementary astronomy at its university had given rise to John of Sacrobosco's famed textbook, the *Tractatus de spera* (undated, but probably composed before 1220), which is attested in hundreds of medieval manuscripts [Thorndike 1949; Ludwig 2010]. Paris also appears to have played a key role in the gradual formation of the so-called *corpus astronomicum*, a loose collection of mutually complementary texts that typically placed astronomical primers such as the *Tractatus de spera* and the old *Theorica planetarum* alongside more technical works such as the astrolabe treatise of [Māshā'allāh] [OPedersen 1975, 73–82]. The importance of the north of

[20] Kunitzsch 1982, 489–491; Juste 2021d.

[21] See, e.g., MS Vienna, Österreichische Nationalbibliothek, 5311, f. 33ra (s. XIV$^{2/2}$).

[22] Edited in Hahn 1982, 6–113. See Knorr 1997.

[23] On the Parisian astrological scene of the second half of the 13th century, see Juste 2018, 68–80.

France for the study of mathematical astronomy in this period is underscored by the *Almagesti minor* (before 1220), whose Latin author (possibly a certain Walter of Lille) rewrote books 1–6 of Ptolemy's *Almagest* in a "Euclidian" manner while adding material from Arabic sources such as al-Battānī's *Ṣābi' Zīj*. As Henry Zepeda's study of the manuscript transmission of this important work has shown, it is extremely likely to have been composed in northern France, where multiple copies of Gerard of Cremona's Arabic to Latin translation of the *Almagest* circulated during the first half of the 13th century [Zepeda 2018, 5–19]. An example that may be worth mentioning in this regard is the illuminated MS Paris, Bibliothèque nationale de France, lat. 16200. The codex was originally copied in December 1213 on the basis of an exemplar from the library of Saint-Victor and later owned and annotated by the Parisian scholar Peter of Limoges (*ca* 1240–1306). An earlier annotator, whose identity is unknown, began studying the text in 1246, the very year in which John of London created his star table.[24]

The letter that John wrote to R. de Guedingue was first made available in print by the aforementioned Fontès, who drew attention to the copy in *P* in two contributions presented to the *Académie des Sciences, Inscriptions et Belles-Lettres de Toulouse* in 1897–1898 [Fontès 1897 and 1897–1898]. The second of these contributions contained a transcription of the text by Édouard Privat [Fontès 1897–1898, 148–155], yet this transcription is marred to the point of uselessness by an excessive number of errors and misreadings. To my knowledge, no use has to date been made of the wholly anonymous copy in *V*, which introduces numerous alterations to the text, or of the fragment in *O*.

The critical re-edition included below is once again based on the text in *P*, while variants in *V* and *O* are recorded in the apparatus.[25] I have normalized the spelling in certain places, especially with regards to the use of *c/t*. The edition is followed by an English translation and by eight brief commentaries, one for each of the eight principal questions that John addresses in the letter.

[24] MS Paris, Bibliothèque nationale de France, lat. 16200, f. 1rb (gloss): "...et incepit liber iste legi anno gratie 1246". See Juste 2019.

[25] The apparatus uses the following abbreviations:

add.	text added;
iter.	text repeated;
om.	text omitted;
om. per. hom.	omission caused by homeoteleuton.

EDITION OF JOHN OF LONDON'S LETTER

[1] Amatissimo magistro suo R. de Guedingue, I. de Londoniis salutem et sincere dilectionis affectum.

Questionibus vestris prout mihi occurrit duxi breviter respondendum. [3] Noveritis quod omnes iudices astrorum quos ego vidi et audivi addunt in iudiciis motum octave spere, ut fiant iudicia secundum nonam speram, que omnes speras inferiores secum rapit. De motu autem octave spere secundum opinionem Thesbith dicit Albategni quod inde sequitur grande mendacium, quia secundum opinionem eius non procedunt stelle fixe ultra 10 gradus et 45 minuta et post ea revertuntur. Sed secundum quod ego frequenter consideravi iam processerunt a tempore Ptholomei quasi 16 gradus et a tempore Abrachis usque ad tempore Ptholomei, sicut ipse dicit capitulo secundo et tertio septimi libri ALMAGESTI, processerunt fere per 3 gradus, et ita a tempore Abrachis usque modo processerunt quasi 19 gradus. [6] Quo manifeste probatur quod positio Thesbith est inconveniens. Tamen, si consid eremus motum octave spere per tabulas Thesbith, a tempore initii annorum Arabum usque modo non fiet inde magna diversitas; sed post multos annos erit falsitas sensibilis. Dicit autem Albategni quod stelle fixe in 66 annis procedunt uno gradu et Ptholomeus dicit quod in 100 annis. [9] Quid autem sit tenendum, cum ille motus non nisi in multitudine temporis possit reperiri? Dividatur numerus annorum a consideratione Abrachis usque ad considerationem meam, que fuit anno Christi 1246 Parisius, et iam poterit sciri in quot annis stelle fixe moveantur uno gradu. Et ita scietur numerus motus octave spere.

1 Amatissimo...affectum *om. V*

2 vestris] *om. P* tuis *V* | prout mihi occurrit] *om. V*

3 Noveritis] Noveris *V* | astrorum] *om. V* | ego] *om. V* | fiant] sint *V*

4 Thesbith] Thebith *V* | opinionem eius] eum *V* | revertuntur] *om. V*

5 usque] utque *P*; *om. V* | tempore Ptholomei] Ptholomeum *V* | per] *om. V* | a tempore] ab *V* | quasi] *om. V*

6 Thesbith] Thebit *V*

7 Thesbith] Thebit *V* | fiet inde] erit *V*

9 reperiri] experiri(?) *V*

10 iam...in] scietur *V*

11 ita...numerus] per consequens *V*

[12] Ad secundo quesitum dico quod omnes astologi supponunt quod dominia planetarum sint secundum horas inequales. In hoc concordat Albumasar, differentia sexta, capitulo 33^{o}, LIBRI INTRODUCTORII. Unde prima hora diei dominice semper dominatur Sol et prima hora diei Luna dominatur Luna, et in hieme et in estate, quantumcumque sint dies longe vel breves. [15] Sic enim probaverunt antiqui planetas dominari.

De tertio quesito dico quod numquam scivi compositionem tabularum de proiectione radiorum, nec multum curo, quia per aliam viam quam qua usi sunt auctores iudiciorum cognosco proiectiones radiorum, ut sit videlicet sextilis aspectus a planeta quolibet ante et retro ad duo signa completa et quartus aspectus ad tria signa completa. Latitudo tamen planete est considerande et precipue in nativitatibus.

[18] De quarto quesito sciatis quod in unoquoque climate orizon et meridianus incipiunt quatuor domos: primam et quartam et septimam et decimam. Et aliarum domorum principia distinguuntur secundum quantitatem horarum inequalium diei et noctis, ita quod quantitas duarum horarum facit unam domum. Et sic innuit Ptholomeus de constitutione domorum et per istum modum facte sunt tabule de constitutione domorum secundum situm Toleti sicut patere potest inspicienti ipsas tabulas.

[21] Non queratis aliam distinctionem domorum quam sapientes antiqui ostenderunt nobis et super hoc canones fecerunt. Quod autem dicitur quod domus in qualibet regione distingu<u>ntur per divisionem azimuth orientalis et occidentalis in 6 partes equales super orizontem et imaginentur 6 circuli transeuntes per illas 6 divisiones et per coniunctionem meridiani et orizontis cuiuslibet regionis et per oppositas partes predicti azimuth sub orizonte, ista sententia valde diversa est a positione antiquorum et ideo de

12 Ad] De *V* | quesitum] quesito *V* | dominia] 7 *add. V*

13 Albumasar] Albat<egni> *P* | In hoc ...introductorii] *om. V*

14 dominatur] *om. V*

16 proiectione] proiectionibus *V* | aspectus] *om. V*

17 planete] semper *add. V*

18 quesito sciatis] dico *V* | climate] ad 4a super *V* | et] *om. V* | et] *om. V* | et] *om. V*

20 de constitutione] *om. V* | secundum...Toleti] ad Toletum *V* | sicut...ipsas] ut patet intuenti *V*

22 domus...distingu<u>ntur] distinguitur in qualibet regione *V* | 6] *om. V* | et[1]] ut sic *V* | coniunctionem] intersectionem *V* | cuiuslibet] cuiusvis *V* | sententia] scientia *V*

ea non est multum curandum. Licet predicti 6 circuli dividant totum emisperium superius et inferius in 6 partes equales, si quod caderet infra illos circulos de toto zodiaco diceretur domus, vix una domus contineret medietatem signi et altera plus quam signum et dimidium. [24] Et cum zodiacus sit circulus vitalis et contineat etiam signa principalia et plus influat in hunc mundum propter planetas sub ipso discurrentes quam alia pars celi, videtur mihi quod hic ratio movit antiquos constituere domos secundum circulum equidistantem equatori, per quem hore cuiuslibet diei distinguntur, ut non esset excessus unius domus super aliam secundum modum precedentem.

Ad quintum dico quod longitudo civitatum sumitur ab occidente. Sed quia quidam incipiunt occidentem a Gadibus Herculis, que sunt posite in ultima insula que inventa fuit in occeano versus occidentem, et quidam incipiunt occidentem a ripa ipsius occeani, que multum distat a Gadibus, sic potest Toletum distare a ripis maris oceani 11 gradibus et a Gadibus per 28. [27] Quando ergo voluerimus scire longitudinem duarum civitatum positarum in tabulis non est timendum quin vere possit sumi, quia compositor illius tabule semper occidentem eodem modo incipit. Dico iterum quod non est necesse nobis scire ubi isti vel illi incipiunt occidentem. Sed si voluerimus facere tabulas secundum longitudinem civitatis nostre, sciamus per armillas loca omnium planetarum ad meridiem nostrum, et sic sciemus ponere radices mediorum motuum in tabulis nostris et tunc per eclipses lunares scire distantiam cuiuslibet civitatis a civitate. [30] Et sic credo quod Arzachel composuit tabulas suas. Vidit enim per horas eclipsium que videbantur in Toleto et supponebantur fieri per tabulas super Arin quod Toletum distaret

23 si] sic *V*

24 mihi] modo *V*

25 civitatum] civitatis *V*

26 quia] *om. V* | que] qui *V* | posite] positi *V* | inventa fuit] fuit inventa *V* | Sic] Et similiter *V* | potest] poterit *V* | maris] *om. V* | per] *om. V* | 28] gradus *add. V*

27 Quando] Cum *V* | positarum] per equatorem *V* | illius tabule] illarum tabularum *V* | occidentem] *om. V* | incipit] incepit *V*

28 illi] isti *V*

29 tabulas] *om. V* | sciamus] sciemus *P* | omnium planetarum] planetarum omnium *V* | nostrum] nostram *V* | radicem *V*

30 composuit] posuit *V*

31 quod...Arin] *iter. P* | 4] 3 *V* | gradus] gradum *P* | est] esset *V* | 28...minutis] per 28 gradus et 30 minuta *V*

ab Arin per 4 horas et 10^{am} unius hore, hoc est per 61 gradus equatoris et dimidium, et ita de necessitate, si Arin est in medio mundi, distaret Toletum ab occidente 28 gradibus et 30 minutis. Nam si tollas 61 gradum et dimidium a quarta circuli, remanebunt 28 gradus et dimidium. [33] Non credo quod aliter investigasset Arzachel distantiam Toleti ab occidente nisi per hanc viam. Si autem non supposuisset tabulas super Arin, sed aliquis discipulorum eius vel sociorum transisset ad Gades Herculis, qui initium eclipsis et finem vidisset ibi sicut Arzachel Toleti, aliam forte posuisset longitudinem Toleti ab occidente.

De sexto sciatis quod Aomar de nativitatibus videtur mihi valde bonus et IUDICIA ARABUM in interrogationibus et etiam NOVEM IUDICES, sed habent verba propter ornatum difficiliora.

[36] Ad septimum dico quod melius est ponere stellas in astrolabio secundum situm earum in gradibus signorum none spere quam octave et etiam propter hoc non erit instrumentum minus perpetuum, quia post 100 annos possumus ingeniare stellas positas ut sint in gradibus consequentibus. Et de hoc quid ad nos? Si sufficiat 100 annis, cogitet alius de sequentibus. [39] Quomodo enim possemus ponere stellas fixas secundum octavam speram cum neque etiam investigare earum loca per aliquod instrumentum nisi secundum nonam speram? Et si forte ponerentur ascenderent plus vel minus in almucantarath in meridie et ceteris horis quam faciant in hoc mundo. Ergo faciamus secundum nonam speram, sicut fecerunt antiqui sapientes, ne magnus error accipiendi horas et ascendens et talia nobis semper incumbat, quia cum iudicia maxime fiant secundum nonam speram, ut dictum est.

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32 gradum et dimidium] et dimidium gradus *V* | dimidium] dimidius *V*

34 sed] si *add. V* | eius vel sociorum] vel sociorum eius *V* | aliam forte] forte aliam *OV* [*O*

35 sciatis] scias *V* | iudicia] iudic(?) sed *V* | in] *om. V* | novem iudices] iudicium *V* | habent verba] verba sunt *O*

36 instrumentum] cum *add. P* | perpetuum] prescisum *V* | consequentibus] constitutibus *P* sequentibus *V*

39 neque] nec *V* | neque etiam] non possumus *O* | earum] eorum *P* | per...instrumentum] *om. O*

40 ascenderent] extenderentur *V* | et] vel *V* | faciant] faciunt *V*

41 Ergo faciamus] Faciamus ergo *OV* | error] *om. P*; labor vel error *V* | et] vel *V*

[42] Tabulam autem tellarum fixarum in astrolabio ponendarum, quam ego Parisius per armillas verificavi, transcriptam vobis transmitto. Tabulam autem longitudinum et latitudinum civitatum vel regionum ubicumque invenietis. Illa erit verior in qua plures concordaverint.

[45] De diebus autem canicularibus et etiam quando ver, estas, autumnus et hyems incipiant, hic est intelligendum quod compositores kalendarii consideraverunt quando manifeste mutationes temporum fiebant in climate quarto, quod est in medio climatum, quod est vicinum climati Diaromes, in quo Roma sita est et quod a Roma denominatur, et ita posuerunt in kalendario. Incipiunt autem ver et estas et cetera tempora in primis climatibus prius et in posterioribus posterius. Sic etiam dico de diebus canicularibus. [48] Sed secundum astronomos et viam celestem <incipiunt> quando Sol est in eodem gradu cum cane Alhabor, que est modo in quarto gradu Cancri et durant per secundum canem, scilicet Algomeysa, que est in 14 gradu Cancri et per totum Leonem, qui est de genere canum, usque ad medium Virginis, cum illud signum sit igneum et colericum et domus Solis, et ideo Sole stante in illo non tantum colera, sed etiam alii humores de facili inflamantur, et in illo anno precipue quando adest aspectus vel coniunctio Martis ad Solem. Ver autem et estas et cetera tempora secundum astronomos incipiunt quando Sol ingreditur equinoctia et tropica signa. Medici autem timentes signum Leonis incipiunt dies caniculares modicum ante Leonem, scilicet

42 Tabulam] Tabularum *P* | autem] *om. V* | astrolabio] astrololobio *P* | ponendarum] positarum *V* | ego...verificavi] per armillas Parisius verificavi *O*; verificavi Parisius per armillas *V*

43 Tabulam] Tabularum *OP* | vel] et *V*

44 verior] melior *O* | concordaverint] concordaverunt *V*

45 autem] *om. V* | etiam quando] terminis ubi *V* | ver, estas] estas, ver *V* | hic] *om. O*; hoc *V* | est] *om. PV* | kalendarii] tabularum *V* | in quo] ubi *V* | quod a Roma] ab ipsa *V* | kalendario] kalendarii *O*

46 autem] vero *V*

47 Sic] Sed *V*

48 Sed] *om. PV* | Alhabor] Alahabor *P* | modo] *om. V* | et durant...Cancri] *om. per hom. V* | in 14...est] *om. per hom. O* | illud] eius *O* | illo] ipso *V* | non...colera] *om. V* | de] ratione *V*

49 Ver...astronomos] durat estas etc. Ipsa autem tempora *V* | equinoctia] equinoctialia *V*

50 vel parum] *om. O* | Medici...eos] Quidam dicunt dies caniculares *V* | quia Leo] que secum *V* | et] atque *V*

in medio Cancri, vel parum post, et dicunt eos durare usque ad medium Virginis, quia Leo inficit precedens signum et subsequens pro parte. [51] Et hoc verum est in calidis regionibus. In septimo tamen climate et in Anglia minus acuitur tempus in Leone quam in calidis regionius cum Sol fuerit in Ariete.

Explicit.

English Translation

To R. of Gedding[?], his most beloved master, John of London [sends] greetings and the affection of sincere love.

[1] I have decided to give brief responses to your questions, as they come to mind. Know that all astrologers that I have seen and heard add the motion of the eighth sphere when they make judgments, so that the judgments are made according to the ninth sphere, which carries all the lower spheres with it. With regard to the motion of the eighth sphere according to Thābit, al-Battānī says that a great deception arises from it, because according to [Thābit's] opinion the stars do not progress beyond 10 degrees and 45 minutes and turn back after these [have been reached]. Yet according to what I have often observed, they have already progressed by approximately 16 degrees since the time of Ptolemy; and between the time of Hipparchus and the time of Ptolemy they progressed by approximately 3 degrees, as [Ptolemy] himself says in the second and third chapters of the seventh book of the *Almagest*; and so they have moved by approximately 19 degrees from the time of Hipparchus until now. It clearly follows from this that the position of Thābit is against the facts. It is nevertheless true that, if we use the tables of Thābit to examine the motion of the eighth sphere from the time when the years of the Arabs began until now, no great discrepancy will arise from this. But after many years there will be a perceptible error.

Now, al-Battānī says that the fixed stars progress by one degree in 66 years and Ptolemy says that [this happens] in 100 years. Yet what should one believe, given that this motion can only be found over a long period of time? Let the number of years from Hipparchus' observation until my observation, which took place in Paris in the year of Christ 1246, be divided, and right

51 hoc verum est] hoc est verum *V*

52 In septima...climate] *om. V* | acuitur] timetur *O*

53 Explicit] Deo gratias *V*

away one will be able to know in how many years the fixed stars move by one degree. And this way the rate of the motion of the eighth sphere will be known.

[2] In response to the second question, I say that all astrologers assume that the planets exert their rulership according to unequal hours. Abū Maʿshar agrees with this in the 33rd chapter of the sixth division of the *Book of Introduction*. The first hour of Sunday is accordingly always ruled over by the Sun and the first hour of Monday is ruled over by the Moon, in winter as much as in summer, regardless of how long or short the days may be. For this is the way the planets exert their rulership according to what the ancients have shown to be true.

[3] In response to the third question, I say that I have never known how to compose tables for the projection of the rays, nor do I worry much [about this], for I find the projections of the rays through a different path than the one that the authors of judgments have used, namely, such that the sextile aspect is located two complete signs before or after a given planet and the quartile aspect three complete signs. The latitude of a planet must nevertheless be examined, and especially in [judging] nativities.

[4] With regard to the fourth question, you must know that in every climate[72] the horizon and meridian are the beginning of four houses: the 1st, 4th, 7th, and 10th. And the beginnings of the other houses differ according to the length of the unequal hours of day and night, such that the length of two hours makes one house. And this is what Ptolemy indicates concerning the construction of the houses and this is the method that was used to make tables for the construction of the houses according to the location of Toledo, as he who inspects these tables will be able to see.

Do not look for any other way of dividing the houses than what the wise men of old have shown us and have made canons for. When it is said, however, that the houses in any region are demarcated through a division of the eastern and western azimuth into six equal parts above the horizon and that one imagines there to be six circles that run through these six divisions and through the intersection of the meridian and the horizon of a given region and through the parts opposite the aforementioned azimuth below the horizon—this opinion is very different from the position of the ancients and therefore should not be paid much heed. For even though the aforementioned six circles divide the whole hemisphere above and below into

[72] *scil.* clime or band of latitude. From «κλίμα».

six equal parts, if one were to call that part of the whole zodiacal [circle] that falls between these circles a "house", one house would barely contain half of a sign and another more than one and a half signs. And since the zodiacal circle is a life-giving circle and contains also the principal signs and has a greater influence on this world—because of the planets that wander below it—than any other part of the heaven, it seems to me that this is the reason that motivated the ancients to constitute the houses according to a circle that is at equal distance from the equator, through which the hours of any given day are divided, so that there would not be an excess of one house over another, as is the case with the aforementioned method.

[5] In response to the fifth [question], I say that the longitude of cities is measured from the west. But because some begin the west from the Pillars of Hercules, which are located on the most distant island that was found in the ocean toward the west, and others begin the west from the bank of this ocean, which is a long way from the Pillars, it is possible for Toledo to be at a distance of 11 degrees from the bank of the ocean and 28 degrees from the Pillars. Whenever we wish to know, then, the longitude of two cities placed in the tables, one need not fear that one might be unable to take the correct value, since the person who composed these tables always begins the west in the same way. I say again that it is not necessary for us to know where these ones or those ones begin the west. But if we wish to make tables according to the longitude of our city, let us use rings to ascertain the positions of all planets at our meridian, and this way we will know how to put the radices of the mean motions in our tables, and thereupon know the distance of any two cities through lunar eclipses.

And I believe that this is how Azarquiel composed his tables. For he saw from the hours of eclipses that were seen in Toledo and were computed to occur from tables for Arin that Toledo was at a distance of 4 hours and one tenth of an hour from Arin, that is to say, [at a distance] of 61½ degrees of the equator. And so, if Arin is in the middle of the world, it would necessarily follow that Toledo is 28½ degrees from the west. For if you take 61½ degrees away from a quarter circle, 28½ degrees will remain. I do not believe that Azarquiel would have investigated the distance of Toledo from the west in any other way. But if he had not based himself on tables for Arin, but instead a student or companion of his had gone to the Pillars of Hercules and had there seen the beginning and end of the same eclipse as did Azarquiel in Toledo, he would perhaps have assigned to Toledo a different longitude from the west.

[6] With regard to the sixth [question], you must know that 'Umar's work on nativities strikes me as very good, as are the *Judgments of the Arabs* on

interrogations as well as the *[Book of] Nine Judges*, but their wording is more difficult, for the sake of ornamentation.

[7] In response to the seventh [question], I say that it is better to position the stars on the astrolabe according to their location in the degrees of the signs of the ninth sphere than the eighth sphere, and that this will not cause the instrument to be less long-lasting, because after 100 we are able to imagine the stars as positioned in the subsequent degrees. And how does this affect us? If it is enough for 100 years, let somebody else think about the following ones. For how could we position the fixed stars according to the eighth sphere if the only way we can investigate their locations through any instrument is according to the ninth sphere? And if one perhaps positioned them [in this way], they would ascend more or less on the almucantars at noon and at the other hours than they do in this world. Let us therefore operate according to the ninth sphere, as did the ancient sages, lest we always be burdened by a great error in finding the hours or the ascendant and such things, seeing as judgments must by all means be made according to the ninth sphere, as has been said.

I transmit to you, however, a copy of a table of fixed stars that are to be placed on the astrolabe, which I have verified in Paris with the aid of rings. You will find a table of longitudes and latitudes of cities or regions in whatever place. One that has most [of the others] agreeing with it will be more reliable.

[8] When it comes to the Dog Days and also when spring, summer, autumn, and winter begin, one must here understand that those who composed the calendar examined when the seasons undergo a manifest change in the fourth climate—this is the middle of the climates, which is adjacent to the climate of "Diaromes", in which Rome is located and which derives its name from Rome—and placed [the seasons] in the calendar accordingly. But spring and summer and the other seasons begin earlier in the first climates and later in the ones that come after. I say the same with regard to the Dog Days.

But according to the astronomers and the celestial path [the Dog Days] begin when the Sun is the same degree as the dog named "Alhabor", which is currently in the fourth degree of Cancer, and they last through the second dog, namely, "Algomeysa", which is in the 14th degree of Cancer, and all the way through Leo, which is of the dog-kind, until the middle of Virgo, as this sign [*scil.* Leo] is fiery and choleric and the domicile of the Sun. And this is why not only choler but also the other humors are easily inflamed when the Sun stands in this sign, and this is especially true in a year when

Mars and the Sun are in aspect or in conjunction. Spring and summer and the other seasons, by contrast, start when the Sun enters the equinoxes and tropical signs.

The physicians, however, because they fear the sign of Leo, begin the Dog Days a little before Leo, namely, in the middle of Cancer or a little after it. And they claim that they last until the middle of Virgo, since Leo partly infects the preceding and subsequent signs. And this is true for hot regions. Yet in the seventh climate and in England, the weather is incited less in Leo than it is in hot regions when the Sun is in Aries.

The End

Commentary

Question 1

One of the fundamental decisions involved in the casting of horoscopes concerned which reference frame to use for the purpose of noting ecliptic longitudes. The choice here was between a sidereal reference frame, typically associated with the so-called eighth sphere, in which the point of reference for planetary longitudes was a fixed star, and a tropical reference frame, where longitudes were reckoned from the vernal equinox and plotted against the "ninth sphere" above the sphere of fixed stars. John of London alludes to this bifurcation at the beginning of his letter, where he asserts that all makers of astrological judgments [§3 *iudices astrorum*] known to him make sure to factor in the motion of the eighth sphere, such that their judgments are founded on longitudes in the ninth sphere.

His remark rings true insofar as most of the Latin horoscopes that have come down to us from the 12th and 13th centuries, and where it has been possible to determine their date and method of computation, presuppose the tropical frame of reference.[73] While a tradition of casting sidereal horoscopes certainly did exist in Latin Europe in the period in question [see Nothaft 2021b], none of the relevant examples exhibit any overt connection with Paris, where John himself was active. Open endorsements of sidereal astrology are instead found further afield, for instance in a letter written in Italy

[73] For studies of horoscopes from this period, see Lipton 1978, 209–222: North 1986, 96–107; 1987, 147–161; 1995: Poulle 1964a; 1987; 1999: de Callataÿ 2000: Boudet 2006, 74–82; 2008: Avelar 2014: Steel, Vanden Broecke, Juste, and Sela 2018, 92–95, 139–147, 237–239, 251–253.

by Campanus of Novara to the Dominican friar Ranerus of Todi at some point after 1269.[74] From the perspective of a 13th-century astrologer such as John or Campanus, the question of which reference frame to use was made all the more salient by the fact that the most widely available set of astronomical tables at the time were the so-called Toledan Tables, whose tables for planetary mean longitudes were based on a sidereal year.[75] The term required to convert these sidereal longitudes into tropical ones was known as the "equation of the eighth sphere", which users of the Toledan Tables could obtain from a set of tables for the so-called access and recess of the eighth sphere. They were based on a model of nonuniform, bidirectional precession commonly, if wrongly, attributed to Thābit ibn Qurra, the great Ṣābian mathematician and astronomer (d. 901). Latin readers could glean the details of this model from a treatise *De motu octave spere*, translated from Arabic in the 12th century, which was one of the most frequently copied astronomical works of the entire Latin Middle Ages.[76]

In his answer to R. de Guedingue's first question, John expresses certain misgivings about [Thābit]'s model. He begins by mentioning the opinion of the ninth-century astronomer al-Battānī, who allegedly rejected this model for involving "a great deception" [§5 *grande mendacium*]. What John appears to have had in mind here is the 52nd chapter of the canons accompanying al-Battānī's *Ṣābi' Zīj*, which is critical of an ancient theory of bidirectional

74 MS Florence, Biblioteca nazionale centrale, Conv. soppr. J.X.40, ff. 46v–56r (s. XV), at f. 53r:

> Loca nempe planetarum inveniuntur semper per proprias tabulas secundum relationem motus ipsorum ad signa mobilia, eo quod omnes planete secuntur motum octave spere in qua habent suas auges et suas sectiones et suas declinationes fixas que a suis locis in perpetuum non seperantur. Et propter istam causam puto quod in iudiciis non debent addi motus octave spere nec minui, sed debeant dari iudicia secundum dispositionem et situm quos habent in spera octava in quo sunt stelle fixe, a quibus magnam influentiam recipiunt ista inferiora et a quibus virtutes planetarum multum immutantur in fortitudine et debilitate.

75 FPedersen 2002; Chabás 2019, 47–75; Samsó 2020, 719–734.

76 For editions of the text, see Millás Vallicrosa 1945; Carmody 1960, 84–113. An English translation with a very useful commentary was published in Neugebauer 1962, 291–299. For recent accounts of the model and its origins, see RMercier 1996; Nothaft 2017, 211–216; Samsó 2020, 579–586. On the wide diffusion of *De motu octave spere*, see Burnett and Juste 2016, 69, which notes the existence of 110 manuscripts.

precession known from Theon of Alexandria's *Little Commentary* on Ptolemy's *Handy Tables*.[77] The heading of this chapter in the 12th-century Latin translation by Plato of Tivoli, *De motu* (or *De scientia*) *stellarum*, does indeed speak of a "great deception" that follows from the theory in question,

> De hoc quod imaginaverunt autores coelum ante et retro motum alterationis habere fatentur, et in eo quod ex illo grande mendacium sequitur [Albategnius, *De motu*. trans. Plato of Tivoli (ed. 1537, f. 80v)]

but John effectively misleads his reader by conflating al-Battānī's objections against the older model with his own doubts regarding the access and recess [Thābit]'s model.

What raised these doubts in John's case was the maximum value of the aforementioned "equation" of the eighth sphere, which is ±10;45° both in [Thābit]'s model and in the tables derived from it. In John's opinion, this value was not borne out by historical data, as available from Ptolemy's *Almagest*. According to this source, the total increase in stellar ecliptic longitudes from Hipparchus' observations in the second century BC to Ptolemy's own star catalog of the mid-second century AD had been 2;40° in 265 years.[78] John rounds this to 3° and adds another 16°, which he claims have accrued since Ptolemy's time, citing his own observations [§5]. His star table, which originally came as an appendix to the letter, agrees with this statement in a roundabout way, as many of its ecliptic longitudes are somewhere between 15° and 16° ahead of the values in Ptolemy's catalog. An increase of exactly 16° is implicit in John's recorded longitude of Arcturus (α Boo), which his table shows at 193° compared to Ptolemy's 177°.[79]

Contrary to what John sought to imply with his criticism, the access and recess of [Thābit]'s model and the Toledan Tables allowed for the stars to move not just 10;45°, but 2 × 0;45° = 21;30° in a single direction before the predicted reversal. Accordingly, the model was incompatible neither with the idea of a 16° shift since Ptolemy nor with a 19° shift since Hipparchus. As a matter of fact, the change in the equation of the eighth sphere that the Toledan Tables predicted between AD 140, the approximate epoch of Ptolemy's star catalog, and 1246, the year of reference of John's table, was approximately 16;3°, coming very close to the value mentioned in John's text. As John himself admitted, the model worked well for predictions of the

77 For a discussion and English translation of this chapter, see Ragep 1996.

78 Ptolemy, *Alm*. 7.2–3 [H13–16, 23] [trans. Toomer 1984, 328–329, 333].

79 FPedersen 2002, 4.1503; Ptolemy, *Alm*. 7.5 [trans. Toomer 1984, 347].

motion of the eighth sphere since the beginning of the Hijri era [§7 *initium annorum Arabum*], which was the epoch employed by the Toledan Tables. If he had projected the "access and recess" further into the past, he could have found that the same held true for predictions since the time of Ptolemy, or even since that of Hipparchus [see Nothaft 2017, 216–217].

Be that as it may, John was not wrong to write that the access and recess model was going to fail perceptibly "after many years" [§7 *post multos annos*]. By the end of the 13th century, Parisian astronomers had indeed detected that the predicted "equation" of the eighth sphere was off by approximately 1°—a consequence of the fact that the model made the rate of precession slow down before reversing direction [Nothaft 2017, 218–227]. John's answer to R. de Guedingue suggests that he instead favored al-Battānī's position, as expressed in the aforementioned 52nd chapter of the *Ṣābi' Zīj*. According to al-Battānī, what the available observational evidence suggested was not a periodic reversal in the direction of precession, but rather an acceleration of its rate, from $1°/100^y$ between Hipparchus and Ptolemy to $1°/66^y$ between Ptolemy and his own day. Al-Battānī himself had been on the fence as to whether this acceleration was the result of some instrumental error and, therefore, merely apparent or indicative of a hidden motion in the heavens that it would take many centuries to uncover [Ragep 1996, 284–291].

While John does not express his own position very clearly, it appears that he gravitated toward the first of these possibilities, which implies a steady rate of precession. This much seems to follow from his recommendation to compute the actual rate of precession [§10 *motus octave spere*] by dividing the years between Hipparchus and 1246 by the observed increase in stellar longitudes. John only describes this operation in general terms, without providing the results of such a calculation, perhaps because he wished to leave R. de Guedingue with a puzzle to solve. Accepting that there were $1246 - 140 = 1106$ years between Ptolemy's star catalog and John's Parisian star table as well as another 265 years between Hipparchus and Ptolemy, his stated total increase of 19° would imply an approximate average rate of $1°/72^y$ ($1371 \div 19 = 72.157\ldots$). The agreement with the modern value is excellent, if somewhat accidental.

Question 2

Another technical bifurcation a medieval astrologer was likely to be confronted with was that between unequal hours, which changed their length with the seasons, and equal or equinoctial hours, which remained uniform, being ¹⁄₂₄th of a diurnal revolution. Astronomical calculations naturally relied on the latter type of hours, whereas most timekeeping methods available in the medieval world measured time in seasonal hours. One of the preliminary steps in casting a horoscope accordingly was to convert the measured time into equal hours before one could proceed to compute the positions of the planets. While horoscopic charts typically stated the equal hours and their fractions for which they had been cast, another piece of information they could contain was the current "planetary hour", which was derived from an ancient doctrine according to which each individual hour of a day and night was ruled by one of the seven planets.[80]

The scheme of planetary hours was widely known in 13th-century Europe, to the extent that it was even addressed in computistical works such as the *Compotus* written earlier in the century by Robert Grosseteste (1217/29).[81] An influential astrological text in which this scheme received an in-depth discussion was the *Liber introductorius* of Abū Maʿshar [or Albumasar, 787–886]. More so than other sources, Abū Maʿshar made it perfectly explicit that the planetary hours were unequal hours, which guaranteed that the change from day to night, and *vice versa*, always coincided with a change of the ruling planet.[82] R. de Guedingue appears to have shown some uncertainty on this point, which is why John uses Abū Maʿshar's authority to assure him that all astrologers treat the planetary hours as unequal.

Question 3

The third question that John of London received from R. de Guedingue concerned the ancient astrological doctrine known as the projection or casting of rays (Arabic: *maṭraḥ al-shuʿāʿāt*), according to which each planet emits its rays in seven directions corresponding to the principal aspects—sextile (60°, 300°), quartile (90°, 270°), trine (120°, 240°), and opposition (180°).[83] Locating these rays on the ecliptic was a relatively trivial task as long as the aspects were also measured on the ecliptic and the planet was presumed to have no latitude. John outs himself as a follower of this simple method,

80 On the ancient background, see Bultrighini and Stern 2021.

81 Robert Grosseteste, *Comp.* c. 3 [Lohr and Nothaft 2019, 76–78.15–34].

82 Albumasar, *Liber intro.* trans. John of Seville, tr. 6, diff. 33 [Lemay 1995–1996, 5.269–270]; trans. Hermann of Carinthia, lib. 6, c. 33 [Lemay 1995–1996, 8.125]. See also Alcabitius, *Intro.* trans. John of Seville, diff. 2.49 [Burnett, Yamamoto, and Yano 2004, 293–294].

83 See Samsó and Berrani 1999, 302–306; Casulleras and Hogendijk 2012, 40–41, 62–79; Samsó 2020, 283–291.

which required no more than the ability to add or subtract an integer number of signs from the present longitude of the planet [§16].

Calculating the projection of rays in this way relieved John of having to understand any of the computational tables dedicated to the projection of rays. Islamic astrologers had constructed voluminous sets of tables for this purpose, two of which were available to their Latin counterparts owing to their inclusion in the Toledan Tables and in Maslama al-Majrīṭī's recension of the astronomical tables of al-Khwārizmī. Both sets have in common that they compute the directions of the rays as a function of the ascendant degree at a specific geographic latitude and that the underlying method places the regular polygons that determine the planetary aspects not on the ecliptic but on the celestial equator.[84] R. de Guedingue was presumably interested in adapting such a table to a northern European latitude but understandably found the principles by which they had been computed wholly opaque, which appears to have prompted his question to John of London.

Question 4

The fourth question revolves around domification, that is, the problem of dividing the ecliptic into 12 houses for the purpose of drawing up a horoscopic chart. It was evidently occasioned by the existence of different systems or approaches to domification known to Arabic astrologers and transmitted to the Latin world via translations.[85] John here recommends what amounts to the standard method in medieval astrology, which he believed to go back to Ptolemy. It divides the ecliptic into four arcs determined by the meridian and horizon line and further subdivides their projections onto the celestial equator into three segments of equal size. In effect, each of these segments will correspond to the right ascension in two diurnal or nocturnal hours. Besides being easily applied with the aid of an astrolabe, this method—as John knew [§20]—also underpinned most computational tables made for the purpose of domification, including those commonly included among the Toledan Tables [FPedersen 2002, 3.1075–1108 (BH11–12)].

John was aware of at least one alternative method of domification, which John D. North has dubbed the "prime vertical method" [North 1986, 27–40; Samsó 2020, 262–267]. The great circle to be divided into 12 arcs

[84] For Maslama's recension of al-Khwārizmī, see Suter 1914, 206–229 (tab. 91–114). For the Toledan Tables, see FPedersen 2002, 4.1520–1529 (NA11–12). For discussions of these tables, see Kennedy and Krikorian-Preisler 1972; Hogendijk 1989.

[85] On the background, see North 1986, 1–69; Samsó 2020, 257–273.

of equal size is here not the celestial equator but the circle perpendicular to the meridian, known as the “prime vertical”—or what John of London calls the *azimuth orientalis et occidentalis* [§22]. To project these arcs onto the ecliptic, one draws circles (so-called horizons) that pass through the boundaries between them as well as the north and south points of the horizon. John is only the second identifiable Latin author to make any mention of this method, which appears to have been the invention of Islamic astrologers. Prior to his letter, it had received a brief description in *De quatuor partibus iudiciorum astronomie*, an astrological textbook written by Roger of Hereford (*fl.* 1176).[86] John considered it a deviant method that had to be rejected, not least because it made the sizes of the individual houses vary to a much greater extent than the standard method [§§22–23]. His opinion no doubt conformed to the mainstream of astrological opinion. So far, no Latin horoscope from the Middle Ages that uses the prime vertical method has been identified.

Question 5

Sets of astronomical computational tables were typically accompanied by extensive lists of the geographic longitudes and latitudes of various cities and regions.[87] One of their purposes, at least in theory, was to enable users to adapt the tables contained in these sets to localities other than the meridian or latitude for which they had been computed. In such geographic lists, the longitudes were normally reckoned from a meridian located somewhere to the west of the inhabited world. This usage went back to Ptolemy, who had designated for this purpose a meridian through the western extremity of the Fortunate Islands. Islamic astronomers and geographers later introduced other prime meridians that were located even farther west.[88]

For Latin astronomers, this multiplicity of conventions was a potential source of confusion, especially in cases where the same table or source mingled together longitudes taken from different traditions.[89] Such was the

[86] See MS Oxford, Bodleian Library, Selden supra 76, f. 4v (s. XIII$^{2/2}$), which is quoted and discussed in North 1986, 39. The relevant passage appears separately in two mid-13th-century manuscripts in the vicinity of canons for the Toledan Tables. See rule CaCo1 edited in FPedersen 2002, 1.320.

[87] On the background, see Wright 1923; Laguarda Trías 1990; Chabás and Goldstein 2012, 201–203.

[88] Comes 1992–1994; 2000: EMercier 2020; 2020–2021: Samsó 2020, 703–708.

[89] On this point, see Wright 1923, 91–97.

case with the Toledan Tables, where the standard list of geographical coordinates assigned to Toledo a longitude of 11° [FPedersen 2002, 4.1509–1518 (MA11–13)]. The associated canons implied a different value, insofar as they located Toledo 61;30° or 4;6^h to the west of the city of Arin. This city, which can be identified with Ujjain in India, was thought to be located on the equator and in the middle of the inhabited world. It provided the meridian of reference for al-Khwārizmī's tables, which were one of the main sources underlying the Toledan Tables. If Arin was situated in the middle of an *oikumene* that extended over 180°, as was expressly assumed in the Toledan canons, a longitudinal difference of 61;30° from Arin entailed that Toledo was positioned 28;30° to the east of the western edge of the world.[90]

John's answer to question 5 reflects his familiarity with the relevant passage in the Toledan canons, which he considered to have been authored by the Andalusian mathematician and astronomer Ibn al-Zarqālluh (d. 1100) or Arzachel.[91] He correctly inferred from it the most probable way in which the difference of 61;30° between Toledo and Arin had been determined, namely, by comparing the time of an eclipse observed at Toledo with the time computed from astronomical tables for the meridian of Arin (i.e., from al-Khwārizmī's tables). As John himself seems to have realized, the reliability of this method was subject to a certain measure of doubt, as there was no firm guarantee that the tables for Arin predicted the time of the eclipse at this location with full accuracy. Had Ibn al-Zarqālluh chosen a purely empirical approach by comparing eclipse times observed both in Toledo and at the location of the western prime meridian, the result may well have been different [§§29–34].

In line with a convention followed by Latin astronomers since the 12th century, John identified the western prime meridian that sprang from this method with the Pillars of Hercules, or Gades Herculis. Writers familiar with this expression sometimes also used "Gades Alexandri" to refer to the eastern extreme, located 90° east of Arin—or 180° east of the Pillars of Hercules.[92] In John's estimation, the Gades Herculis were located on the

90 See canons Ca82, 90 and Cb133 in FPedersen 2002, 1.250–251, 1.254–255, 2.430–431. For Arin in the tables of al-Khwārizmī, see *Ezich Elkaurezmi*, trans. Adelard of Bath [Suter 1914, 1].

91 On the attribution of the Toledan canons (specifically canons Cb) to Ibn al-Zarqālluh, see FPedersen 2002, 2.333–334.

92 See, e.g., *Investigantibus astronomiam primo sciendum...*, Jn28–29 [FPedersen 1990, 229]; [Gerard of Cremona], *Theorica planetarum* §106 [Carmody 1942, 45]; Robert

westernmost island found in the western ocean. By contrast, the table that put Toledo at 11° used a reference point corresponding to the eastern shore of the same ocean [§26].

John reassured his addressee that the existence of two different western prime meridians was not a major cause of concern, as one could trust that the compilers of such tables would use the same reference point throughout [§ 27]. That such rigor did not always prevail in actual practice may be seen from the tabular list of coordinates in MS Paris, Bibliothèque de l'Arsenal, 1128, f. 28v (s. XIII/XIV), which accompanies a set of astronomical tables for Ferrara. The list here consists of three columns, of which the first two correspond very closely to the standard Toledan coordinate table. The third by contrast, offers an independent set of coordinates, taken from a source yet to be identified. In cases where this column features place names also included in the Toledan coordinate table, the longitudes are drastically increased, mostly by 17;30°. This increase corresponds to the precise difference between the two common values for the longitude of Toledo, 28;30° and 11°, both of which appear in this list. As is clear from a comment added below the three columns, the compiler responsible was unaware that the discrepancies between them were mostly just a matter of different prime meridians. Instead, he assumed that the higher longitudinal values in the third column, which he took from an unidentified table, were more reliable than the lower ones. His main reason for believing so was that the longitude of Toledo cited in this source agreed with the canons to the Toledan Tables.[93]

of Northampton, *Diversi astrologi...* (MS Oxford, Bodleian Library, Savile 21, f. 43r); *Notandum quod VII sunt puncta...* (MS Cambridge, University Library, Kk.1.1, f. 141r–v); *Circulus solis dicitur esse eccentricus...* (MS Cambridge, University Library, Kk.1.1, ff. 193r, 194r); *Motuum Solis alius est medius...* (MS Toledo, Archivo y Biblioteca Capítulares, 98–22, fol. 1va); and *Nostri temporis astronomici...* (MS Leipzig, Universitätsbibliothek, 1487, f. 55r). See also Gautier Dalché 2000, 422–424.

[93] MS Paris, Bibliothèque de l'Arsenal, 1128, f. 28v:

> Inveni quamdam tabulam civitatum, latitudines quarum quasi cum istis concordabant, sed longitudines civitatum eiusdem tabule erant maiores istis istarum duarum tabularum, scilicet prime et secunde. Tertia vero istarum extracta fuit de illa quam inveni. Unde concordat cum ea. Erat enim maiores longitudines istis per 17 gradus et dimidum. Et credo tertie tabule magis quam primis duabus, quia concordat cum canone de Aym et Toleto.

John returns to the subject of coordinates very briefly at the end of his answer to question 7. There he remarks on the ubiquity of geographic coordinate lists among sets of astronomical tables and offers a simple heuristic to determine whether a given list of coordinates is reliable, based on the agreement between different copies [§§43–44].

Question 6

From John's answer to the sixth question, it appears that R. de Guedingue had previously asked his opinion of certain astrological texts translated from Arabic into Latin. The first text mentioned in this part of the letter is a treatise on the interpretation of nativity horoscopes by the Persian astrologer ʿUmar ibn al-Farrukhān al-Ṭabarī (*fl.* 762–812), which had been translated by John of Seville in the first half of the 12th century [Juste 2016, 190]. The other two texts belong to a specialist branch of horoscopic astrology known to medieval readers as "interrogations" (*interrogationes*). One is the *De interrogationibus* of Zael (Sahl ibn Bishr, *ca* 786–*ca* 845), which also went by the name "Iudicia Arabum". This, too, was translated by John of Seville, being part of a cohesive corpus of five astrological treatises by Zael.[94] The third text mentioned by John is the *Liber novem iudicum*, a 12th-century compilation based mostly on Latin translations of different Arabic and Greek authorities.[95]

Question 7

Question 7 can be regarded as a sequel to question 1 in that it once again revolves around the choice between the two different reference frames for measuring ecliptic longitudes. One potential advantage of maintaining a sidereal reference frame was that the fixed stars retained their longitudes in perpetuity, whereas their longitudes in the ninth sphere shifted over time due to precession. For star pointers located on the rete of an astrolabe, this shift entailed that they were going to remain in an accurate position only for a limited period of time. R. de Guedingue appears to have been sufficiently worried by this prospect to consider the possibility of keeping these pointers permanently fixed, by using sidereal longitudes.

Having been queried on this point, John comes down firmly in favor of the established practice of equipping astrolabes with tropical star coordinates.

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[94] Juste 2016, 186. The alternative name "Iudicia Arabum" is attested in *Speculum astronomiae* c. 9 [Zambelli 1992, 236.20–21]: "Et liber *De interrogationibus* Zahel Israelitae, quem vocant *Iudicia Arabum*".

[95] Juste 2016, 189. See also Burnett 2006, 99–118; 2015.

This was a logical stance to take, seeing as the principal function of an astrolabe was to simulate the diurnal revolution of the firmament with respect to a given horizon. While sidereal stellar positions remained fixed in an ecliptic coordinate system that used the eighth sphere as its reference frame, the same was true neither in an equatorial coordinate system nor in a horizontal system, as defined by the astrolabe's almucantars (circles of equal altitude) and azimuths. John alludes to this fact when he reminds his addressee that placing the stars on the rete according to the eighth sphere would mean that, over time, their meridian altitude as shown on the astrolabe would end up smaller or greater than their actual altitude [§40].

Another argument that John provides in favor of the conventional practice is that any empirical measurement of stellar longitudes will necessarily be based on their position in the ninth sphere [§39]. His claim that this is the only possible approach, while not entirely correct, reflects a commitment to the Ptolemaic order of investing celestial coordinates, as laid out in the *Almagest*. For Ptolemy, the fundamental parameter of astronomy was the tropical solar year, such that the positions of all other celestial objects, including the fixed stars, were ultimately measured in relation to the tropical longitude of the Sun. In plotting the ecliptic longitudes of the fixed stars, Ptolemy's method was to start from a reference star whose ecliptic longitude he had previously inferred from the position of the Moon, which in turn depended on the known solar position.[96] His instrument of choice in this context was the armillary instrument, or *astrolabon* [Duke 2020, 250–252; Nothaft 2021a], which is clearly what John had in mind when speaking, later in this same passage, of his act of verifying stellar coordinates *per armillas* [§42]. Indeed, the *instrumentum armillarum* is also commonly mentioned in manuscript headings to John's star table [see pp. 4–6 above].

Responding to his correspondent's worries that tropical star pointers will lose their validity over time, John reassures him that this deterioration is much too slow to pose a serious problem [§§36–38]. Perhaps for rhetorical reasons, he here refers to Ptolemy's slow precession rate of $1°/100^{y}$ rather than the quicker rate that would follow from the data mentioned in his response to question 1.

Question 8

The final issues John addresses in his letter are the dates of the so-called Dog Days (*dies caniculares*), a period associated with the hottest days of

[96] See Ptolemy, *Alm.* 7.4 [trans. Toomer 1984, 339].

the summer, as well as the calendrical beginnings of the four seasons. In medieval medical lore, the four seasons were deemed a useful parameter for predicting changes in the four humors contained in the human body, which in turn called for adjustments to one's dietary, hygienic, and bloodletting practices.[97] The entries found in medieval calendars (*kalendaria*) typically distinguish the beginnings of these seasons from the corresponding astronomical turning points, namely, the equinoxes and solstices. Among the sources underpinning this distinction was Isidore of Seville, according to whom the seasons each originated a month ahead of their respective equinox or solstice: spring on 22 February, summer on 24 May, autumn on 23 August, winter on 25 November.[98] A different set of seasonal beginnings had been inherited from Pliny, according to whom the climatic seasons began even earlier, on 8 February, 10 May, 11 August, and 11 November.[99] A schematic variant of Pliny's dates, in which each season began on the seventh day before the ides (7 February, 9 May, 7 August, and 7 November) became widely known through Bede's *De temporum ratione* (725).[100] Unable to decide between these conflicting traditions, early and high-medieval scribes often included two sets of dates (Isidoran and Plinian) in their *kalendaria*.[101]

An attempt to discern some sort of rationale behind the calendrical beginnings of the four seasons was made by Robert Grosseteste in his treatise on the *Compotus*, which he probably wrote in Paris [see p. 25 above]. According to Grosseteste, these beginnings were noted by physicians as corresponding to the time when the action of the Sun altered the complexions predominating in nature—as defined by the admixtures of the primal qualities of heat,

97 A classic source in this regard is the pseudo-Hippocratic letter *Ad Antigonum regem*, which was influentially cited in Bede, *De temp. rat*. c. 30 [Jones 1943, 235–236].

98 Isidore of Seville, *De nat. rer*. 7.5 [Fontaine 1960, 203].

99 Pliny, *Nat. hist*. 2.122–125 [Rackham 1938, 262–266].

100 Bede, *De temp. rat*. c. 35 [Jones 1943, 248.35–45]. The same convention previously appeared in *De rat. conp*. c. 50 [Walsh and Ó Cróinín 1988, 160.4–6].

101 See Borst 2001, 547 (3 Feb), 552 (5 Feb), 555 (6 Feb), 558 (7 Feb), 562 (8 Feb), 565 (9 Feb), 592 (18 Feb), 599 (21 Feb), 602 (22 Feb), 606 (23 Feb), 859 (5 May), 868 (8 May), 871 (9 May), 879 (11 May), 906 (21 May), 909 (22 May), 912 (23 May), 914 (24 May), 917 (25 May), 1169 (6 Aug), 1173 (7 Aug), 1180 (9 Aug), 1183 (10 Aug), 1212 (21 Aug), 1214 (22 Aug), 1217 (23 Aug), 1224 (25 Aug), 1471 (6 Nov), 1474 (7 Nov), 1477 (8 Nov), 1507 (19 Nov), 1514 (22 Nov), 1517 (23 Nov), 1521 (24 Nov), 1524 (25 Nov).

cold, dryness, and moisture. He also emphasized that the dates of these seasonal turnovers necessarily vary with geographic latitude, as seen from the fact that southern regions have an earlier onset of seasonal heat and northern regions an earlier onset of cold and wetness. This being the case, it stood to reason that the beginnings conventionally recorded in calendars were meant to apply only to one of the seven known climates (climes) or bands of latitude. Grosseteste speculated that the intended climate of reference was the most temperate out of the seven, namely, the fourth.[102]

John follows this reasoning rather closely, making it seem likely that he knew the relevant chapter in Grosseteste's *Compotus*. He points out that the fourth climate occupies the middle of the seven known climates and that it is adjacent to a climate named "Diaromes" owing to its including the city of Rome. He could have taken this information from another Parisian text, John of Sacrobosco's *Tractatus de spera*, which reports the names "Diarhodos" and "Diaromes" for the fourth and fifth climates, respectively, and assigns to their centers latitudes of 36;24° and 41;20°, respectively.[103] If the dates recorded in calendars are valid only for the fourth climate, it follows by implication that the other six climates will have the individual seasons begin significantly earlier or later [§§45–46].

John took a similar view with regard to the Dog Days, which were widely held to pose certain health hazards besides being unsuitable for bloodletting.[104] These days owed their name to the Dog Star, or Sirius, in the constellation of Canis Major (α CMa). John also knew this star by its Arabic name, "Alhabor", which is how it appears in his star list of 1246. His claim in the letter, according to which Alhabor is currently found in the fourth degree of the sign of Cancer [§48], is not inconsistent with its position in the list, which is 3° Cancer and thus the beginning of the fourth degree [FPedersen 2002, 4.1503]. Even though the Dog Days were classically tied to the heliacal rising of the star in question, John attributes to the astronomers a different convention, according to which the Dog Days begin when the Sun is in conjunction with Alhabor [§48]. In John's time, this would have occurred around 18/19 June. A second star with canine associations was Procyon in Canis Minor (α CMi), which John knew as Algomeysa. His list

102 Robert Grosseteste, *Comp.* c. 2 [Lohr and Nothaft 2019, 68.2–20]. On the concept of climates in antiquity and the Middle Ages, see Honigmann 1929.

103 John of Sacrobosco, *Tract. de spera* c. 3 [Thorndike 1949, 112].

104 On the Dog Days, see Chardonnens 2007, 154–156, 270–289, 564.

of 1246 gives its ecliptic longitude as 14° Cancer [FPedersen 2002, 4.1503], while in his letter John speaks of the "14th degree" of Cancer [§48]. In his time, the Sun reached this position on 29/30 June.

From a medico-astrological perspective, the potential dangers posed by the Dog Days were mostly related to the Sun's presence in the sign of Leo, which had a hot and dry, and, hence, choleric, complexion. Together with the fact that Leo was the astrological domicile of the Sun, this meant that the Sun was capable of greatly exciting the bodily humors as it journeyed through this sign.[105] These effects could be reinforced by a conjunction of the Sun with Mars, or certain aspects relative to this planet, which according to Ptolemy partook of the Sun's dry and fiery nature.[106] Upon giving a succinct summary of these ideas [§§47–49], John states that physicians tend to define the Dog Days as beginning near the middle of Cancer and ending in mid-Virgo, since they believe that Leo's effects can extend to the neighboring signs [§50]. In the mid-13th century, this range of zodiacal positions would have corresponded approximately to the months of July and August.[107]

John concludes his letter with a reminder that medical claims about the dangerous heat generated or experienced during the Dog Days held true mainly in the most southern climates. They rarely had an acute relevance in the seventh and northernmost climate (which included Paris), let alone in England, which was located outside the seven traditional climates [§51].[108]

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105 For a 12th-century source transmitting this view, see [Bede], *De mundi caelestis terrestrisque constitutione* 1.4.13 [Pradel-Baquerre, Biasi, Gévaudan 2016, 110].

106 Ptolemy, *Quad.* 1.4, trans. Plato of Tivoli [ed. 1493, f. 12ra].

107 There was no universally agreed upon convention as to the precise date range of the Dog Days, although a relatively common pair of dates in medieval sources was 14 July and 5 September. See Chardonnens 2007, 564; Borst 2001, 1063 (6 Jul), 1081 (12 Jul), 1084 (13 Jul), 1087 (14 Jul), 1090 (15 Jul), 1099 (18 Jul), 1202 (17 Aug), 1269 (5 Sep), 1272 (6 Sep), 1285 (11 Sep).

108 According to John of Sacrobosco [see p. 32 n101], the seventh climate only reaches up to a latitude of 50;30°.

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