A Third Latin Translation of Ibn al-Ṣaffār's Treatise on the Uses of the Astrolabe*

C. Philipp E. Nothaft
All Souls College, Oxford

Abstract

This article addresses the contents of the twelfth-century fascicle contained in MS Lyon, Palais des Arts, 45, which is largely devoted to texts on *computus* and the astrolabe. Included among the latter are 24 anonymous chapters on astrolabe use, which appear to stem from a previously unrecorded translation of Ibn al-Ṣaffār's *Kitāb fī-l-ʿamal bi-l-asṭurlāb* (*Book on the Uses of the Astrolabe*). This would make the chapters in the Lyon manuscript the third such translation to come to light after the well-known twelfth-century translations by John of Seville and Plato of Tivoli. The article includes an edition of the text in question as well as two further appendices providing a breakdown of its content as well as a description of the Lyon fascicle.

Key Words

Astrolabe; Arabic-to-Latin translation; Ibn al-Ṣaffār; John of Seville; Plato of Tivoli

MS Lyon, Palais des Arts, 45 (hereafter abbreviated as *L*) is a mathematical and scientific composite manuscript whose individual fascicles range widely in terms of their period of origin, from the late twelfth to the beginning of the sixteenth century (and including every century in between). The twelfth-century part appears on folios 118r–156v, which is itself a miscellany assembled from numerous different sources, most of them dealing with the astrolabe or with topics belonging to the wider ambit of *computus* (see Appendix A below for a list of contents).[1]

* The research leading to these results has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Sklodowska-Curie grant agreement No 894940.

1 The published descriptions of this manuscript do not give an adequate picture of the content of fol. 118r–156v. See *Catalogue général des manuscrits des bibliothèques publiques de France:*

Among the works that are here reproduced in their entirety are Hermann of Reichenau's *De mensura astrolabii* (fol. 124va–128rb) and the Venerable Bede's *De natura rerum* (fol. 149ra–155ra). The latter receives an extension in the form of several chapters drawn from Helperic of Grandval's *Liber de computo* (fol. 155ra–156vb), which continue until the end of the fascicle. They correspond to chapters 18 to 21 in the eighteenth-century edition by Bernhard Pez[2] and are followed by another rubricated heading, *Qualiter equinoctia et solsticia oculis deprehendantur* (fol. 156vb), which matches the content of chapter 31.[3] No text belonging to this heading appears below it. Instead, it is accompanied by a contemporary note informing us that the remainder of the present book is in the possession of a certain Peter of Chartres and that it contains some disputation or polemic regarding astrology: *Petrus de Carnoto habet residuum istius libri, in quo decertabatur de iudiciis*. The *residuum istius libri* can here hardly refer to Helperic's text, but would rather seem to suggest that *L*'s twelfth-century fascicle was separated early on from a more voluminous codex.

The single largest item in the surviving part of this codex is an anonymous translation of the so-called *Calendar of Córdoba*, which is also known from five other manuscripts.[4] One of these is MS Berlin, Staatsbibliothek, lat. qu. 198, fol. 135v–

Départements, vol. 31, Librairie Plon, Paris 1898, p. 17–19; Dieter Blume, Mechthild Haffner, Wolfgang Metzger, *Sternbilder des Mittelalters: Der gemalte Himmel zwischen Wissenschaft und Phantasie*, vol. II: *1200–1500*, de Gruyter, Berlin 2016, p. 470–474.

2 Helperic of Grandval, *Liber de computo*, c. 18–21, in Bernhard Pez, *Thesaurus anecdotorum novissimus*, vol. II, Augsburg: Veith, 1721, pt. 2, col. 200–206; repr. in *Patrologia latina*, vol. CXXXVII, Migne, Paris, 1853, col. 32C–36C.

3 The heading in Pez's edition is *De Aequinoctiis, & Solsticiis, qualiter etiam corporali intuitu deprehendantur, & de ascensu, & descensu Solis*. See Helperic of Grandval, *Liber de computo*, ed. Pez, pt. 2, col. 212 = *Patrologia latina*, vol. CXXXVII, col. 40.

4 MSS Berlin, Staatsbibliothek, lat. qu. 198, fol. 135v–143v (*c.* 1132); Madrid, Biblioteca nacional de España, 6036, fol. 38r–45v (s. XIV); Vatican City, Biblioteca Apostolica Vaticana, Reg. lat. 596, fol. 36r–45v (s. XII$^{1/2}$); Vich, Museo Episcopal, 167, fol. 1r–8r (*c.* 1235); Vienna, Österreichische Nationalbibliothek, 2462, fol. 27r–72v (s. XII). The copies in Madrid and Vich were used for the edition in José Martínez Gázquez, Julio Samsó, « Una nueva traducción latina del calendario de Cordoba (siglo XIII) », in Juan Vernet (ed.), *Textos y estudios sobre astronomía española en el siglo XIII*, Facultad de Filosofía y Letras, Universidad Autónoma de Barcelona, Barcelona 1981, p. 9–78. For discussions of the content and background to the *Calendar of Córdoba*, see José Martínez Gázquez, « Santoral del calendario del s. XIII contenido en el *Liber Regius* del Museo Episcopal de Vic », *Revista Catalana de Teología*, 6 (1981), p. 161–174; Id., « ¿Una nueva traducción latina del calendario de Córdoba del 961 en un manuscrito del siglo XIII? », in *Unidad y pluralidad en el mundo antiguo: actas del VI Congreso Español de Estudios Clásicos (Sevilla, 6-11 de abril de 1981)*, vol. II, Editorial Gredoes, Madrid, 1983, p. 373–379; Id., « *Dicunt experimentatores / Dicunt qui experimento locuti sunt*: l'expérience dans les indications du calendrier de Cordoue (10^{e} siècle) », in Thomas Bénatouïl, Isabelle Draelants (eds.), Expertus sum: *l'expérience par les sens dans la philosophie naturelle médiévale; actes du colloque international de Pont-à-Mousson (5–7 février 2009)*, SISMEL—Edizioni del Galluzzo, Florence 2011 (Micrologus' Library, 40), p. 239–255; Julio Samsó, « Sobre los materiales

143v, a codex written in Southern France in *c.* 1132.[5] This confirms that the version of the *Calendar* preserved in these manuscripts must be significantly earlier than the translation by Gerard of Cremona (1114–1187), known as *Liber Anoe* (from *Kitāb al-anwāʾ*), seeing as Gerard's activity as a translator of Arabic texts only sets in towards the middle of the century.[6] Charles Burnett, in an unpublished talk delivered in 2017, has suggested the possibility of a tenth-century Catalonian origin of the anonymous translation, while also noting that the saints recorded in *L*'s recension of the *Calendar* indicate a connection with the diocese of Angers.[7]

astronómicos en el 'Calendario de Córdoba' y en su versión latina del siglo XIII », in Juan Vernet (ed.), *Nuevos estudios sobre astronomía española en el siglo de Alfonso X*, CSIC, Barcelona, 1983, p. 125–138; Id., *On Both Sides of the Strait of Gibraltar: Studies in the History of Medieval Astronomy in the Iberian Peninsula and the Maghrib*, Brill, Leiden 2020 (Handbook of Oriental Studies, Section One, 144), p. 51–52, 684–686; Julio Samsó, José Martínez Gázquez, « Algunas observaciones al texto del Calendario de Córdoba », *Al-Qanṭara*, 2 (1981), p. 319–344; Mercè Viladrich, « The *Mumtaḥan* Tradition in Al-Andalus: Analysis of Data from the *Calendar of Cordova* Related to the Entrance of the Sun in the Zodiacal Signs », in Josep Casulleras, Julio Samsó (eds.), *From Baghdad to Barcelona: Studies in the Islamic Exact Sciences in Honour of Prof. Juan Vernet*, vol. I, Instituto Millás Vallicrosa de Historia de la Ciencia Árabe, Barcelona 1996, p. 253–265; Arno Borst, *Die karolingische Kalenderreform*, Hahnsche Buchhandlung, Hannover 1998 (Monumenta Germaniae Historica: Schriften, 46), p. 344–350; Stephen C. McCluskey, *Astronomies and Cultures in Early Medieval Europe*, Cambridge University Press, Cambridge 1998, p. 166–171; Miquel Forcada, « The *Kitāb al-anwāʾ* of ʿArīb b. Saʿīd and the *Calendar of Cordova* », in Menso Folkerts, Richard Lorch (eds.), *Sic Itur ad Astra: Studien zur Geschichte der Mathematik und Naturwissenschaften; Festschrift für den Arabisten Paul Kunitzsch zum 70. Geburtstag*, Harrassowitz, Wiesbaden 2000, p. 234–251; Ann Christys, *Christians in al-Andalus (711–1000)*, Routledge, Abingdon 2002, p. 108–134; José Manuel Fradejas Rueda, « *shadhāniqāt al-balansiyya* or *shadhāniqāt al-baḥriyya*: On the Arabic Text and the Latin Translations of the *Calendar of Cordova* », in Michèle Goyens, Pieter De Leemans, An Smets (eds.), *Science Translated: Latin and Vernacular Translations of Scientific Treatises in Medieval Europe*, Leuven University Press, Leuven 2008 (Mediaevalia Lovaniensia, Series I/Studia, 40), p. 59–72; Charles Burnett, « The Roads of Córdoba and Seville in the Transmission of Arabic Science in Western Europe », in Charles Burnett, Pedro Mantas-España (eds.), *Mapping Knowledge: Cross-Pollination in Late Antiquity and the Middle Ages*, CNERU / The Warburg Institute / Oriens Academic, Córdoba 2014 (Arabica Veritas, 1), p. 143–152 (148–150); Id., « Time, the *Liber floridus* and the Science of the Stars in the Twelfth Century », in Patrizia Carmassi (ed.), *Time and Science in the* Liber floridus *of Lambert of Saint-Omer*, Brepols, Turnhout 2021 (Les Études du RILMA , 13), p. 169–181 (174–175).

5 On this copy, see José Martínez Gázquez, « El texto del Calendario de Córdoba en el manuscrito Berlín lat. qu. 198 », in *Studia in honorem prof. M. de Riquer*, vol. IV, Quaderns Crema, Barcelona 1991, p. 657–668.

6 For Gerard of Cremona's Latin translation, the Arabic text, and a modern French translation of the latter, see *Le calendrier de Cordoue*, ed. Reinhart Dozy, Charles Pellat, Brill, Leiden 1961 (Medieval Iberian Peninsula: Texts and Studies, 1). On Gerard's life and works, see the contributions in Pierluigi Pizzamiglio (ed.), *Gerardo da Cremona*, Libreria del Convegno, Cremona 1992 (Annali della Biblioteca statale e libreria civica di Cremona, 41).

7 Charles Burnett, « New Manuscripts and Texts of the *Calendar of Cordoba* », paper read at the conference « Calendars in Antiquity and the Middle Ages », University College London, 5 July 2017. I am very grateful to Charles Burnett for sharing with me a copy of his script. On the

The Berlin copy omits the lengthy prologue that is associated with the calendar in other manuscripts, while *L* separates this prologue (fol. 123ra–124va) from the calendar proper (fol. 130v–142r) by a sequence of unrelated texts that include the aforementioned copy of Hermann of Reichenau's *De mensura astrolabii*. This placement of the prologue also drives a thematic wedge between Hermann's treatise on astrolabe construction and the preceding chapters on astrolabe use, which begin on 118r. Most of these chapters belong to an otherwise unattested text on astrolabe use, which is untitled and anonymous and starts with the words *Si vis scire altitudinem Solis in quacumque hora diei...* (fol. 118ra; see Appendices B and C below for a content-breakdown and edition). A very similar beginning (*Si vis scire altitudinem solis in omni...*) is recorded in the *Catalogue of Incipits* compiled by Thorndike and Kibre, in an entry that lumps the astrolabe section in the Lyon manuscript together with a treatise on the quadrant found in fourteenth-century manuscripts in Cambridge and Munich, which is unrelated.[8]

The chapters on astrolabe use in *L* span five leaves, from fol. 118ra to 122vb. Their sequence is interrupted towards the end by a series of excerpts (fol. 120va–121vb) taken from the earliest known Latin texts on the same subject,[9] commonly known as the *Sententie astrolabii* (late tenth century)[10] and *De utilitatibus astrolabii*

possibility of a Catalonian origin, see also Martínez Gázquez, Samsó, « Una nueva traducción », p. 52 (n. 210), 74 (n. 355); Samsó, Martínez Gázquez, « Algunas observaciones », p. 321; Martínez Gázquez, « ¿Una nueva traducción? », p. 375; Borst, *Die karolingische Kalenderreform*, p. 346. This hypothesis is treated sceptically in Fradejas Rueda, « *shadhāniqāt al-balansiyya* », p. 62–63.

8 Lynn Thorndike, Pearl Kibre, *A Catalogue of Incipits of Mediaeval Scientific Writings in Latin*, rev. edn, Mediaeval Academy of America, London 1963, col. 1473.

9 For an overview of Latin astrolabe literature written before 1100, see Paul Kunitzsch, « Glossar der arabischen Fachausdrücke in der mittelalterlichen europäischen Astrolabliteratur », *Nachrichten der Akademie der Wissenschaften in Göttingen*, phil.-hist. Kl., 1982/11, p. 455–571 (476–483). For studies of this literature, see José María Millás Vallicrosa, *Assaig d'història de les idees físiques i matemàtiques a la Catalunya medieval*, vol. I, Institució Patxot, Barcelona 1931 (Estudis Universitaris Catalans: Sèrie Monogràfica, 1); Werner Bergmann, *Innovationen im Quadrivium des 10. und 11. Jahrhunderts: Studien zur Einführung von Astrolab und Abakus im lateinischen Mittelalter*, Steiner, Stuttgart 1985 (Sudhoffs Archiv: Beihefte, 26); Arno Borst, *Astrolab und Klosterreform an der Jahrtausendwende*, Winter, Heidelberg 1989 (Sitzungsberichte der Heidelberger Akademie der Wissenschaften, phil.-hist. Kl., Jg. 1989, 1); Arianna Borrelli, *Aspects of the Astrolabe: 'Architectonica ratio' in Tenth- and Eleventh-Century Europe*, Steiner, Stuttgart 2008 (Sudhoffs Archiv: Beihefte, 57).

10 *Sententie astrolabii*, ed. Millás Vallicrosa, p. 275–288. For a different version of the text, edited from MS Bern, Burgerbibliothek, 196, fol. 1r–7r, 8r (s. XI$^{1/2}$) and accompanied by a German translation, see Martin Schramm, Carl-Philipp Albert Schütz, Michael Schütz, Martin Brunold, Martin Germann, « Der Astrolabtext aus der Handschrift Codex 196, Burgerbibliothek Bern—Spuren arabischer Wissenschaft im mittelalterlichen Abendland », *Zeitschrift für Geschichte der arabisch-islamischen Wissenschaften*, 17 (2006–2007), p. 199–300 (208–247, 258–259).

(*c.* 1000).[11] While these excerpts are distinguished from each other via rubricated chapter headings, the same is not true of the surrounding text, where the only heading that is marked as such via rubrication and placement in a separate line comes at the very beginning: *Titulus de altitudine Solis capienda* (fol. 118ra). The rest of the text is nevertheless clearly divided by visual markers, which show where a new paragraph or unit begins even in the absence of any line breaks or rubrication. Of the 30 or so sections thus marked, 14 have an opening line that must have originally been a separate heading, each beginning with the word *Titulus*. Such *Tituli* are also found at the head of the some of the chapters in the aforementioned *Sententie astrolabii*, where the word presumably translates the Arabic *bāb* ('door', 'entry', 'chapter').[12] Beyond this parallel use of *Titulus* and the shared subject matter, however, the similarities between the two texts are very modest.

Compared to early Latin works such as the *Sententie astrolabii*, the text in *L* is fairly sparing in its use of Arabic loan words. One frequently occurring example is *al-murī*, which refers to a pointer on the rete of the astrolabe for counting degrees on the outer scale. In ch. 6–11 (according to the chapter numbering used in Appendices B and C below), the term is transliterated consistently as *almari*, whereas other Latin texts tend to have either *almeri* or *almuri*.[13] Ch. 3–5, 7, 10, 13, and 15 make reference to *al-muqanṭarāt*, the curves of equal altitude on the horizon plate. While there is nothing unusual about the presence of the word itself, which is part of the standard vocabulary of medieval Latin astrolabe literature,[14] our text differs from most of this literature in transcribing *al-muqanṭarāt* as *almacantara* or (rarely) *almucantara* rather than *almucantarat* or *almucantarath* and declining it as if it were a Latin noun of the first declension.

---

[11] The text was edited in *Gerberti postea Silvestri II papae Opera Mathematica (972–1003)*, ed. Nicolaus Bubnov, Friedländer & Sohn, Berlin 1899, p. 114–147. For a bibliography and list of manuscripts, see Marie-Hélène Jullien (ed.), *Clavis des auteurs du Moyen Âge: territoire français 735–987*, vol. III: *Faof – Hilduin*, Brepols, Turnhout 2010, p. 138–142. The attribution of this text to Gerbert of Aurillac, which was upheld in some of the earlier literature, is forcefully rejected by Patrick Gautier Dalché, « Le 'tuyau' de Gerbert, ou la légende savante de l'astronomie: origines, thèmes, échos contemporains (avec un appendice critique) », *Micrologus*, 21 (2013), p. 243–276 (256–275). The previous literature on this question is summarized in Marta Materni, « Attività scientifiche di Gerberto d'Aurillac », *Archivum Bobiense*, 29 (2007), p. 225–317 (274–282).

[12] *Sententie astrolabii*, ed. Millàs Vallicrosa, p. 281–283. Parts of this text were translated from an astrolabe treatise by al-Khwārizmī (ninth century). See Paul Kunitzsch, « Al-Khwārizmī as a Source for the *Sententie astrolabii* », in David A. King, George Saliba (eds.), *From Deferent to Equant: A Volume of Studies in the History of Science in the Ancient and Medieval Near East in Honor of E.S. Kennedy*, New York Academy of Sciences, New York 1987 (Annals of the New York Academy of Sciences, 500), p. 227–236. Another instance of this use of *titulus* is in Petrus Alfonsi's translation (*c.* 1116) of al-Khwārizmī's astronomical tables. See Otto Neugebauer, *The Astronomical Tables of Al-Khwārizmī*, Munksgaard, København 1962 (Det Kongelige Danske Videnskabernes Selskab, Historisk-filosofiske Skrifter, 4.2), p. 219, 221–222, 224.

[13] Occurrences of the term are documented in Kunitzsch, « Glossar », p. 538–539.

[14] See Kunitzsch, « Glossar », p. 535–538.

One other text where the term is handled grammatically in this way is an anonymous description of the parts of the astrolabe beginning *Cum hominum habitaciones equales sibi fore...*, the only known copy of which appears in the famous eleventh-century MS Barcelona, Archivo de la Corona de Aragón, Ripoll 225, fol. 68v–84v.[15] The word is here (at fol. 74r) transcribed as *almocantara*, but misapplied as the name of the east-west line on the backplate of the astrolabe. Another text uniquely preserved in the same manuscript is *De divisione igitur climatum que fit per almucantarath...* (fol. 98r–102v). It uses the term *almucantarath* in the familiar sense, but at one point reprises *almocantara* with the same meaning as in the earlier text.[16] That the two texts are not wholly unrelated is also clear from their mistaken uses of the words *tecuba* and *scat(h)aba*, which are both rare in Latin astrolabe literature. *Tecuba* transcribes the Arabic *ṯuqba* ('hole'), which normally refers to the openings in the centre of each sighting vane of the alidade, whereas the texts in the Ripoll manuscript apply it to the sighting vanes themselves. Conversely, the word *scatab(h)a*, from the standard Arabic term for the sighting vane, *aš-šaṭba*, is here wrongly applied to the openings.[17]

Ch. 1, 5, 16, and 24 of the 'use' text in *L* render *šaṭba* as *sadaba* – or *sabada*, via metathesis, as is the case in ch. 24 –, this time deploying it in the correct sense of 'sighting vane'. This makes this text only the fourth medieval Latin source identified so far to contain this Arabic expression.[18] Besides the two texts in the Ripoll manuscripts, there is also the singular occurrence of *assabata* in a Latin astrolabe treatise by the Jewish astrologer Abraham Ibn Ezra, which dates approximately from the middle of the twelfth century.[19] The presence of *sadaba* in

[15] See the transcriptions in Millás Vallicrosa, *Assaig*, p. 312, l. 145, 148; Kunitzsch, « Glossar », p. 536; Gemma Puigvert i Planagumà, *Astronomia i astrologia al monestir de Ripoll: edició i estudi dels manuscrits científics astronomicoastrològics del monestir de Santa Maria de Ripoll*, Universitat Autònoma de Barcelona, Servei de Publicacions, Barcelona 2000, p. 157. On the date and significance of this manuscript, see also Julio Samsó, « Cultura científica àrab i cultura científica llatina a la Catalunya altmedieval: el monestir de Ripoll i el naixement de la ciència catalana », in *Symposium Internacional sobre els orígens de Catalunya (segles VIII–IX)*, vol. I, Real Academia de Buenas Letras, Barcelona 1991 (Memorias de la Real Academia de Buenas Letras de Barcelona, 23), p. 253–269; Borrelli, *Aspects*, p. 85–86, 226.

[16] Millás Vallicrosa, *Assaig*, p. 321, l. 51; Puigvert i Planagumà, *Astronomia*, p. 167; Kunitzsch, « Glossar », p. 536, 553.

[17] As was noted by Kunitzsch, « Glossar », p. 480, 556, 558. See also the transcriptions of the relevant passages in Millás Vallicrosa, *Assaig*, p. 310, 321; Puigvert i Planagumà, *Astronomia*, p. 154–155, 167.

[18] For the other three occurrences, see Kunitzsch, « Glossar », p. 556, who additionally records two Castilian texts in the thirteenth-century *Libros del saber de astronomía* compiled for King Alfonso X.

[19] See the edition in José María Millás Vallicrosa, « Un nuevo tratado de astrolabio de R. Abraham Ibn ʿEzra », *Al-Andalus*, 5 (1940), p. 1–29 (9). On this text, see Id., « Sobre un 'Tratado de astrolabio' atribuído a R. Abraham Ibn ʿEzra », *Sefarad*, 4 (1944), p. 31–38; Josefina Rodríguez Arribas,

L can be taken as indicative of this text's terminological independence from the mainstream of Latin astrolabe literature, which is highlighted further by the way the astrolabe's alidade is referred to throughout as *ezada* in place of the much more familiar *alidada* (from *al-ʿiḍāda*).[20] We find the former term in ch. 1–2, 16, 20–24, but apparently nowhere else in the literature. Its origin is unclear.[21] It may be worth adding, however, that the expressions *sabacdarum* (from *sadaba* via *sabada*) and *ezada* are repeated in *L* on fol. 126v, in notes the main scribe added to Hermann of Reichenau's treatise on astrolabe construction:

> Sabacdarum foramina sunt foramina regule tabularum que etiam regula dicitur ezada et alchidada. [...] Sabacdarum. Ezada. Alchidada. Rete. Abancabuz. Volvellum. Walzachora. Almacantharath.

Rather than being plausibly derived from the *Sententie astrolabii* or any other part of the Latin astrolabe literature available before 1100, the text in *L* finds its closest counterpart in the two twelfth-century translations of an Arabic treatise on astrolabe use, the *Kitāb fī-l-ʿamal bi-l-asṭurlāb* (i.e., *Book on the Uses of the Astrolabe*) by Aḥmad ibn al-Ṣaffār (d. 1035), who was an Andalusian astronomer and student of the famous Maslama al-Majrīṭī.[22] The translations in question were carried out by John of Seville and Plato of Tivoli, who were both active on the Iberian peninsula during the 1130s.[23] Their translations are independent of each other and

« Medieval Jews and Medieval Astrolabes: Where, Why, How, and What For? », in Sacha Stern, Charles Burnett (eds.), *Time, Astronomy, and Calendars in the Jewish Tradition*, Brill, Leiden 2014 (Time, Astronomy, and Calendars: Texts and Studies, 3), p. 221–271 (249–258); Samsó, *On Both Sides*, p. 414–417.

20 For attestations of the standard term, see Kunitzsch, « Glossar », p. 527–528.

21 It cannot be excluded that the form *ezada* was the consequence of particularly severe scribal corruption. The same may apply to the strange expression *circulus quirialis* in ch. 17 for what should normally be *circulus equinoctialis*.

22 On this author, see Mònica Rius, « Ibn al-Ṣaffār: Abū al-Qāsim Aḥmad ibn Abd Allāh ibn Umar al-Ghāfiqī ibn al-Ṣaffār al-Andalusī », in Thomas Hockey (ed.), *The Biographical Encyclopedia of Astronomers*, vol. II, Springer, New York 2007, p. 566–567, and the references in Samsó, *On Both Sides* (see index). The Arabic text of one version of his astrolabe treatise, preserved in MS El Escorial, Real Biblioteca del Monasterio de San Lorenzo, ár. 964, fol. 3v–20v, was published in José María Millás Vallicrosa, « Los primeros tratados de astrolabio en la España árabe », *Revista del Instituto Egipcio de Estudios Islámicos en Madrid*, 3 (1955), p. 47–76 (Arabic section), and translated into Catalan in Id., *Assaig*, p. 29–48. Other manuscripts and recensions are noted in Julio Samsó, « Nota acerca de cinco manuscritos sobre astrolabio », *Al-Andalus*, 31 (1966), p. 385–392 (385–387); Id., *On Both Sides*, p. 376–377; Fuat Sezgin, *Geschichte des arabischen Schrifttums*, vol. VI: *Astronomie, Bis ca. 430 H.*, Brill, Leiden 1978, p. 250.

23 John of Seville's translation is printed in José María Millás Vallicrosa, *Las traducciones orientales en los manuscritos de la Biblioteca Catedral de Toledo*, CSIC, Madrid 1942, p. 261–284, on the basis of MS Madrid, Biblioteca nacional de España, 10053, fol. 112ra–117vb (s. XIII$^{2/2}$) and (for c. 1) MS Toledo,

reflect diverging recensions of Ibn al-Ṣaffār's text. John's version was by far the more widely copied of the two and provided the basis for the most popular of all medieval Latin texts on astrolabe use, which by the end of the thirteenth century circulated with a false ascription to Māshā'allāh.[24]

A synopsis of the chapters on astrolabe use in *L* and the parallel chapters in Ibn al-Ṣaffār's *Kitāb fī-l-ʿamal bi-l-asṭurlāb* – according to the recension edited by Millás Vallicrosa and the Latin translations by John and Plato – is given in Appendix B below. It shows that our anonymous treatise follows an order of exposition that is on the whole remarkably similar to that in Ibn al-Ṣaffār's work, although it skips over individual chapters and entire thematic blocks such as the astrological applications of the astrolabe (aside from the ascendant degree, which is covered in ch. 3 and 15). The degree to which the text in *L* mirrors the precise wording and sentence structure in Ibn al-Ṣaffār's *Kitāb fī-l-ʿamal* or its translations varies from one chapter to the next. A case of relatively close convergence is *L*'s ch. 18, on finding geographic latitude, where is here compared with ch. 25 in Plato of Tivoli's translation.

L, fol. 121va–122ra (see ch. 18 in Appendix C):	*Liber abualcasin in operibus astrolabii a Platone tyburtino translatus* (ch. 25):[25]
Scias quia hec latitudo civitatum quantum distat plaga celi que est super ipsam civitatem a linea que facit equalem diem et noctem. Hec vero est linea super quam vadunt per quamque horam caput Arietis et caput Libre. Et quantum distat a plaga celi que est super civitatem usque ad	Cuiuslibet regionis latitudinem eiusdem cenit capitum ab equidiei circulo, qui est initii arietis et libre circumrotatio, longitudinem fore manifeste cognoscas, a qua poli septentrionalis elevatio super orizontem polique meridionalis depressio sub orizonte nullatenus discordant. Hee

Archivo y Biblioteca Capítulares, 98-27, fol. 48v–49r (s. XV). The number of preserved copies exceeds 25. For a partial list, see Francis J. Carmody, *Arabic Astronomical and Astrological Sciences in Latin Translation: A Critical Bibliography*, University of California Press, Berkeley 1956, p. 142–143; Thorndike, Kibre, *A Catalogue*, col. 1118. Plato of Tivoli's translation is edited critically from MSS Vatican City, Bibliotheca Apostolica Vaticana, Ottob. lat. 309, fol. 136ra–143ra (s. XIII/XIV) and Oxford, Bodleian Library, Digby 51, fol. 28rb–35rb (s. XII^{med}) in Richard Lorch, Gerhard Brey, Stefan Kirschner, Christoph Schöner, « Ibn aṣ-Ṣaffārs Traktat über das Astrolab in der Übersetzung von Plato von Tivoli », in Bernhard Fritscher, Gerhard Brey (eds.), *Cosmographica et geographica: Festschrift für Heribert M. Nobis zum 70. Geburtstag*, vol. I, Institut für Geschichte der Naturwissenschaften, Munich 1994, p. 125–180 (138–174).

[24] See Pseudo-Māshā'allāh, *On the Astrolabe*, ed. and trans. Ron B. Thomson, 2 vol., Volumes Publishing, Waterloo 2022, vol. II. The dependence on John of Seville's translation of Ibn al-Ṣaffār was demonstrated by Paul Kunitzsch, « On the Authenticity of the Treatise on the Composition and Use of the Astrolabe Ascribed to Messahalla », *Archives internationales d'historie des sciences*, 31 (1981), p. 42–62 (48–56).

[25] Ibn al-Ṣaffār, *Kitāb fī-l-ʿamal bi-l-asṭurlāb*, trans. Plato of Tivoli, ed. Lorch, Brey, Kirschner, Schöner, p. 157–158.

lineam que facit equalem diem et noctem, tantum descendit unus polus et alter ascendit. Et scias quia semper est equa longitudo inter ipsos tres, inter duos polos scilicet et lineam supradictam. Et unusquisque horum trium vocatur 'latitudo' civitatis.	autem tres longitudines semper erunt equales, quarum unaqueque terre latitudo nuncupatur.
Si es in civitate aliqua nec scis latitudinem eius et vis scire, aspice quando Sol fuerit in medio celi in illa die qua facere volueris, hoc est in media die, et nota quanta erit altitudo ipsius stelle Solis. Et si Sol fuerit in illa die in capite Arietis vel in capite Libre, tunc erunt equales dies et nox et tunc minorabis altitudinem solis de XC. Et quantum restabit de numero, tantum erit a plaga celi que est super civitatem usque ad lineam que facit equalem diem et noctem et hoc est latitudo civitatis illius.	Cumque in aliqua regionum cuius latitudinem ignoraveris extiteris et eam scire volueris, solis altitudinem cum in celi medio fuerit observa, tunc enim quam altior esse poterit apparebit. Quod si sol in arietis vel libre principio fuerit, quod bis in anno, scilicet in equinoctiis, cum sol per circulum equinoctialem pertransibit, continget, acceptam altitudinem de LX [!][26] demes, et residuum erit id quod inter solem et cenit capitum apparebit; quod eiusdem regionis latitudinem fore non ambigas.
Et si Sol est in alio gradu quam in capite Arietis vel in capite Libre, aspice tunc quam longe fuerit gradus Solis a linea que facit equalem diem et noctem, sicut supradictum est. Et si erit illa longitudo a parte septemtrionali, tunc minorabis altitudinem Solis in illa die. Et si fuerit longitudo a parte meridiei, tunc augmentabis super altitudinem Solis. Quantus fuerit numerus, vel de minoratione vel augmentatione, tanta erit altitudo linee que facit equalem diem et noctem in illa civitate. Minorabis illum numerum de XC et quantum restabit, tanta erit latitudo civitatis illius.	Si autem in alio signo sol extiterit, post eius altitudinem acceptam illius gradus in quo fuerit, declinationem ab equidiei circulo velut supradiximus addiscas. Et si declinatio septentrionalis fuerit, eam ex altitudine sumpta deme; si vero meridionalis extiterit, ei superadde; et quod post augmentum vel diminutionem habueris, erit elevatio circuli equinoctialis, super orizontem in regione illa. Qua de LX [!] [27] dempta reliquum erit illius terre latitudo.

[26] The error of LX for LXXXX or XC in the edition by Lorch, Brey, Kirschner, Schöner (see n. 25) can be explained by Plato of Tivoli's use of the 'x aspada' or *xl*-ligature in place of XXXX or XL. See the text in MS Oxford, Bodleian Library, Digby 51, fol. 32r, and Charles Burnett, « Ten or Forty? A Confusing Numerical Symbol in the Middle Ages », in Joseph W. Dauben, Stefan Kirschner, Andreas Kühne, Paul Kunitzsch, Richard P. Lorch (eds.), *Mathematics Celestial and Terrestrial: Festschrift für Menso Folkerts zum 65. Geburtstag*, Deutsche Akademie der Naturforscher Leopoldina, Halle a. d. Saale 2008 (Acta Historica Leopoldina, 54), p. 81–89.

[27] See previous footnote.

Et si vis scire nocte, accipere altitudinem aliquarum stellarum que sunt in astrolapsu, quando erit in medio celi, et inspice qua longe sit a supradicta linea que facit equalem diem et noctem, sicut supradictum est. Et poteris accipere latitudinem civitatis alio modo: aspicies stellam que propinquior est polo septemtrionali magis altera quam poteris invenire et nota quot graduum erit altitudo. Et post capies altitudinem eiusdem stelle quam inferiorem poteris. Et videbis quot erunt inter unum numerum et alium et iunge in simul. Deinde partire per medium et quanta erit medietas, tanta erit latitudo civitatis.	At si de nocte latitudinem terre nosse cupis, cuiuslibet stellarum altitudinem, cum in celi medio fuerit, accipe et serva, quia tunc altior quam esse poterit ostendetur. Post hec ipsius ab equidiei circulo declinationem addiscas et quemadmodum in sole diligenter operando [!] ad latitudinis illius regionis cognitionem per stellas, scilicet que iuxta polum septentrionalem sunt que in illa regione numquam occultantur, veraciter pervenies. Earum etenim cuiuslibet altitudinem, cum altior quam esse poterit extiterit et item cum inferior quam esse poterit apparebit, accipiens, eas in unum collige collectique dimidium sume, et quod fuerit erit illius terre latitudo. Scito eam.

The affinity between *L* and Plato of Tivoli's translation is in this particular instance much closer than between *L* and John of Seville, who completely omits the first paragraph in these two versions of the chapter, as does ch. 25 of the recension of the Arabic text edited by Millás Vallicrosa.[28] Another instance where the length of *L*'s chapter agrees with Plato against John is ch. 22, which finds its equivalent in ch. 32 in Plato's translation. Both versions of the chapter are reduced to only two sentences on how to convert a known degree of solar longitude into the length of the corresponding noon shadow. By contrast, John's ch. 30 and ch. 32 in the aforementioned Arabic text add an account of how to extrapolate from this the times of the two afternoon prayers observed by Muslims, *dhuhr* and *asr*.

This tendency to abridge or condense the source text can also be observed elsewhere in *L*, especially in ch. 2, 6, 9, 13, 19–21, and 24. Ch. 2, for instance, deals with finding the degree of the Sun from the known date. It is very similar to a chapter near the beginning of Ibn al-Ṣaffār's treatise (ch. 2 in Millás Vallicrosa and John's translation, ch. 3 in Plato's translation), but omits final sentence describing the reverse operation (i.e., finding the date from the known degree). Ch. 9 resembles the second half of Ibn al-Ṣaffār's chapter on how to calculate any completed or remaining hours of the day or night as it addresses only night-time operations. Conversely, ch. 13, on computing the meridian altitude of the Sun, ignores the second half of the chapter in Ibn al-Ṣaffār's treatise, which extends the same technique to the maximum altitude of a star. Ch. 19, on geographic longitude, is a particularly straightforward case of abridgement in that it leaves out Ibn al-

[28] Ibn al-Ṣaffār, *Kitāb fī-l-ʿamal bi-l-asṭurlāb*, ed. Millás Vallicrosa, p. 52–53.

Ṣaffār's added remarks on Ptolemy's *Geography*. Ch. 24 reproduces only the first paragraph of Ibn al-Ṣaffār's chapter on altimetry, which considers the simple case of measuring height of an accessible object while moving between locations with the alidade set at 45°. The other cases, such as measuring the same height without moving or measuring the height of an inaccessible object, are omitted.

There are also instances where the text in *L* describes operations in more detail than do the two other Latin translations of Ibn al-Ṣaffār's text. This is true of ch. 15 and 16, which here appear in the same sequence as in John of Seville's translation, whereas Plato of Tivoli and the Arabic text edited by Millás Vallicrosa have these chapters in reverse order. Ch. 16 adds two sentences that are not present in any of these versions. They simply note that stars placed outside of the zodiac circle on the rete have a southern latitude, while those inside have a northern one.

In structural terms, the two most pronounced departures from Ibn al-Ṣaffār's *Kitāb fī-l-ʿamal* occur early on among the chapters on time-measurement. The text in *L* devotes a separate *Titulus* to the problem of finding the ascendant degree during daytime (ch. 3), placing it ahead of its explanation of how to find the hour of the day (ch. 4). In Ibn al-Ṣaffār's treatise, the keeping of time during the day and the determination of the ascendant degree are integrated into a single chapter (ch. 5 in John, ch. 6 in Plato). Equally striking is the fact that *L* has two separate chapters on how to calculate the fraction of an hour that has already passed or is remaining, as it distinguishes between day (ch. 8) and night (ch. 11). The chapter on daytime operations has a clear counterpart in Ibn al-Ṣaffār (ch. 10 in John, ch. 12 in Plato) as far its placement in the overall order of chapters is concerned, whereas the second seems extraneous to this order. It is followed by an explanation of how to use the changing altitude of the Sun to infer one's time with respect to noon (ch. 12), which is likewise not encountered in the known versions of Ibn al-Ṣaffār's treatise. Instead, a brief chapter on this topic appears in *De utilitatibus astrolabii*, although the wording there is very different.[29]

Overall, the evidence at hand suggests that most of the material on astrolabe use preserved in *L*, fol. 118r–122v, goes back to a previously unrecorded Latin translation or paraphrase of an Arabic source text, which can be identified with Ibn al-Ṣaffār's *Kitāb fī-l-ʿamal bi-l-aṣṭurlāb*. The recension used by this translator apparently differed significantly from those underlying the translations by John of Seville and Plato of Tivoli, which had no discernible influence on the present text. Whether this third translation was likewise carried out in the second quarter of the twelfth century, or possibly even earlier, seems difficult to decide. What may be worth noting, however, is that none of the chapters in *L* mention the azimuth curves on the astrolabe's horizon plate, or even the concept of azimuth

[29] *De utilitatibus astrolabii*, c. 20, ed. Bubnov, p. 146–147.

itself, despite the fact that these play a prominent role in several chapters of Ibn al-Ṣaffār's treatise.[30] While most of the pertinent chapters are not even present in *L*, the term could have appeared in ch. 16 and 23, which correspond to ch. 18 and 33 in the Arabic text edited by Millás Vallicrosa and ch. 19 / 20 and 31 / 33 in the translations by John and Plato. The second of these chapters gives a rule for finding the altitude and azimuth of the Sun as well as the shadow length from the known degree of solar longitude and the time of day. In ch. 23 of *L*, the steps to compute the length of the shadow with the help of the alidade and shadow square are described in slightly more detail than in the other known versions, but at the same time there is no mention whatsoever of azimuth.

What makes this omission potentially revealing is that an absence of azimuth curves also belongs to the general hallmarks of the Latin astrolabe texts created during the tenth and eleventh centuries, which by and large presuppose the same limited set of design features for the instrument.[31] A clear visual presentation of this astrolabe design is given in the eleventh-century MS Paris, Bibliothèque nationale de France, lat. 7412, fol. 19r–23v, which depicts the rete, horizon plates without azimuth curves, and back plate of an Andalusian astrolabe made by a certain Khalaf ibn al-Muʿādh.[32] It seems possible that the text *L* was compiled with the same archaic astrolabe type in mind, which would explain why none of the azimuth-related content of Ibn al-Ṣaffār's *Kitāb fī-l-ʿamal* appears in it.

[30] Ibn al-Ṣaffār, *On the Uses of the Astrolabe*, trans. John of Seville, c. 1, 19, 21, 27, 31–32, ed. Millás Vallicrosa, p. 263, 271–272, 276, 279; trans. Plato of Tivoli, c. 1, 20, 23, 29, 33–34, ed. Lorch, Brey, Kirschner, Schöner, p. 140, 153–154, 156, 161, 165.

[31] On the astrolabe design in early Latin texts and the changes introduced in the twelfth century, see Emmanuel Poulle, « La fabrication des astrolabes au Moyen Âge », *Techniques et Civilisations*, 4 (1955), p. 117–128; Id., « Les instruments astronomiques de l'Occident latin aux XI^e^ et XII^e^ siècles », *Cahiers de civilisation médiévale*, 15 (1972), p. 27–40 (27–36); Id., « La littérature astrolabique latine jusqu'au XIII^e^ siècle », *Physis*, 32 (1995), p. 227–237.

[32] See Paul Kunitzsch, « Traces of a Tenth-Century Spanish-Arabic Astrolabe », *Zeitschrift für Geschichte der arabisch-islamischen Wissenschaften*, 12 (1998), p. 113–120; Borrelli, *Aspects*, p. 203–210; Samsó, *On Both Sides*, p. 373–375. Another such set of drawings appears in MS Bern, Burgerbibliothek, 196, fol. 1v–2r, 3r, 7v (s. XI^1/2^). See the reproductions in Schramm, Schütz, Schütz, Brunold, Germann, « Der Astrolabtext », p. 207, 284, 286–287, 289, 298.

Appendix A

CONTENTS OF MS LYON, PALAIS DES ARTS, 45 (= *L*), FOL. 118R–156V

fol. 118ra–rb: *Ovidius de commendacione <astr>onomie* [rubr.]. *Felices quibus hec anime cognoscere primis...* | *... ponemusque suos ad vaga signa dies* = OVID, *Fasti* 1.297–310

fol. 118ra–120va: *Titulus de altitudine Solis capienda* [rubr.]. *Si vis scire altitudinem Solis in quacumque hora diei...* | *... Et cognosces omnia opera eius.* = anonymous text on astrolabe use derived from Ibn al-Ṣaffār, *Kitāb fī-l-ʿamal bi-l-asṭurlāb* (see Appendices B and C)

fol. 120va–vb: *Ut scias ad quod clima singule tabule pertinent* [rubr.]. *Si queris scire ipse tabule...* | *... non nisi in aliqua terra in longioribus diebus.* = *Sententie astrolabii* (ed. MILLÁS VALLICROSA, p. 287, l. 364–375)

fol. 120vb–121rb: *Quomodo orbis in VII partitur climata* [rubr.]. *Initium climatis primi est...* | *... quod cuilibet probandum dimittitur.* = *De utilitatibus astrolabii*, c. 19.1–8 (ed. BUBNOV, p. 142–146)

fol. 121rb: *Ut scias horas in dorso astrolabii* [rubr.]. *Quando vis scire horas in dorso...* | *... diversa poteris fabricare horologia.* = *De utilitatibus astrolabii*, c. 21 (ed. BUBNOV, p. 147)

fol. 121rb: *De alio orologio* [rubr.]. *Ianus et Apollo dum sibi pariter...* | *... partes incunctanter assignat.* = *Sententie astrolabii* (ed. MILLÁS VALLICROSA, p. 288, l. 383–387)

fol. 121va: *Ad inveniendum climata* [rubr.]. *Per octo repperies latitudines climatum...* | *... et sic deinceps.* = *De utilitatibus astrolabii*, c. 18.2 (ed. BUBNOV, p. 141, l. 2–8)

fol. 121va–vb: *De climatibus* [rubr.]. *Climatis primi latitudo XVI gradus...* | *... dies XVI horarum sequitur.* = MILLÁS VALLICROSA, *Assaig*, p. 290–292, l. 1–28

fol. 121vb–122vb: *Titulus ad capiendam latitudinem cuiuslibet civitatis...* | *... tanta erit altitudo altitudinis illius.* = continuation of anonymous text on astrolabe use derived from Ibn al-Ṣaffār, *Kitāb fī-l-ʿamal bi-l-asṭurlāb* (see Appendices B and C)

fol. 122vb–123ra: *Alius de eodem* [rubr.]. *Si vis alicuius arboris vel turris vel columne...* | *... hipotenuse vicem habere dinoscitur.* = *Geometria incerti auctoris* III, 6 (ed. BUBNOV, p. 321–322)

fol. 123ra–124va: *Conpilator huius libelli dixit. Codex iste ponitur in memoria horarum...* | *... Quod non nostro sed Dei confisus auxilio agere aggressi sumus.* = prologue to anonymous translation of the *Calendar of Córdoba* (ed. MARTÍNEZ GÁZQUEZ, SAMSÓ, « Una nueva traducción », p. 15–23)

fol. 124va–128rb: *Hermannus Christi pauperum peripsima...* | *... in huiusmodi rerum usu exercitati alias notificatur.* = HERMANN OF REICHENAU, *De mensura astrolabii*[33]

fol. 128rb–129ra: *De colligendo signo et gradu Solis* (heading). *Si certissime horas naturales sive artificiales...* | *... XX die Aprilis Sol est in V gradu Tauri.* = *De utilitatibus astrolabii*, c. 3.1–3 (ed. BUBNOV, p. 124–126)

fol. 129ra: *De aurora* [rubr.]. *Si vis scire quam prope sit aurora...* | *... ex parte almagrib ecce aurora.* = *De utilitatibus astrolabii*, c. 14 (ed. BUBNOV, p. 135)

fol. 129ra–b: *Ad horas cum quadro inveniendas* [rubr.]. *Componitur horologium cum astrolabii quarta parte...* | *... ipsa hora diei esse dicatur.* = MILLÁS VALLICROSA, *Assaig*, p. 304, l. 1–305, l. 14

fol. 129rb: *Accipe astrolabii quartam et in sexta hora...* | *... usque ad XC computatus habetur.* = MILLÁS VALLICROSA, *Assaig*, p. 307, l. 64–71

fol. 129rb–vb: *De bissexto* [rubr.]. *Bissextili anno prima hora noctis...* | *... et reliqua hoc modo usque ad alium bissextum.*[34]

fol. 129vb: *Perizodion de signis XII Grece* [rubr.]. *Aries, Taurus...* | *... Ermis, Selim.* = a list of the zodiacal signs and planets with their Greek names

fol. 129vb–130ra: *Nomina mensium Hebraice* [rubr.]. *Martius, Aprilis...* | *... Adar.* = a list of the Julian months with their Hebrew names (and *Dustrus* in place of *Av*)

fol. 130ra: *Secundum Grecos* [rubr.]. *Martius, Aprilis...* | *... Gurpineus, Berricos.* = a list of the Julian months with their Greek (Macedonian) names

fol. 130ra–rb: *Locus postulat ut de stellis horarum dicam quote sint...* | *... sunt in astrolapsu quarum signa et gradus et altitudines in ipso repperies.* = modified version of *De utilitatibus astrolabii*, c. 17 (ed. BUBNOV, p. 136–138)

fol. 130rb–va: *Quamvis apud Theodosii Macrobii auctoritatem universi orbis rationabilis habeatur...* | *... tot dicuntur inveniri in totius mundi circuitione.*[35]

fol. 130v–142r: *Ianuarius cuius regula est unum* | *... et alba papavera seminantur.* = anonymous translation of the so-called *Calendar of Córdoba* (ed. MARTÍNEZ GÁZQUEZ, SAMSÓ, « Una nueva traducción », p. 24–78)

---

[33] Edition: JULIUS DRECKER, « Hermannus Contractus: Über das Astrolab », *Isis*, 16 (1931), p. 200–219 (203–212).

[34] This text is an abridgment of *De cursu Solis per menses et signa: qualiter bissextilem diem quarto suo compleat anno*, in *Bedae Venerabilis Opera, pars VI: Opera didascalia*, vol. III, ed. CHARLES W. JONES, Turnhout 1980 (Corpus Christianorum Series Latina, 123C), p. 649, l. 1–p. 650, l. 14.

[35] A slightly different recension of this text is printed as *De magnitudine ambitus universi orbis* in *Patrologia latina*, vol. CXLIII, Migne, Paris, 1853, col. 408A–C.

fol. 142r: *Supputatio heszre sacerdotis de qualitatibus annorum. Si fuerit kal. Ianuarii die dominica... | ... Domus peribunt.* = *Revelatio Esdrae*[36]

fol. 142va–143ra: *Philosophi qui sua sapientia motus siderum... | ... si quartariam IIII puncti, si quintanam V.* = *De mensura astrolapsus* (ed. MILLÁS VALLICROSA, *Assaig*, p. 293, l. 1–p. 295, l. 44)

fol. 143ra–va: *Astronomie modus multafarie consistit... | ... proprius ad septemtrionem estatem reddit.* = collection of excerpts from Isidore of Seville, *Etymologiae*, bk III

fol. 143va–b: compilation of verses on astronomy. *Quinque tenent zone quarum una chorusco ... | ... Illic sera rubens accendit lumina vesper.* = VIRGIL, *Georgicon* 1.233–251; *Verque novum stabat cinctum florente corona ... | ... Et glacialis hiems canos hirsuta capillos.* = OVID, *Metamorphoses* 2.27–30; *Ad boree partes arcti vertuntur et anguis ... | ... Hinc sequitur Pistris simul Heridanique fluenta.* = PSEUDO-PRISCIAN, *Carmen de sideribus*[37]

fol. 143vb–144ra: *Subsolanus primus cardinalis ... | ... quia non discutit nubes, sed stringit.* = excerpts (rearranged) from Isidore of Seville, *De natura rerum*, c. 37

fol. 144ra: *Eurus ad auroram Nabatheaque regna recessit ... | ... Nubibus assiduis pluvioque madescit ab austro.* = OVID, *Metamorphoses* 1.61–66

fol. 144ra–rb: *Nomina ventorum. Bis sex septemtrio primi ... |... Argente, Graio vocitant cognomine iusto.* = verses (31 lines) on the names of the winds

fol. 144rb–145rb: *Tempora anni quatuor ex equalitate cursus... |... Asiamque determinans.* = collection of excerpts from Isidore of Seville, *Etymologiae*, bk. III, V, XIII, and XIV

fol. 145rb–va: *Duo sunt extremi vertices mundi ... | ... quem serpentarius tenet appropinquat.* = *Excerptum de astrologia Arati* (beginning only)[38]

fol. 145va–vb: *Descriptio XII^cim signorum... | ... Alexander Macedo composuit diligentissime posterius describemus.* = *Liber Alchandrei*, c. 14–15[39]

fol. 145vb–146rb: *De supinis. Sciendum est quod omnia gerundiva atque supina secundum Priscianum... |... appellare potes quolibet nomine horum nominum, scilicet gerundivum vel supinum.* = a note on grammar

---

[36] On this text, see LÁSZLÓ SÁNDOR CHARDONNENS, *Anglo-Saxon Prognostics, 900–1100: Study and Texts*, Brill, Leiden 2007 (Brill's Studies in Intellectual History, 153), p. 491–500; MARILINA CESARIO, « Weather Prognostics in Anglo-Saxon England », *English Studies*, 93 (2012), p. 391–426.

[37] Edition: ALEXANDER RIESE (ed.), *Anthologia Latina sive Poesis Latine supplementum*, vol. I.2: *Carmina in codicibus scripta*, *Reliquorum librorum carmina*, 2nd ed., Teubner, Leizpig 1906, p. 154–155 (no. 679).

[38] Edition: ERNESTUS MAASS (ed.), *Commentariorum in Aratum reliquiae*, Weidmann, Berlin 1898, p. 309, l. 2–16.

[39] Edition: DAVID JUSTE, *Les* Alchandreana *primitifs: étude sur les plus anciens traités astrologiques latins d'origine arabe (X^e siècle)*, Brill, Leiden, 2007 (Brill's Studies in Intellectual History, 152), p. 433–472 (441–442).

fol. 146rb–148rb: *Liquamen de piris castimoniale sic fiet...* | *... ipsa sub divo obruta sabulone texerunt.* = collection of recipes (culinary, medical), mostly excerpted from PALLADIUS, *Opus agriculturae*, bk. I–IV, VII, XI

fol. 148rb–vb: *Servus ait domino: gratis famulabor...* = collection of verses added by later hand, opening with Hildebert of Lavardin, *Carmen* 24[40]

fol. 149ra–155ra: *Incipit liber Bede de natura rerum* [rubr.]. *Naturas rerum varias labentis et evi...* | *... atque inde Affrica a meridie versus ad occidentem extenditur.* = BEDE, *De natura rerum*[41]

fol. 155ra–156vb = *De saltu lune* [rubr.]. *Hoc loco congruum videtur de saltu lune...* | *...quod inter defectam et recentem sit lunam.* = HELPERIC OF GRANDVAL, *Liber de computo*, c. 18–21 (ed. PEZ, pt. 2, col. 200–206; repr. *Patrologia latina*, vol. CXXXVII, col. 32C–36C)

[40] Edition: HILDEBERTUS CENOMANNENSIS EPISCOPUS, *Carmina minora*, ed. A. BRIAN SCOTT, 2nd ed., Saur, Munich 2001, p. 16, l. 1–6.

[41] Edition: *Bedae Venerabilis Opera, pars I: Opera didascalia*, vol. I, ed. CHARLES W. JONES, Brepols, Turnhout 1975 (Corpus Christianorum Series Latina, 123A), p. 189–234.

Appendix B

BREAKDOWN OF THE TEXT ON ASTROLABE USE IN *L*, FOL. 118RA–122VB

The following table breaks down the content of the text on astrolabe use in *L*, fol. 118r–120va, 121vb–122vb and compares it with the astrolabe treatise by Ibn al-Ṣaffār. Its seven columns signify (i) the chapter number according to the edition in Appendix C; (ii) the corresponding folios/columns in *L*; (iii) an indication of whether the manuscript preserves a heading starting *Titulus*; (iv) a brief description of the content; (v)–(vii) the number of the parallel chapters in MV = Ibn al-Ṣaffār, *Kitāb fī-l-ʿamal bi-l-asṭurlāb* (ed. MILLÁS VALLICROSA) and the Latin translations by JS = John of Seville (ed. MILLÁS VALLICROSA) and PT = Plato of Tivoli (ed. LORCH, BREY, KIRSCHNER, SCHÖNER).

i	ii	iii	iv	v	vi	vii
	fol. in *L*	*Titulus*	content	MV	JS	PT
1	118ra	y	solar altitude, measured with alidade	4	4	5
2	118ra	y	degree of solar longitude, via calendar scale	2	2	3
3	118ra–rb	y	ascendant degree during daytime, via solar altitude	5	5	6
4	118rb	n	time of day, via solar altitude	5	5	6
5	118rb–va	n	time of night, via stellar altitude	6	6	7
6	118va	n	arc of daylight and night-time	8	8	10
7	118va–vb	n	length of temporal hour of day or night	9	9	11
8	118vb–119ra	n	completed or remaining part of the current diurnal hour	10	10	12
9	119ra	n	completed or remaining equinoctial hours of the night	12	12	14
10	119ra–rb	n	mutual conversion of equinoctial and temporal hours	13	13	15
11	119rb–va	n	completed or remaining part of the current nocturnal hour	--	--	--
12	119va	n	discerning time relative to noon, via solar altitude	--	--	--

13	119va	n	solar meridian altitude, via degree of longitude	14	14	16
14	119va–vb	y	degree of solar longitude and calendar date, via solar altitude	16	16	18
15	119vb–120ra	y	time when a given star or degree is ascending, culminating, or descending	19	18	21
16	120ra–rb	y	identifying an astrolabe star in the sky, via position of a familiar star	18	19	20
17	120rb–va	y	declination of an ecliptic degree or star	24	22	24
18	121va–122ra	y	latitude of a place, via solar or stellar altitude	25	23	25
19	122ra–rb	y	longitude of a place, via eclipse times	28	26	28
20	122rb–va	y	shadow length, via solar altitude	30	28	30
21	122va	y	solar altitude, via shadow length	31	29	31
22	122va	y	noon shadow, via known degree of solar longitude	32	30	32
23	122va–vb	y	shadow length, via known degree of solar longitude and time of day	33	31	33
24	122vb	y	height of an object	35	33	35

Appendix C

TRANSCRIPTION OF THE TEXT ON ASTROLABE USE IN *L*, FOL. 118RA–122VB[42]

[1]

|118ra| **Titulus[43] de altitudine Solis capienda**

Si vis scire altitudinem Solis in quacumque hora diei volueris, accipe astralabium et pone anulum in maiori digito dextre manus, ita ut facies eiusdem sit adversus manum. Et post verte te ad Solem et manum cum astralabio et deduc illam *ezadam* in illa quarta astralabii[44] que est de oriente ad medium celi levando et deponendo quousque Sol intret et exeat per illa duo foramina que sunt in utraque *sadaba*. Quo facto nota gradum quem tetigerit caput illius *ezade* in circulo superiori. Et tunc incipies numerare gradus ab oriente usque ad supra notatum gradum. Et quot fuerint, tot graduum erit altitudo Solis in oriente ante meridiem et in occidente similiter post meridiem.

[2]

Titulus Solis ad cognoscendum in quo gradu signorum fuerit Sol

Si scire volueris in quo signo et in quo gradu eiusdem signi fuerit Sol in unoquoque dierum anni, in primis scias diem mensis et pones illam *ezadam* super eumdem diem quem reppereris[45] in circulo mensium. Et ubi attigerit illa *ezada* in circulo signorum, in eadem gradu eiusdem signi erit Sol in illa die.

[3]

Titulus ad cognoscendum gradum ascendentem in orientem

Si tu |118rb| scire desideras qualis gradus et cuius signi ascendit in orientem in quacumque hora diei, ipsa hora accipies altitudinem Solis sicut iam demonstratum est habebisque cum hoc certitudinem signi et gradus in quo Sol in illa die morabitur. Et tunc versa facie astralabii requires numerum graduum altitudinis

---

[42] This transcription of the text on fol. 118ra–120va, 121vb–122vb excludes marginal glosses and additions by later hands. Arabic loan words are highlighted using italics. The apparatus (in the footnotes) documents my conjectural emendations to the text as well as corrections already found in the manuscripts. It uses the following abbreviations: *a.c.* = *ante correctionem* (state of the text before correction); *p.c.* = *post correctionem* (state of the text after correction); *s.l.* = *supra lineam* (text found above the line).

[43] titulus] titululus

[44] astralabii] astralis(?)

[45] reppereris] reipereris

Solis in *almucantara* orientis, si est ante meridiem, vel in *almacantara*[46] occidentis,[47] si est post meridiem. Deinde requires gradum signi in quo Sol tunc fuerit in circulo signorum qui est in illa rete ponesque illum eumdem gradum Solis super numerum supradictum altitudinis Solis in *almacantaris* inventum. Quo facto nota qualem gradum et cuius signi inveneris in prima *almacantara* orientis, quia ille erit gradus qui tunc ascendit in orientem.

[4]

Si scire vis que hora diei est, pone gradum signi in quo Sol in illa die fuerit super numerum altitudinis Solis illius hore inventum in *almucantaris.*[48] Et ubi invenies gradum oppositum gradui Sole in illa die continenti, ibi invenies horam diei quelibet.

[5]

Si vis habere notitiam horarum noctis cuiuslibet, quot videlicet iam transierunt |118va| vel que fuerit illa hora in qua tunc eris, capies altitudinem illarum stellarum que sunt in astrolapsu, illius stelle scilicet quam videre poteris de omnibus, hoc modo ut videas illam stellam per illa duo foramina *sadabarum* supradicte *ezade*. Deinde verso astrolapsu require numerum altitudinis illius stelle in numero *almucantararum*. Et desuper illam *almucantaram* in qua numerus ille fuerit pone illam stellam altitudinis cuius est numerus. Et in illa hora super quam[49] inveneris gradum signorum in quo Sol fuerit in antecedenti die proxima, ipsa est hora noctis quam queris.

[6]

Si volueris scire arcum diei[50] et arcum noctis quante sint magnitudinis, scire te oportet in quo signo et in quo gradu eiusdem signi Sol moratur in illa die. Et pones eumdem gradum super primum *almacantara* orientis et considerabis quem locum tetigerit *almari* in limbo astralabii. Et ibi pones signum. Et deduces rete donec gradus signi superius notatus veniat super primum *almancatara* occidentis. Et notabis locum quem rursus tetigerit *almari*. Et numerabis quot gradus fuerint ab illo loco quo prius signasti tactum *almari* usque ad illum locum quem postea tetigerit illa *almari*. Et quot gradus ibi inveneris, scias tantum esse arcum diei.

46 almacantara] *p.c.* almucantara
47 occidentis] *a.c.* occidens
48 almucantaris] almucantari
49 quam] quem
50 diei] *a.c.* dt(?)

Item: si vis cognoscere arcum noctis eiusdem diei, numerabis quantum restabit de numero trecentorum sexaginta et quot remanserit, tot graduum erit arcus noctis illius.

[7]

Item: si vis scire horam diei non rectam et horam |118vb| noctis non rectam quam magne sint, debes scire quod unaqueque dies habet XII partes et nox totidem. Illas vero horas[51] vocamus 'non rectas'. Si vis scire de hora diei quanta sit, accipe gradum oppositum gradui in quo Sol in eadem die moratur et pone super primum *almacantara* occidentis. Deinde nota locum quem tetigerit *almari* in limbo astralabii. Quo notato movetur[52] rete donec veniat oppositus gradus signi ubi Sol fuerit super complementum hore prime rursusque notabis quem gradum tetigerit *almari*. Et tot gradus continebit hora illius diei quot fuerint a primo loco quem tetigerit *almari* usque ad secundum locum tactum ab eodem.

Item: si vis scire quot[53] partes habet hora noctis eiusdem diei. Accipe quantum remanet de XXX post completionem hore diei. Et quantum remanserit de illo numero, tot erunt partes hore illius noctis.

Item: si vis scire horam noctis tantummodo, pones gradum signi in quo est Sol super primum *almacantara* occidentis notabisque ubi tangerit *almari*. Deinde moveatur rete donec veniat gradus Solis super ultimum gradum prime hore, qui est proximus secunde. Notabis iterum ubi tetigerit *almari* et quantum fuerit de primo loco ubi prius tetigit usque ad ultimum quem tetigit, tot erunt partes illius noctis. Et numeratis hoc modo partibus hore noctis, quot remanserint de XXX, tot erunt partes hore diei.

[8]

Item: si queris scire quocumque die quot partes transierunt illius hore in qua tu fueris, pone gradum in quo Sol morabitur in illa die cum numero altitudinis Solis illius puncti de quo scire |119ra| cupis et hoc facto considera gradum oppositum gradum Solis et nota horam in qua fuerit. Deinde aspicies ubi tetigerit *almari* deducitoque rete quousque veniat ille gradus oppositus gradui Solis super primum punctum eiusdem hore, si scire volueris quot partes ipsius[54] eiusdem hore iam transierunt. Et si scire volueris quot partes eiusdem hore restant venture,[55] adduces illum gradum oppositum gradui Solis super ultimum punctum eiusdem hore. Et tunc videas ubi attigerit illa *almari* notaque illum locum. Et quantum

51 vero horas] *a.c.* horas vero
52 movetur] *p.c.* movatur
53 quot] *a.c.* quidem
54 ipsius] *a.c.* illius
55 venture] *a.c.* vente

habebit de primo loco prius tacto ab *almari* usque ad locum quem[56] secundo tetigit, tot partes illius hore transierunt, si ad primum punctum posueris oppositum gradum gradui Solis, et tot partes restant venture, si ad ultimum illius hore punctum posueris oppositum gradum gradui Solis.

[9]

Item: si volueris scire quot recte hore noctis transierunt, accipe altitudinem alicuius illarum stellarum quas tu cognoscis in ipso astrolapsu et pones illam stellam super tot *almacantaras* quantus fuerit ille numerus altitudinis et notabis ubi tetigerit *almari*. Deinde capies gradum Solis illius diei et mittes super primum *almacantaram* de occidente. Et notabis ubi tetigerit *almari*. Et illum numerum quem tu invenies a primo usque ad alium *almari* divide per XV. Et quot vicibus invenies XV, tot hore illius noctis transierunt integre. Et quantum restabit ad complendum XV, tantum restabit ad conplendam horam.

[10]

Item: si volueris facere de rectis horis non[57] rectas vel non rectis rectas, sive diei, sive noctis, facies ita. Si de horis diei non rectis facere volueris rectas, accipies op|119rb|positum Solis et pones super primum *almacantara*[58] occidentis. Et post notabis ubi tetigerit *almari*. Et post movebis oppositum Solis et pones super tot horas quot volueris facere rectas. Et notabis ubi tetigerit *almari*. Et quantum fuerit de primo ad ultimum partire per XV. Et quantum convenerit unicuique pone de illis XV. Tot habentur recte hore in illis non rectis.

Si de horis noctis non rectis facere volueris rectas horas, accipe gradum Solis et pone super primum *almacantara* de occidente. Et notabis ubi primum tetigerit *almari*. Deinde movebis ipsum gradum super complementum tot horarum quod volueris. Et post nota ubi tangit *almari*. Et post scies quot hore recte habentur in illis non rectis unicuique recte hore numerando XV. Et videbis quantus fuerit numerus.

Et movebis *almari* de illo ubi fuerit tot gradibus quotus fuerit ille numerus supradictus. Et videbis ubi tetigerit oppositum Solis in quibus horis vel in quibus partibus horarum. Et quantum semovit oppositum Solis de primo loco usque ad alium locum, tot habentur hore non recte in illis rectis quas tu cupis scire.
Et si vis scire in rectis horis numeratis quot habentur non recte hore noctis, pone gradum Solis supra primum *almacantara* de occidente. Et notabis ubi tetigerit *almari*. Et similiter facies de istis sicut fecisti et sicut scriptum est in superioribus.

[56] quem] *a.c.* quod
[57] non] *a.c.* de non
[58] almacantara] *a.c.* alcacantara

Sed mutabis oppositum Solis et pones in loco illo ipsu gradum in quo Sol est. Et tunc invenies quod queris in nocte.

[11]

Si scire desideras in quacumque nocte quantum transactum est illius hore in qua tu es, tunc capies altitudinem alicuius stellarum illarum quas tu cognoscis in illo astrolapsu. Et post verte faciem astralabii et pone illam stellam super tot *almacantaras* quantus fuerit numerus altitudinis |119va| illis stelle, si fuerit in oriente, in oriente, si in occidente, in occidente. Et videbis ubi tetigerit gradus signi in quo est Sol et ibi est ipsa hora.[59] Deinde notabis ubi tangit illa *almari*. Et movebis rete et pones super notatum gradum signi in principio illius hore, si tu scire vis quot partes illius hore sunt transacte, vel pones in fine, si vis scire quot partes sunt inde venture. Et tunc videbis ubi tetigerit *almari* et nota locum. Et quantum habebit de primo loco tacto[60] ab *almari* usque ad alium locum secundo tactum, tantum erit transactum illius hore vel venturum.

[12]

Item: si tu acceperis altitudinem Solis et ignoraveris utrum sit meridies sive ante meridiem vel post, capies altitudinem cuiuslibet signi et alia vice paulo post. Et si videris quod altior sit, scies pro certo quia ante meridiem erat. Et si inveneris inferiorem, scies quia post meridiem est. Ipsum vero medium inter ascensum et descensum meridies est.

[13]

Si vis scire altitudinem Solis in unoquoque die anni in meridie, capies gradum signi in quo Sol fuerit in illa die qua[61] scire volueris et pones illum gradum super illam lineam que[62] dividit mediam diem. Et numerabis quot almucantaras[63] ibi invenies. Et quot inveneris, tanta erit altitudo illius diei in meridie.

59 hora] *s.l.*
60 tacto] *a.c.* tacito
61 qua] *a.c.* in qua
62 que] quam
63 almucantaras] *a.c.* almicantaras

[14]

Titulus ad cognoscendum gradum signi in quo Sol fuerit et cuius signi et ad cognoscendum certum diem mensis in quo moratur Sol in qualibet die per altitudinem Solis.

|119vb| Si hoc scire volueris, capies altitudinem Solis in media die et post requires in facie astralabii in linea que partitur medium diem tot *almacantaras* quantus fuerit numerus illius altitudinis et notabis eandem *almacantaram* in eadem linea. Deinde deduces rete tantum quousque videbis qualis gradus et cuius signi gradus advenerit super illam *almacantaram* prius designatam. Et non potest falli qui inveniant duo gradus diversorum signorum super illum locum notatum in illa linea qui dividit mediam diem, si non supervenerit primus gradus Cancri vel Capricorni. Et in aliquo illorum duorum graduum qui supervenerit erit Sol in illa die sine dubio. Et sic cognito gradu Solis poteris cognoscere diem mensis.

[15]

Titulus ad cognoscendum de omnibus illis stellis que sunt in astrolapsu vel de omnibus gradibus illorum signorum qualis illarum stellarum vel quis gradus illorum signorum quali hora diei vel noctis ascendit in orientem.

Si tu vis hoc scire, accipe illam stellam de qua cupis scire vel illum gradum de quo similiter cupis scire et pone super primum *almacantara* de oriente. Et scire te oportet ubi tetigerit gradus signi in quo Sol est in illa die. Et si inveneris illum locum ubi tetigerit super terram, aspice oppositum suum. Et in qua hora |120ra| fuerit, in illa hora diei ascendit stella vel gradus de quo queris in orientem. Et si subtus terram inveneris gradum[64] Solis, in eadem hora in qua inveneris ipsum gradum in eadem hora noctis ascendit illa stella vel illa gradus de quo scire vis in orientem.

Item: si vis scire de eisdem stellis et de eisdem gradibus quando sunt in medium celi vel quando cubant in occidente, accipe gradum signi quem volueris et pone in linea que est ad medium celi, si vis scire quando erit in medium celi, vel pones in extremo *almacantara* occidentis, si vis scire quando cubat in occidente. Et considera ubi sit gradus signi in quo est Sol. Si inveneris super terram, notabis ubi tangit oppositum suum. Et in illa hora qua tanget oppositum[65] gradum [!] gradui in quo est Sol, in eadem hora diei erit gradus signi vel stella in loco quem scire volueris. Et si inveneris gradum signi in quo est Sol subtus terram, notabis horam quam tetigerit et in eadem hora noctis erit stella vel gradus signi in loco quem scire volueris.

[64] gradum] *a.c.* gradus
[65] oppositum] *a.c.* oposito suum

[16]

Titulus ad cognoscendum stellas in celo que scripte sunt in astrolapsu quas non cognoveris per aliquam illarum quas tu cognoveris [66]

Si tu hoc scire volueris, capies altitudinem illius stelle quam cognoscis. Deinde versa facie[67] astralabii pones illam stellam super tot *almacantaras* quantus fuerit numerus altitudinis stelle. Si fuerit in oriente, in oriente, si in occidente, in occidente. Et post queres in rete astralabii stellam quam cognoscere vis et videbis in quali numero *almacantararum* |120rb| tetigerit illa stella. Et super numerum quem inveneris in illis *almacantaris* pones *ezadam* in dorso astralabii et invento illo numero levabis manum cum astralabaio ad illam partem in qua stella fuit, quecumque sit de illis IIII partibus celi, et non movebis illam *ezadam*. Et si feceris ita, sine dubio illa stella quam videris per illa duo foramina *sadabarum*, ipsa est de qua dubitas.

Preter hoc sciendum quod omnes stelle que sunt extra circulum signorum que est in illa rete sunt in partibus meridiei. Cetere vero que intra circulum sunt notate sunt in partibus septemtrionis omnes.

[17]

Titulus ad cognoscendum quantum distat gradus cuiusque signi vel quelibet stella a quiriali[68] [!] linea que[69] partitur equaliter dies et noctes

Cum hoc scire vis, pone gradum de quo scire vis super lineam que partitur medium diem et videre super quot *almacantaras* attigerit et ille erit numerus sue altitudinis. Deinde videas numerum quem tetigerit quirialis circulus in illa linea que dividit medium, qui est altitudinis illius circuli numerus. Et post numerabis quantum distat inter utrumque numerum. Et quantum est, tantum distat ille gradus de quo scire vis ab illo quiriali circulo qui facit equalitatem diei et noctis.

Ad hoc debes scire quod si gradus fuerint de illis signis que sunt in parte meridiei, semper erit minor numerus numero altitudinis circuli. Et si est gradus illorum signorum que sunt in septemtrione, |120va| semper erit maior numerus illius gradus numero altitudinis circuli. Et scias quod a primo gradu Arietis usque ad primum gradum Libre dicuntur et sunt illa sex signa septemtrionalia. Et a primo gradu Libre usque ad primum gradum Arietis illa VI signa alia[70] meridianalia, id est de parte meridiei. Et ille gradus signorum septemtrionalium[71] qui remotior est ab

66 per ... cognoveris] *in margine*
67 facie] *a.c.* vice
68 quiriali] *a.c.* quiriam
69 que] *a.c.* quem
70 alia] *a.c.* vel
71 septemtrionalium] *a.c.* septemtrionaliorum

illo circulo quiriali est primus gradus Cancri, quia longe est ab eo XXIIII gradibus. Et de illis gradibus signorum que sunt in meridiana plaga est primus gradus Capricorni, qui est longe XXIIII gradibus ab eodem circulo.

Item: si vis scire de qualibet stella itidem quod scivisti de gradu, pone illam stellam supra lineam supradictam de meridie. Et nota qualem numerum inveneris in *almacantaris*. Et quod inveneris, tot erit altitudo eius. Et scias quantum est ab altitudine eiusdem stelle usque ad circulum qui facit equalem diem et noctem. Et sicut fecisti de gradu supradicto, sic facies de stella. Et cognosces omnia opera eius.

[18]

|121vb| **Titulus ad capiendam latitudinem cuiuslibet civitatis in qua fueris**

Scias quia hec latitudo civitatum quantum distat plaga celi que est super ipsam civitatem a linea que facit equalem diem et noctem. Hec vero est linea super quam vadunt per quamque horam caput Arietis et caput Libre. Et quantum distat a plaga celi que est super civitatem usque ad lineam que facit equalem diem et noctem, tantum descendit unus polus et alter ascendit. Et scias quia semper est equa longitudo inter ipsos tres, inter duos polos scilicet et lineam supradictam. Et unusquisque horum trium vocatur 'latitudo'[72] civitatis.

Si es in civitate aliqua nec scis latitudinem eius et vis scire, aspice quando Sol fuerit in medio celi in illa die qua facere volueris, hoc est in media die, et nota quanta erit altitudo ipsius stelle Solis. Et si Sol fuerit in illa die in capite Arietis vel in capite Libre, tunc erunt equales dies et nox et tunc minorabis[73] altitudinem solis de XC. Et quantum restabit de numero, tantum erit a plaga celi que est super civitatem usque ad lineam que facit equalem diem et noctem et hoc est latitudo civitatis illius.

Et si Sol est in alio gradu quam in capite Arietis vel in capite Libre, aspice tunc quam longe fuerit |122ra| gradus Solis a linea que facit equalem diem et noctem, sicut supradictum est. Et si erit illa longitudo a parte septemtrionali, tunc minorabis altitudinem Solis in illa die. Et si fuerit longitudo a parte meridiei, tunc augmentabis super altitudinem Solis. Quantus fuerit numerus, vel de minoratione vel augmentatione, tanta erit altitudo linee que facit equalem diem et noctem in illa civitate. Minorabis illum numerum de XC et quantum restabit, tanta erit latitudo[74] civitatis illius.

Et si vis scire nocte, accipere altitudinem[75] aliquarum stellarum que sunt in astrolapsu, quando erit in medio celi, et inspice qua longe sit a supradicta linea que facit equalem diem et noctem, sicut supradictum est. Et poteris accipere

[72] latitudo] longitudo
[73] minorabis] *a.c.* immorabis
[74] latitudo] *a.c.* altitudo
[75] altitudinem] latitudinem

latitudinem civitatis alio modo: aspicies stellam que propinquior est polo septemtrionali magis altera quam poteris invenire et nota quot graduum erit altitudo. Et post capies altitudinem eiusdem stelle quam inferiorem poteris. Et videbis quot erunt inter unum numerum et alium et iunge in simul. Deinde partire per medium et quanta erit medietas, tanta erit latitudo civitatis.

[19]

Titulus ad capiendam longitudinem[76] cuiuslibet civitatis in qua fueris

Hec est longitudo quantum habet a medio die illius civitatis in qua fueris ab illa media die alterius civitatis de qua vis scire longitudinem de gradibus circuli qui facit equalem diem et noctem. Et quando volueris scire quantum longitudi|122rb|nis est inter duas civitates, opus erit ut aspicias eclipsim Lune quando inceperit vel finierit post mediam diem utriusque civitatis de quibus scire volueris, et quot hore recte erunt inter principia eclipsis utrarumque civitatum, vel inter fines eclipsis earumdem, et facies de unaquaque hora XV gradus. Et quot erunt gradus, tanta erit longitudo earumdem civitatum.

[20]

Titulus ad sciendum magnitudinem umbre cuiuslibet rei per altitudinem Solis

Quando volueris scire quanti digiti sunt in qualibet umbra, accipe tunc altitudinem Solis. Et si invenies altitudinem in XLV gradus, tunc est umbra iacens XII digitorum. Et umbra stans similiter. Et erit tunc umbra totius rei tanta quanta et ipsa res cuius umbra erit.

Sed si est altitudo Solis altior XLV graduum, tunc iacebit caput *ezade* super umbram iacentem astralabii. Et tunc perspice super quot digitos umbre iacuerit caput *ezade*. Et quot digitos inveneris, tanta erit umbra rei de qua scire volueris.

Et si altitudo Solis erit inferior XLV gradibus, tunc iacebit caput *ezade* super umbram stantem astralabii. Et inspice super quot digitos erit. Et quot inveneris, tot erit umbra de qua scire volueris.

Et quando scies quot digitorum erit umbra iacens et per ipsam volueris scire quot erit umbra stans et econverso, partire CXLIIII super digitos umbre de qua scis. Et quot de |122va| illis CLXIIII contigerint unicuique digito, tot erit umbra de[77] qua queris.

[76] longitudinem] latitudinem
[77] de] *s.l.*

[21]

Titulus ad sciendum altitudinem Solis per umbram cuiuslibet rei

Si vis scire altitudindem Solis per umbram iacentem, inspice quot digitos habuerit umbra iacens. Et si habuerit XII digitos vel minus, pone caput *ezade* super tot digitos quos inveneris in umbra iacente astralabii et vide ubi attigerit aliud caput *ezade*. Et super quot digitos fuerit, tanta erit altitudo Solis. Et si umbra fuerit maior XII digitis, partire super illos digitos CXLIIII et quantum contigerit unicuique digito de illis CXLIIII scias. Deinde pones caput *ezade* super tot digitos umbre stantis et vide super quot[78] gradus tetigerit aliud caput ezade. Et super quot tetigerit, tanta fuit altitudo Solis. Et si vis scire altitudinem Solis per umbram stantem, vide si habuerit ipsa umbra stans XII digitos vel minus et econverso. Fac sicut de umbra supradicta iacente.

[22]

Titulus ad sciendum magnitudinem umbre cuiuslibet in quolibet tempore in hora[79] medii diei

Nota in quo gradu signi fuerit Soli in illa die et previde in quot gradibus erit altitudo Solis in medio die et pone caput *ezade* super tot gradus quot erit altitudo Solis in illa media die et vide ubi tangit aliud caput *ezade* in umbra iacente. Et quot digitos tetigerit, tanta erit umbre magnitudo.

[23]

Titulus ad sciendum magnitudinem umbre in qualibet hora in quovis die anni

Primitus scias in quo gradu signi Sol fuerit et tunc verte faciem astralabii et pone oppositum gradum signi in quo fuerit Sol super horam qua volueris scire magnitudinem umbre et nota super quot *almacantara* tetigerit gradus signi in quo erit Sol. Et tunc verte |122vb| iterum dorsum astralabii et mute super tot gradus quot invenisti in *almacantaris* caput *ezade* et vide super quot digitos umbre venerit aliud caput *ezade*. Et super quot venerit, tanta erit magnitudo umbre illius hore. Et si vis scire per hanc umbram magnitudinem alterius[80] umbre, fac sicut in supradicto titulo didicisti.

78 quot] *a.c.* tot
79 hora] *a.c.* ora
80 alterius] *a.c.* illius

[24]

Titulus ad sciendum altitudinem turris vel cuiuslibet alie rei erecte

Mitte caput *ezade* inter duas umbras astralabii et fac pendere astralabium digito et vade ante et retro, intuens donec videas per ambo foramina *sabadarum* cacumen altitudinis de qua scire vis. Et cum videris cacumen per foramina, pone signum ubi tenueris pedes tuos et mensurabis quantum habebit de pedibus tuis usque ad oculos tuos. Et quantum erit iunges signo quo prius tenuisti pedes tuos et pone ibi signum, quia quantum erit ab illo signo usque ad fundamentum altitudinis, tanta erit altitudo altitudinis illius.

Bibliography

Manuscripts

Barcelona, Archivo de la Corona de Aragón, Ripoll 225
Berlin, Staatsbibliothek, lat. qu. 198
Bern, Burgerbibliothek, 196
El Escorial, Real Biblioteca del Monasterio de San Lorenzo, ár. 964
Lyon, Palais des Arts, 45
Madrid, Biblioteca nacional de España, 6036
Madrid, Biblioteca nacional de España, 10053
Oxford, Bodleian Library, Digby 51
Paris, Bibliothèque nationale de France, lat. 7412
Toledo, Archivo y Biblioteca Capítulares, 98-27
Vatican City, Biblioteca Apostolica Vaticana, Ottob. lat. 309
Vatican City, Biblioteca Apostolica Vaticana, Reg. lat. 596
Vich, Museo Episcopal, 167
Vienna, Österreichische Nationalbibliothek, 2462

Printed Sources

Bede, *De natura rerum*, in *Bedae Venerabilis Opera, pars I: Opera didascalia*, vol. I, ed. Charles W. Jones, Brepols, Turnhout 1975 (Corpus Christianorum Series Latina, 123A), p. 189–234.

De cursu Solis per menses et signa: qualiter bissextilem diem quarto suo compleat anno, in *Bedae Venerabilis Opera, pars VI: Opera didascalia*, vol. III, ed. Charles W. Jones, Turnhout 1980 (Corpus Christianorum Series Latina, 123C), p. 649–653.

De magnitudine ambitus universi orbis, in *Patrologia latina*, vol. CXLIII, Migne, Paris 1853, col. 408A–C.

De utilitatibus astrolabii, in *Gerberti postea Silvestri II papae Opera Mathematica (972–1003)*, ed. Nicolaus Bubnov, Friedländer & Sohn, Berlin 1899, p. 114–147.

Excerptum de astrologia Arati, in Ernestus Maass (ed.), *Commentariorum in Aratum reliquiae*, Weidmann, Berlin 1898, p. 309–312.

Geometria incerti auctoris, in *Gerberti postea Silvestri II papae Opera Mathematica (972–1003)*, ed. Nicolaus Bubnov, Friedländer & Sohn, Berlin 1899, p. 317–365.

Helperic of Grandval, *Liber de computo*, in Bernhard Pez (ed.), *Thesaurus anecdotorum novissimus*, vol. II, Augsburg: Veith, 1721, pt. 2, col. 181–222; repr. in *Patrologia latina*, vol. CXXXVII, Migne, Paris, 1853, col. 17B–48D.

Hermann of Reichenau, *De mensura astrolabii*, in Julius Drecker, « Hermannus Contractus: Über das Astrolab », *Isis*, 16 (1931), p. 200–219 (203–212).

Hildebertus Cenomannensis Episcopus, *Carmina minora*, ed. A. Brian Scott, 2nd ed., Saur, Munich 2001, p. 16.

Ibn al-Ṣaffār, *Kitāb fī-l-ʿamal bi-l-asṭurlāb*, in José Maríá Millás Vallicrosa, « Los primeros tratados de astrolabio en la España árabe », *Revista del Instituto Egipcio de Estudios Islámicos en Madrid*, 3 (1955), p. 47–76 (Arabic section).

Ibn al-Ṣaffār, *Kitāb fī-l-ʿamal bi-l-asṭurlāb*, trans. John of Seville, in José Maríá Millás Vallicrosa, *Las traducciones orientales en los manuscritos de la Biblioteca Catedral de Toledo*, CSIC, Madrid 1942, p. 261–284.

Ibn al-Ṣaffār, *Kitāb fī-l-ʿamal bi-l-asṭurlāb*, trans. Plato of Tivoli, in Richard Lorch, Gerhard Brey, Stefan Kirschner, Christoph Schöner, « Ibn aṣ-Ṣaffārs Traktat über das Astrolab in der Übersetzung von Plato von Tivoli », in Bernhard Fritscher, Gerhard Brey (eds.), *Cosmographica et geographica: Festschrift für Heribert M. Nobis zum 70. Geburtstag*, vol. I, Institut für Geschichte der Naturwissenschaften, Munich 1994, p. 125–180 (138–174).

Le calendrier de Cordoue, ed. Reinhart Dozy, Charles Pellat, Brill, Leiden 1961 (Medieval Iberian Peninsula: Texts and Studies, 1).

Liber Alchandrei, in David Juste, *Les* Alchandreana *primitifs: étude sur les plus anciens traités astrologiques latins d'origine arabe (X^e siècle)*, Brill, Leiden, 2007 (Brill's Studies in Intellectual History, 152), p. 433–472.

Pseudo-Māshā'allāh, *On the Astrolabe*, ed. and trans. Ron B. Thomson, 2 vol., Volumes Publishing, Waterloo 2022.

Pseudo-Priscian, *Carmen de sideribus*, in Alexander Riese (ed.), *Anthologia Latina sive Poesis Latine supplementum*, vol. I.2: *Carmina in codicibus scripta, Reliquorum librorum carmina*, 2nd ed., Teubner, Leizpig 1906, p. 154–155.

Sententie astrolabii, in José María Millás Vallicrosa, *Assaig d'història de les idees físiques i matemàtiques a la Catalunya medieval*, vol. I, Institució Patxot, Barcelona 1931 (Estudis Universitaris Catalans: Sèrie Monogràfica, 1), p. 275–288.

Modern authors (after 1789)

Blume, Dieter, Mechthild Haffner, Wolfgang Metzger, *Sternbilder des Mittelalters: Der gemalte Himmel zwischen Wissenschaft und Phantasie*, vol. II: *1200–1500*, de Gruyter, Berlin 2016.

Bergmann, Werner, *Innovationen im Quadrivium des 10. und 11. Jahrhunderts: Studien zur Einführung von Astrolab und Abakus im lateinischen Mittelalter*, Steiner, Stuttgart 1985 (Sudhoffs Archiv: Beihefte, 26).

Borrelli, Arianna, *Aspects of the Astrolabe: 'Architectonica ratio' in Tenth- and Eleventh-Century Europe*, Steiner, Stuttgart 2008 (Sudhoffs Archiv: Beihefte, 57).

Borst, Arno, *Astrolab und Klosterreform an der Jahrtausendwende*, Winter, Heidelberg 1989 (Sitzungsberichte der Heidelberger Akademie der Wissenschaften, phil.-hist. Kl., Jg. 1989, 1).

— *Die karolingische Kalenderreform*, Hahnsche Buchhandlung, Hannover 1998 (Monumenta Germaniae Historica: Schriften, 46).

Bubnov, Nicolaus (ed.), *Gerberti postea Silvestri II papae Opera Mathematica (972–1003)*, Friedländer & Sohn, Berlin 1899.

Burnett, Charles, « Ten or Forty? A Confusing Numerical Symbol in the Middle Ages », in Joseph W. Dauben, Stefan Kirschner, Andreas Kühne, Paul Kunitzsch, Richard P. Lorch (eds.), *Mathematics Celestial and Terrestrial: Festschrift für Menso Folkerts zum 65. Geburtstag*, Deutsche Akademie der Naturforscher Leopoldina, Halle a. d. Saale 2008 (Acta Historica Leopoldina, 54), p. 81–89.

— « The Roads of Córdoba and Seville in the Transmission of Arabic Science in Western Europe », in Charles Burnett, Pedro Mantas-España (eds.), *Mapping Knowledge: Cross-Pollination in Late Antiquity and the Middle Ages*, CNERU / The Warburg Institute / Oriens Academic, Córdoba 2014 (Arabica Veritas, 1), p. 143–152.

— « Time, the *Liber floridus* and the Science of the Stars in the Twelfth Century », in Patrizia Carmassi (ed.), *Time and Science in the* Liber floridus *of Lambert of Saint-Omer*, Brepols, Turnhout 2021 (Les Études du RILMA , 13), p. 169–181.

Carmody, Francis J., *Arabic Astronomical and Astrological Sciences in Latin Translation: A Critical Bibliography*, University of California Press, Berkeley 1956.

Catalogue général des manuscrits des bibliothèques publiques de France: Départements, vol. 31, Librairie Plon, Paris 1898.

Cesario, Marilina, « Weather Prognostics in Anglo-Saxon England », *English Studies*, 93 (2012), p. 391–426.

Chardonnens, László Sándor, *Anglo-Saxon Prognostics, 900–1100: Study and Texts*, Brill, Leiden 2007 (Brill's Studies in Intellectual History, 153).

Christys, Ann, *Christians in al-Andalus (711–1000)*, Routledge, Abingdon 2002.

Forcada, Miquel, « The *Kitāb al-anwāʾ* of ʿArīb b. Saʿīd and the *Calendar of Cordova* », in Menso Folkerts, Richard Lorch (eds.), *Sic Itur ad Astra: Studien zur Geschichte der Mathematik und Naturwissenschaften; Festschrift für den Arabisten Paul Kunitzsch zum 70. Geburtstag*, Harrassowitz, Wiesbaden 2000, p. 234–251.

Fradejas Rueda, José Manuel, « *shadhāniqāt al-balansiyya* or *shadhāniqāt al-baḥriyya*: On the Arabic Text and the Latin Translations of the *Calendar of Cordova* », in Michèle Goyens, Pieter De Leemans, An Smets (eds.), *Science Translated: Latin and Vernacular Translations of Scientific Treatises in Medieval Europe*, Leuven University Press, Leuven 2008 (Mediaevalia Lovaniensia, Series I/Studia, 40), p. 59–72.

Gautier Dalché, Patrick, « Le 'tuyau' de Gerbert, ou la légende savante de l'astronomie: origines, thèmes, échos contemporains (avec un appendice critique) », *Micrologus*, 21 (2013), p. 243–276.

Jullien, Marie-Hélène (ed.), *Clavis des auteurs du Moyen Âge: territoire français 735–987*, vol. III: *Faof - Hilduin*, Brepols, Turnhout 2010.

Kunitzsch, Paul, « Al-Khwārizmī as a Source for the *Sententie astrolabii* », in David A. King, George Saliba (eds.), *From Deferent to Equant: A Volume of Studies in the History of Science in the Ancient and Medieval Near East in Honor of E.S. Kennedy*, New York Academy of Sciences, New York 1987 (Annals of the New York Academy of Sciences, 500), p. 227–236. Reprinted as chapter IX in Id., *The Arabs and the Stars: Texts and Traditions on the Fixed Stars, and their Influence in Medieval Europe*, Variorum, Northampton 1989.

— « Glossar der arabischen Fachausdrücke in der mittelalterlichen europäischen Astrolabliteratur », *Nachrichten der Akademie der Wissenschaften in Göttingen*, phil.-hist. Kl., 1982/11, p. 455–571.

— « On the Authenticity of the Treatise on the Composition and Use of the Astrolabe Ascribed to Messahalla », *Archives internationales d'historie des sciences*, 31 (1981), p. 42–62. Reprinted as chapter X in Id., *The Arabs and the Stars: Texts and Traditions on the Fixed Stars and Their Influence in Medieval Europe*, Variorum, Northampton 1989.

— « Traces of a Tenth-Century Spanish-Arabic Astrolabe », *Zeitschrift für Geschichte der arabisch-islamischen Wissenschaften*, 12 (1998), p. 113–120. Reprinted as chapter XVI in Id., *Stars and Numbers: Astronomy and Mathematics in the Medieval Arab and Western Worlds*, Ashgate, Aldershot 2004.

Martínez Gázquez, José, « *Dicunt experimentatores / Dicunt qui experimento locuti sunt*: l'expérience dans les indications du calendrier de Cordoue (10e siècle) », in Thomas Bénatouïl, Isabelle Draelants (eds.), Expertus sum: *l'expérience par les sens dans la philosophie naturelle médiévale; actes du colloque international de Pont-à-Mousson (5–7 février 2009)*, SISMEL—Edizioni del Galluzzo, Florence 2011 (Micrologus' Library, 40), p. 239–255.

— « El texto del Calendario de Córdoba en el manuscrito Berlín lat. qu. 198 », in *Studia in honorem prof. M. de Riquer*, vol. IV, Quaderns Crema, Barcelona 1991, p. 657–668.

— « Santoral del calendario del s. XIII contenido en el *Liber Regius* del Museo Episcopal de Vic », *Revista Catalana de Teología*, 6 (1981), p. 161–174.

— « ¿Una nueva traducción latina del calendario de Córdoba del 961 en un manuscrito del siglo XIII? », in *Unidad y pluralidad en el mundo antiguo: actas del VI Congreso Español de Estudios Clásicos (Sevilla, 6-11 de abril de 1981)*, vol. II, Editorial Gredoes, Madrid, 1983, p. 373–379.

Martínez Gázquez, José, Julio Samsó, « Una nueva traducción latina del calendario de Cordoba (siglo XIII) », in Juan Vernet (ed.), *Textos y estudios sobre astronomía española en el siglo XIII*, Facultad de Filosofía y Letras, Universidad Autónoma de Barcelona, Barcelona 1981, p. 9–78.

Materni, Marta, « Attività scientifiche di Gerberto d'Aurillac », *Archivum Bobiense*, 29 (2007), p. 225–317.

McCluskey, Stephen C., *Astronomies and Cultures in Early Medieval Europe*, Cambridge University Press, Cambridge 1998.

Millás Vallicrosa, José María, *Assaig d'història de les idees fisiques i matemàtiques a la Catalunya medieval*, vol. I, Institució Patxot, Barcelona 1931 (Estudis Universitaris Catalans: Sèrie Monogràfica, 1).

— *Las traducciones orientales en los manuscritos de la Biblioteca Catedral de Toledo*, CSIC, Madrid 1942.

— « Sobre un 'Tratado de astrolabio' atribuído a R. Abraham Ibn ʿEzra », *Sefarad*, 4 (1944), p. 31–38.

— « Un nuevo tratado de astrolabio de R. Abraham Ibn ʿEzra », *Al-Andalus*, 5 (1940), p. 1–29.

Neugebauer, Otto, *The Astronomical Tables of Al-Khwārizmī: Translation with Commentaries of the Latin Version ed. by H. Suter, Supplemented by Corpus Christi College MS 283*, Munksgaard, København 1962 (Det Kongelige Danske Videnskabernes Selskab, Historisk-filosofiske Skrifter, 4.2).

Pizzamiglio, Pierluigi (ed.), *Gerardo da Cremona*, Libreria del Convegno, Cremona 1992 (Annali della Biblioteca statale e libreria civica di Cremona, 41).

Poulle, Emmanuel, « La fabrication des astrolabes au Moyen Âge », *Techniques et Civilisations*, 4 (1955), p. 117–128.

— « Les instruments astronomiques de l'Occident latin aux XI^e^ et XII^e^ siècles », *Cahiers de civilisation médiévale*, 15 (1972), p. 27–40.

— « La littérature astrolabique latine jusqu'au XIII^e^ siècle », *Physis*, 32 (1995), p. 227–237.

Puigvert i Planagumà, Gemma, *Astronomia i astrologia al monestir de Ripoll: edició i estudi dels manuscrits científics astronomicoastrològics del monestir de Santa Maria de Ripoll*, Universitat Autònoma de Barcelona, Servei de Publicacions, Barcelona 2000.

Rius, Mònica, « Ibn al-Ṣaffār: Abū al-Qāsim Aḥmad ibn Abd Allāh ibn Umar al-Ghāfiqī ibn al-Ṣaffār al-Andalusī », in Thomas Hockey (ed.), *The Biographical Encyclopedia of Astronomers*, vol. II, Springer, New York 2007, p. 566–567.

Rodríguez Arribas, Josefina, « Medieval Jews and Medieval Astrolabes: Where, Why, How, and What For? », in Sacha Stern, Charles Burnett (eds.), *Time, Astronomy, and Calendars in the Jewish Tradition*, Brill, Leiden 2014 (Time, Astronomy, and Calendars: Texts and Studies, 3), p. 221–271.

Samsó, Julio, « Cultura científica àrab i cultura científica llatina a la Catalunya altmedieval: el monestir de Ripoll i el naixement de la ciència catalana », in *Symposium Internacional sobre els orígens de Catalunya (segles VIII-IX)*, vol. I, Real Academia de Buenas Letras, Barcelona 1991 (Memorias de la Real Academia de Buenas Letras de Barcelona, 23), p. 253–269.

— « Nota acerca de cinco manuscritos sobre astrolabio », *Al-Andalus*, 31 (1966), p. 385–392.

— *On Both Sides of the Strait of Gibraltar: Studies in the History of Medieval Astronomy in the Iberian Peninsula and the Maghrib*, Brill, Leiden 2020 (Handbook of Oriental Studies, Section One, 144).

— « Sobre los materiales astronómicos en el 'Calendario de Córdoba' y en su versión latina del siglo XIII », in Juan Vernet (ed.), *Nuevos estudios sobre astronomía española en el siglo de Alfonso X*, CSIC, Barcelona, 1983, p. 125–138. Reprinted as chapter V in Id., *Islamic Astronomy and Medieval Spain*, Variorum, Aldershot, 1994. Reprinted as chapter VII in Id., *Astrometeorología y astrología medievales*, Universitat de Barcelona, Barcelona 2008.

Samsó, Julio, José Martínez Gázquez, « Algunas observaciones al texto del Calendario de Córdoba », *Al-Qanṭara*, 2 (1981), p. 319–344. Reprinted as chapter VI

in Julio Samsó, *Astrometeorología y astrología medievales*, Universitat de Barcelona, Barcelona 2008.

Schramm, Martin, Carl-Philipp Albert Schütz, Michael Schütz, Martin Brunold, Martin Germann, « Der Astrolabtext aus der Handschrift Codex 196, Burgerbibliothek Bern—Spuren arabischer Wissenschaft im mittelalterlichen Abendland », *Zeitschrift für Geschichte der arabisch-islamischen Wissenschaften*, 17 (2006–2007), p. 199–300.

Sezgin, Fuat, *Geschichte des arabischen Schrifttums*, vol. VI: *Astronomie, Bis ca. 430 H.*, Brill, Leiden 1978.

Thorndike, Lynn, Pearl Kibre, *A Catalogue of Incipits of Mediaeval Scientific Writings in Latin*, rev. edn, Mediaeval Academy of America, London 1963.

Viladrich, Mercè, « The *Mumtaḥan* Tradition in Al-Andalus: Analysis of Data from the *Calendar of Cordova* Related to the Entrance of the Sun in the Zodiacal Signs », in Josep Casulleras, Julio Samsó (eds.), *From Baghdad to Barcelona: Studies in the Islamic Exact Sciences in Honour of Prof. Juan Vernet*, vol. I, Instituto « Millás Vallicrosa » de Historia de la Ciencia Árabe, Barcelona 1996, p. 253–265.