

Were the tables of Ibn Ishāq al-Tūnisī known in Paris c. 1300?

Journal for the History of Astronomy
2024, Vol. 55(4) 490–503
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DOI: 10.1177/00218286241269044
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Abstract

Two Latin sources from the years around 1300 (John of Sicily's commentary on the canons to the Toledan tables and a parchment slip documenting the astronomical activities and observations of Alard of Diest) contain brief references suggesting that Parisian scholars of this period had access to a set of astronomical tables for Tunis known as *tabulae Benesac*. According to the argument developed in this article, the tables in question probably corresponded to a Maghribī *zīj* originally created by Ibn Ishāq al-Tūnisī in c. 1222. The article goes on to discuss the possible channels of transmission that could have brought these tables to Paris as well as the potential implications of this finding for the history of Latin astronomy in the late 13th and early 14th century. Attention is also drawn to the presence of eclipse-related material from the *Muqtabas zīj* by Ibn al-Kammād in a Northern French manuscript of the second half of the 13th century, which was independently translated from the Arabic and accordingly does not derive from the well-known translation by John of Dumpno (Palermo, 1260).

Keywords

Astronomical tables, Maghribī astronomy, Paris, Ibn Ishāq, Ibn al-Kammād, Alard of Diest, John of Sicily

MS Erfurt, Universitätsbibliothek, Dep. Erf. CA 4° 371, a 14th-century book formerly in the possession of Johannes de Wasia (d. 1395), preserves a small parchment slip with writing on one side, which a modern librarian's pencil note designates as 'Einlegezettel 7'. This slip once used to be unattached and simply stuck between two pages of the book (fols. 20v and 21r) but is now glued to the verso of the front flyleaf (fol. IIv).¹ Its top half is occupied by a table containing the ecliptic coordinates of 10 fixed stars, which

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according to the heading were ‘verified in AD 1307 at Diest in Brabant by Master Alard’ (*Stelle fixe verificate anno domini 1307 apud Dieste in Brabancia per magistrum Alardum*). Below the table, the same hand added seven brief notes that all seem to concern Master Alard’s activities as an astronomer. In addition to some intriguing information about his astronomical tables, which shall concern us in what follows, these notes report the value of a local co-latitude ($39;2,44^\circ$), presumably that of Diest, as well as the time of the vernal equinox in 1308 (12 March, 3;40 p.m., sixth degree of Virgo ascending) and some fairly unusual values for the obliquity of the ecliptic ($23;30,20^\circ$), maximum solar equation ($1;53,50^\circ$), and length of the tropical year ($365d\ 5;47h$).²

Beyond the *Einlegezettel* just mentioned, the available documentation regarding the life and career of Alard of Diest is very sparse. His name appears in a list of witnesses from Diest dated 8 December 1302, which refers to him as a *medicus*.³ We also have two copies of a calendar with the times of lunisolar conjunctions for 1301–1376, which Alard claimed to have computed for the meridian of Diest.⁴ His preface to this calendar mentions the time difference between Diest and Paris, which Alard estimated to be approximately half an hour on the basis of eclipses observed from both locations.⁵ In an article published in 1951, Ernst Zinner used some of the data inscribed on the *Einlegezettel* to support his identification of Alard of Diest as the anonymous astronomer whose solar and planetary observations, made in Paris in 1312–1315, are recorded in MS Oxford, Corpus Christi College, 144, fols. 97r–98v.⁶ A more recent study of the solar observations has added weight to Zinner’s conjecture, arguing that it is indeed likely that Alard measured the eccentricity of the solar orbit on three separate occasions in 1308 (Diest), 1312 (Paris), 1314 (perhaps Diest).⁷

A part of the *Einlegezettel* that Zinner passed over in his discussion are the third and fourth of the notes below the star table, which make the surprising claim that ‘Master Alard’ used astronomical tables that were cast for the coordinates of Tunis:

Motus 8^e spere additus locis planetarum inventis per tabulas benesac quibus utitur dictus magister Alardus, et sunt ad latitudinem Thunicii, anno 1307^o: 10 gradus et 55 minuta.

Longitudo Thunicii ab occidente: 29 gradus.

The motion of the eighth sphere that is added in the year 1307 to the positions of the planets found via the tables *benesac*, which are the ones the aforementioned Master Alard uses, and they are for the latitude of Tunis: $10;55^\circ$.

The longitude of Tunis from the West: 29° .

The text just quoted informs us that Alard calculated planetary positions using *tabulae benesac*, which are here said to have been cast for the ‘latitude’ of *Thunicium*, which is Tunis. Given the nature of tables for planetary positions, the claim in the first note that the tables were for the *latitudo* of Tunis is likely to be a mistake, the correct word being *longitudo*. Indeed, the second note gives the *longitudo* of Tunis as 29° ‘from the West’, which must here refer to some variant of the Ptolemaic zero meridian through the Fortunate Islands. Latin astronomers in Alard’s day were familiar with this reference point thanks to

the list of geographic coordinates commonly included in the Toledan Tables, which placed Toledo at 11° from the west and Tunis at 29° , exactly as attested in our source.⁸

An additional piece of information we can glean from the first note is that the *tabulae benesac* were cast for sidereal coordinates, as was typical of Andalusī *zījēs* such as the Toledan Tables.⁹ This is revealed by the statement that the ‘motion of the eighth sphere’ (*motus 8^e spere*), which here refers to an accumulated rate of precession, must be added to the ‘places of the planets’ (*locis planetarum*) shown by Alard’s tables. The method described is analogous to how tropical longitudes were computed via the Toledan Tables, whose tables for the ‘access and recess’ of the eighth sphere would have shown a *motus* of $c.9;31^\circ$ for the beginning of AD 1308.¹⁰ The value our source cites in connection with the *tabulae benesac* is greater by more than a degree, at $10;55^\circ$.

What, then, may be the significance of the label *benesac*? To my knowledge, the only other Latin astronomical text to contain this combination of letters is John of Sicily’s voluminous commentary (inc. *Inter cetera veritatis philosophicae documenta. . .*) on the most commonly attested Latin canons to the Toledan Tables (inc. *Quoniam cuiusque actionis. . .*).¹¹ John’s text, which survives in at least ten complete copies and some fragments, expands on an earlier commentary (inc. *Sicut dicit Hermes. . .*) on the same canons, which was written in Paris at the beginning of the 1290s.¹² From the evidence of passages in John’s commentary that are independent of this source, it appears that he, too, was based in Paris and that he wrote between 1291 and 1293.¹³ Very little else can be said about the author, who appears to have left behind no other surviving work. That he wrote more than just the commentary on the Toledan canons is suggested by an inventory made in 1380 for the books owned by the deceased French king Charles V, which records an *Almagestum* credited to his name.¹⁴ It is perhaps worth considering that this title may refer to a separate work or commentary on planetary theory (*theorica planetarum*), which John appears to have envisaged at the time he composed the commentary on the Toledan canons.¹⁵ What is more important for our present purposes is the following passage in the introduction to the surviving work:

Pars tamen, ad cuius expositionem intenditur, est circa motus et quasdam habitudines et aspectus, de quibus diversi philosophi diversimode tractaverunt. Quidam enim demonstrative, certis probationibus omnia declarando, sicut Ptolemaeus; quidam vias leves et regulas a praedictis demonstrationibus extrahendo, quibus per instrumenta vel per quasdam numerorum collectiones, quas tabulas vocaverunt, loca stellarum, quantitates motuum et alias condiciones certitudinaliter invenerunt, sicut Benesac, Theon et alii plures compositores tabularum, et Azarchel, quem prae ceteris elegi secundum quod deus dederit exponendum.¹⁶

The part [of astronomy], however, whose explanation is [here] intended, concerns the movements and certain conditions and aspects [of celestial bodies], about which different philosophers have written in different ways. For some, like Ptolemy, have taken a demonstrative approach, explaining everything through precise proofs; others have derived easy methods and rules from the aforementioned demonstrations, with which they accurately determined the positions of the stars, the quantities of [their] movements, and other conditions, using instruments or certain numerical collections that they called ‘tables’, as did Benesac, Theon, and many other compilers of tables, and Ibn al-Zarqālluh [*Azarchel*], whom I have chosen to comment on before the others according to what God has given.

In the context of this passage, the word *Benesac* clearly functions as the proper name of an astronomer, who is here mentioned in the illustrious company of Theon of Alexandria and Ibn al-Zarqālluh, the putative author of the Toledan canons.¹⁷ Theon and *Benesac* are explicitly counted amongst the *compositores tabularum*, meaning that they created sets of astronomical tables. In my view, it is hardly plausible that John of Sicily's mention of *Benesac*, the table-maker, and the statement on the *Einlegezettel* about Alard of Diest's use of *tabulae benesac* are unrelated. It would appear instead that John and Alard were aware of the same set of astronomical tables created or compiled by a certain *Benesac*, whose name looks like it may be the result of a Latin transliteration of a Hebrew or Arabic patronym, that is, Ben Yitzhak or Ibn Ishāq.

Given the documented association of the tables of *Benesac* with the coordinates of Tunis, it is tempting to identify this table-maker with Ibn Ishāq al-Tamīmī al-Tūnisī, who was active in Tunis as well as in Marrakesh in c. 1193–1222. He is best known for composing the earliest extant Maghribī *zīj*, datable to c. 1222, which closely adhered to the conventions of earlier Andalusī astronomy.¹⁸ It was accordingly cast for sidereal coordinates and made use of an access-and-recess model to convert sidereal into tropical coordinates. As a follower of certain parameters and models introduced in the 11th century by Ibn al-Zarqālluh, Ibn Ishāq was also a proponent of a variable obliquity of the ecliptic, a variable solar eccentricity, a proper motion of the solar apogee, and a modified Ptolemaic lunar model.¹⁹

While Ibn Ishāq apparently never completed his *zīj*, the tables he managed to compose survive in the form of later 'editions'. One of these is in MS Hyderabad, Andhra Pradesh Government Oriental Manuscripts Library and Research Institute, 298 (Homs, a. 1317), which preserves a large set of tables compiled by an anonymous Tunisian astronomer in the period 1266–1281. Parts that are traceable to Ibn Ishāq include tables for planetary mean motions, equations, eclipses, the equation of time, parallax, and possibly also solar and lunar velocities. The tables for mean motions are calculated for the meridian of Toledo but accompanied by a second set of radices for Tunis.²⁰ Other editions of Ibn Ishāq's *zīj* were made by Ibn al-Bannā' (1256–1321), who used the meridian of Marrakesh,²¹ and Ibn al-Raqqām, who worked in Tunis, Béjaïa and Granada (d. 1315). The latter adapted Ibn Ishāq's original tables no fewer than three times, turning them into *zīj*es that carry the designations *Mustawfi* (for Tunis, after 1280–1281), *Qawīm* (for Tunis, after 1280–1281, later revised for Granada), *Shāmil* (for Béjaïa, c. 1290?).²²

The important role of Ibn al-Raqqām in continuing Ibn Ishāq's legacy warrants a quick aside. As E. S. Kennedy pointed out some decades ago, a Latin manuscript of the late 13th or early 14th century, originally written in Italy but now MS Vienna, Österreichische Nationalbibliothek, 2452, contains a table of geographic coordinates that overlaps significantly with a table in one of the aforementioned *zīj*es by Ibn al-Raqqām, the *Zīj al-Shāmil*.²³ A more compact arrangement of the same coordinate table has come down to us in MS Florence, Biblioteca Riccardia, 866, which shows signs of being closely related with the Vienna manuscript.²⁴ In addition to sharing lists of geographic coordinates, both manuscripts preserve renditions of a small gnomonic table for solar azimuths and shadow lengths, which according to the headings was calculated for the latitude of Tunis (36°).²⁵ A closer study of these manuscripts would fall outside the remit of the present article.²⁶ What they demonstrate, however, is that a transmission of

astronomical material from the Maghrib to Latin Europe *did* occur during the period under discussion (approx. 1275–1325) and that it was not limited to the singular case of the *tabulae Benesac* used by Alard of Diest.

Now, if the reference to *Benesac* in John of Sicily's commentary is indeed to Ibn Ishāq, this presumably means that some version of his tables had arrived in Paris by c.1293, which would in turn explain how Alard of Diest became acquainted with them. That Alard received his training as an astronomer and physician in Paris seems rather likely based not just on the relatively close geographic proximity between Paris and Diest (making Paris the nearest available university), but because of Alard's own mention of Parisian eclipse observations in the introduction to his calendar of c.1301.²⁷

If the tables of Ibn Ishāq were known at the University of Paris by the end of the 13th century, the question arises through which channels of transmission they could have arrived there. One fairly obvious point of origin is the Toledan court of Alfonso X of Castile and León (1252–1284), seeing as (a) Ibn Ishāq's tables were available there by the 1270s and that (b) the transmission of astrological and astronomical material from Alfonso's court to Paris is a documented occurrence.²⁸ The material in question famously included the so-called Alfonsine Tables, which began to be adopted into widespread use around 1320. David Juste has recently drawn attention to manuscript evidence suggesting that either the Alfonsine Tables themselves or the star catalogue associated with them had become known in France or Italy well before this date, by 1304.²⁹ Other works that travelled from Alfonso's court to Paris in this period include *De iudiciis astrorum* by 'Alī ibn Abī l-Rijāl (or Haly Abenragel) and 'Alī ibn Riḍwān's (Haly Abenrudian) commentary on Ptolemy's *Quadripartitum*, which were both rendered into Latin by the Alfonsine translator Egidius de Tebaldis between 1253 and 1275.³⁰ These texts must have arrived in Paris well before 1306, as seen from two manuscripts commissioned, owned and annotated by the Parisian scholar Peter of Limoges (MSS Paris, Bibliothèque nationale de France, lat. 16206 and lat. 16653).³¹ The suggestion that Ibn Ishāq's tables travelled to Paris via a similar route, that is, via the Alfonsine court in Toledo, does not seem too far-fetched.

There is, however, another possibility that would seem to merit serious consideration. From a letter addressed to the scholars of Paris in 1263, it can be inferred that King Manfred of Sicily (1258–1266) gifted to the university a larger number of philosophical books, which he advertised as newly commissioned translations from Greek and Arabic.³² While numerous Greek-to-Latin translations are indeed known to have been made in Manfred's kingdom under his patronage, it is difficult to identify examples of direct translations from Arabic.³³ One such case may be John of Dumpno's Latin version of the *Muqtabas zīj* by the Andalusī astronomer Ibn al-Kammād (*fl.* 1116/17), which was completed in Palermo on 27 August 1260.³⁴ The only surviving manuscript of this translation, MS Madrid, Biblioteca nacional de España, 10023, has the appearance of a presentation copy that could well have been intended for a royal patron such as Manfred.³⁵ Here the question arises if a Latin translation of Ibn Ishāq's *zīj* may have been produced in a similar context. The geographic proximity between Sicily and Tunis may speak in favour of this conjecture, as may the fact that the first Latin writer to mention *Benesac* went by the name of John of Sicily.

Assuming that my interpretation of the evidence presented above is correct, the conclusion that Ibn Ishāq's *zīj* travelled as far as Paris and Diest has potentially far-reaching consequences for our understanding of the history of Latin astronomy in the last quarter of the 13th and the first quarter of the 14th century. In 2019 Julio Samsó published an important article showing that the mean-motion parameters in the extant Latin version of the Alfonsine Tables were derived from those in Ibn Ishāq's tables, which he took as confirmation of the view that this Latin version had the same Toledan origin as its lost Castilian counterpart. Arguing against an influential hypothesis according to which the Latin Alfonsine Tables were instead created in Paris in the 1320s, Samsó went on to note that 'it seems difficult to conceive that Ibn Ishāq's *zīj* could have been available to the Parisian astronomers'.³⁶ While I see no reason to disagree with Samsó about the Toledan origin of the Latin Alfonsine Tables, the potential finding that Ibn Ishāq's *zīj* was, in fact, available in Paris prior to the adoption of the Alfonsine Tables complicates our picture. At the very least, it raises questions about the influence Ibn Ishāq's tables may have exerted in this period, and whether it is still detectable in some hitherto overlooked or unexplained aspects of Latin computational astronomy.

One work from this tradition that has to some extent puzzled modern researchers are the tables of Jean Vimond, which were created for the meridian of Paris and an epoch date in 1320. While these tables share most of their parameters with the Latin Alfonsine Tables, they also exhibit numerous idiosyncrasies that cannot be fully explained on this basis. This includes features that lack a clear precedent in Latin astronomy but are familiar from earlier Andalusī and Maghribī *zīj*es.³⁷ Among the instances first identified by José Chabás and Bernard R. Goldstein in their groundbreaking study of Jean Vimond's tables is the fact that they make the solar and planetary apogees move at an implicit rate of $0;0,0,11,13,35^{\circ}/d$. What is surprising about this rate of motion is that it seems too rapid to reflect merely the assumed rate of precession, which in that case would amount to 1° per approx. 52;41y. Chabás and Goldstein have suggested that it was supposed to represent a combined motion that included both a precession parameter of approx. $0;0,0,9^{\circ}/d$ and an apogeal proper motion of approx. $0;0,0,2^{\circ}/d$.³⁸ The idea that the solar apogee moves at something close to the latter rate ($0;0,0,2,7,10,38^{\circ}/d$) goes back to Ibn al-Zarqālluh's treatise *On the Solar Year* (1075/1080), from where it passed into subsequent Andalusī and Maghribī *zīj*es. In some of them, including Ibn al-Kammād's *Muqtabas zīj* and certain 'editions' of Ibn Ishāq's tables, this proper motion is also applied to the apogees of the five planets, which thus move at a fixed interval from the solar apogee.³⁹ Jean Vimond's tables operated on the same assumption.

Another trait that Vimond's tables happen to share with *zīj*es in the Andalusī and Maghribī tradition is the separation of the equation of centre and equation of anomaly for each of the five planets into different tables.⁴⁰ No other set of Latin astronomical tables extant from before 1320 presents the equations in this way. Instead, they follow the traditional Ptolemaic model of presenting the terms needed to compute the total equation for one planet in a single table. Separate sets of tables for the equations of centre and anomaly are instead a feature of the tables of Ibn Ishāq, as revealed by the extant 13th-century editions.⁴¹ Moreover, Chabás and Goldstein have pointed out that Vimond's tables for the equation of anomaly contain two unusual columns that are functionally

identical with columns in the tables for the equation of anomaly of Saturn and Jupiter in the *zīj* of Ibn al-Bannā': one showing the equation of anomaly when the epicycle is at maximum (as opposed to mean) distance and another showing the difference between the corrections necessary at maximum and minimum distance.⁴²

A thorough search for hidden traces of Ibn Ishāq's influence on Latin astronomy would also have to include the highly complex manuscript tradition of the Toledan Tables, which features a host of sporadically attested tables that do not seem to share an origin with the main set. One such example is a table for computing the proper motion of the solar apogee according to the model of Ibn al-Zarqālluh, which has so far only been found in three manuscripts: MSS London, Royal Astronomical Society, Add. 1 Vol. 2, fol. 54v (s. XIII); Paris, Bibliothèque nationale de France, lat. 7198, fol. 97r (Northern France, probably Paris; s. XIII^{ex}/XIVⁱⁿ); Vatican City, Biblioteca Apostolica Vaticana, Reg. lat. 1013, fol. 80v (s. XIVⁱⁿ).⁴³ All three manuscripts have in common that they were written in or close to the period under discussion, while one of them is very likely to have originated in Paris.⁴⁴ Although it seems perfectly possible that this table came to Latin Europe through other (presumably Andalusī) channels, one should at least note that the five known editions of the tables of Ibn Ishāq all contain a table for the solar apogee that is structurally and numerically nearly the same as the one found in these manuscripts.⁴⁵ It also seems worth recording that two of the manuscripts just mentioned, MSS London, Royal Astronomical Society, Add. 1, Vol. 2, fol. 61v, and Vatican City, Biblioteca Apostolica Vaticana, Reg. lat. 1013, fol. 80v, are among the three known Latin witnesses to an Andalusī table for lunar crescent visibility, which is once again not a standard part of the Toledan Tables but can be found in the Hyderabad manuscript containing a 13th-century Tunisian edition of Ibn Ishāq's tables.⁴⁶

Another manuscript of the Toledan Tables whose contents may be relevant to an investigation of Ibn Ishāq's influence is MS Vatican City, Biblioteca Apostolica Vaticana, Pat. lat. 1414 (= *V*), which originated in Northern France, probably in Paris, in the second half of the 13th century (a colophon added on fol. 224rb gives the date of the final item as 12 November 1266).⁴⁷ The Toledan Tables (fols. 86r–140r) are here followed by an unusual canon for eclipses, headed *Incipit quedam doctrina de invenienda eclipsi solis et lune breviter* (fols. 140v–141r), and eight associated tables (fols. 141v–143r), which all have close counterparts in the *Muqtabas zīj* of Ibn al-Kammād.⁴⁸ As was already mentioned above, the *Muqtabas zīj* was translated into Latin by John of Dumpno in 1260, which may seem to suffice as an explanation why some of its tables reappear in a Northern French manuscript written not much later. One reason to remain sceptical, however, are the irritating discrepancies that exist between the eclipse-related material found in *V* and the main witness to John of Dumpno's translation, which is MS Madrid, Biblioteca nacional de España, 10,023 (= *M*). These discrepancies are not limited to some deviations in the tables' numerical content but also include changes to the order and format in which the tables are presented as well as striking differences in the wording of individual table headings.⁴⁹ What also deserves to be highlighted are the significant differences between the eclipse canon that precedes the tables in *V* and the corresponding chapter 27 in *M*. Even in passages where their content is parallel, there is little to no overlap between the respective wording, as one may see from the following comparison:

M, fols. 15vb–16ra:

Directio autem eclipsium lunarium per tabulam est ut scias oppositionem eclipsis cuius hore est tempus dimidii eclipsis specialiter, que oppositio fuerit in nocte et fuerit sol prope hos duos nodos [ms. modos], videlicet caput et cauda, minus 12^{cim} gradibus.

Et accipe longitudinem que fuerit inter locum lune et locum illius nodi super quo nodo erit eclipsis, <si> precedens fuerit luna ipsum nodum vel succedens, et intra cum ipsa latitudine [sic] in tabula eclipsium lunarium et accipe quod in directo eius inveneris in porta prima ex digitis corporis lune et minutis eius, et hoc erit quod eclipsabitur de luna.

Et accipe etiam quod inveneris in directo eius in porta secunda ex horis temporis eclipsis et minutis earum et accipe etiam quod inveneris in directo eius in porta tertia ex horis temporis durationis lune in nigredine et minuta earum. Deinde divide horas secunde porte in duas partes equales et subtrahe unam partem ex ipsis duabus partibus [16ra] ab horis oppositionis eclipsis, erit initium eclipsis.

Et adde partem secundam ex ipsis duabus partibus super horis oppositionis, erit perfectio claritudinis lune.

Et quod accepisti ex horis durationis erit tempus in quo permanebit luna denigrata.

V, fol. 141r:

Cum volueris invenire eclipsim lune, scias oppositionem solis et lune et utrum sit nocturna et quod sit luna prope nodum draconis minus 12 gradibus.

Et accipe longitudinem que est inter nodum draconis et lunam, sive sit draco ante lunam, sive post, et intra cum hac longitudine in tabulam eclipsis lune. Et accipe quod in directo inveneris [141rb] in prima ianua numerum digitorum corporis lune et minuta et hoc erit quod eclipsabitur de corpore lune.

Et iterum intra in ianua secundam in directo illius numeri digitorum et minorum in horas et minuta. Et similiter in tertiā ianuam in horas cooperationis et in minuta.

Deinde divide horas ianue secunde per medium et minue unam medietatem de horis cooperationis et hoc erit initium eclipsis.

Et alteram medietatem adde supra illud et erit finis decooperationis.

Et hore quas accepisti in tertia ianua sunt quod luna moratur in tenebris. Et hore quas accepisti cooperationis est tempus quod luna est tota nigra.

While some of the manifest differences in sentence structure and length may have come about through editorial intervention, the differences in technical vocabulary are so stark that they are best explained as reflecting two independent Arabic-to-Latin translations. A case in point is the Arabic word *bāb* (literally ‘door’), which designates the three columns of Ibn al-Kammād’s table of lunar eclipses, that is, for (1) magnitudes, (2) eclipse duration, and (3) duration of totality. In John of Dumpno’s translation (M, fol. 52v), these three columns are headed *prima porta*, *secunda porta* and *tercia porta*, which is also the terminology used in the chapter quoted above.⁵⁰ By contrast, the version in V employs *ianua* instead of *porta* in both the table (V, fol. 143r) and the corresponding part of the canon. A similar picture emerges from a comparison between the headings for a table for finding the declination of upper midheaven as a function of the longitude of the ascendant, which is headed *Tabula rectitudinum ad eclipsos (sic) solares* in John of Dumpno’s translation (M, fol. 52v), but *Tabula azimuth eclipsis solis* in V (fol. 141v), where *tabula azimuth* partly translates and partly transliterates the Arabic *jadwal al-samt*.⁵¹

If V preserves an independent translation of the material concerning eclipses on fols. 140v–143r, it cannot be taken for granted that the source in question was the *Muqtabas zij*.

Instead, it may be the case that eclipse canon and associated tables were taken from another Andalusī or Maghribī *zīj* influenced by it, such as the *tabulae Benesac*. One reason for considering this possibility is that the earliest preserved edition of the tables of Ibn Ishāq (Hyderabad MS 298) incorporates numerous canons and tables drawn from Ibn al-Kammād's *zīj*es, including tables that closely resemble the parallax tables in *M* (fol. 53r–v) and *V* (fols. 142v–143r).⁵²

The note mentioning Alard's use of the tables of *Benesac* contains a piece of information that warrants one further comment. As seen from the passage quoted at the start of this article, the claim is made that the *motus* of the eighth sphere necessary to convert the planetary longitudes found with this set of tables from sidereal into tropical is $10;55^\circ$. This exceeds the maximum value of $10;45^\circ$ in the Toledan Tables, but also the $10;24^\circ$ allowed for by most *zīj*es in the tradition of Ibn Ishāq.⁵³ While it is always possible that the $10;55^\circ$ on the *Einlegezettel* are the result of a scribal error, Alard of Diest may have assumed a larger *motus* of $10;55^\circ$ on purpose in order to yield better predictions of tropical longitudes than his tables would have otherwise provided. A relevant example in this regard is provided by William of Saint-Cloud, active in Paris in the 1290s, who famously used observational evidence to increase the *motus* of the eighth sphere according to the Toledan model by $0;50^\circ$.⁵⁴ If Alard desired to test or improve the accuracy of the tables available to him, this may, in fact, explain some of his observational activities, as are documented by the *Einlegezettel* and possibly also by the Parisian observations of 1312–1315. It may not be a coincidence that several of these observations concerned the obliquity of the ecliptic and the eccentricity of the solar orbit – quantities that were constant according to the common Toledan Tables but subject to variation according to the tables of Ibn Ishāq.⁵⁵ Even if we discard the Parisian observations on account of their anonymity, the *Einlegezettel* by itself shows that Alard took an active interest in these parameters, as it lists a maximum solar equation of $1;53,50^\circ$ and an obliquity of $23;30,20^\circ$. It seems worth noting that the latter value would have been incompatible with Ibn Ishāq's tables, where $23;32,30^\circ$ (raised to $23;32,40^\circ$ in two of Ibn al-Raqqām's *zīj*es) is the theoretical minimum for the obliquity of the ecliptic.⁵⁶

In a 2014 article reviewing the Arabic influence on medieval European astronomical tables, José Chabás came to the conclusion that '[t]he overall picture of the transmission of Arabic astronomical tables to medieval Europe seems quite clear, but to fill the gap between Andalusian and Maghribi tables up [to] the 13th century and those developed in Latin Europe beginning in the early 14th century, more research has to [be] done on both sides'.⁵⁷ The present article has attempted to offer some new perspectives that may help us fill the gap identified by Chabás. My arguments in favour of the hypothesis that Ibn Ishāq's tables were known in Paris in the years around 1300, and that they may have had some influence on the development of Latin astronomy, must necessarily remain speculative, owing to the terse and fragmentary nature of the evidence. I nevertheless hope that they will be of some use to other researchers, by opening perspectives for future enquiry into this important period in the history of pre-modern mathematical astronomy.

Notes on Contributor

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Notes

1. A digital presentation of the manuscript is available at <https://dnh.thulb.uni-jena.de/receive/ufb_cbu_00022189>. See also the older description in W. Schum, *Beschreibendes Verzeichnis der Amplonianischen Handschriften-Sammlung zu Erfurt* (Berlin: Weidmann, 1887), p. 622. On Johannes de Wasia, see K. De Cock and A. Pattin, “Joannes de Wasia († 1395), wijsgeer, theoloog en eerste deken van de theologische faculteit van de universiteit te Keulen,” *Tijdschrift voor Filosofie*, 35 (1973), 344–51.
2. A more precise value for the tropical year of 365d 5;47,9h is ascribed to *magister Alardus* in a gloss contained in MS Berlin, Staatsbibliothek, lat. fol. 610, fol. 130r.
3. K.F. Stallaert, “Inventaire analytique des chartes concernant les seigneurs et la ville de Diest,” *Compte-rendu des séances de la commission royale d’histoire*, 10th ser., 3 (1876), 165–314 (197); F. Vercauteren, “Les médecins dans les principautés de la Belgique et du nord de la France, du VIII^e au XIII^e siècle,” *Le Moyen Âge*, 57 (1951), 61–92 (87, 90).
4. MS Erfurt, Universitätsbibliothek, Dep. Erf. CA 4^o 370, fols. 1r–7v. The other copy is in a private collection. See J.P. Gumbert, *Bat Books: A Catalogue of Folded Manuscripts Containing Almanacs or Other Texts* (Turnhout: Brepols, 2016), pp. 74, 93–5.
5. MS Erfurt, Universitätsbibliothek, Dep. Erf. CA 4^o 370, fol. 1v: “Locus autem super cuius meridiem hoc kalendarium est factum est Dist in Brabantia, cuius latitudo est 50 graduum et 58 minutorum. Meridies autem eius precedit meridiem Parisiensem fere per dimidiam horam, sicut per eclipses ibidem et Parisius observantes inveni.”
6. E. Zinner, “Magister Alard von Diest und die Pariser Beobachtungen von 1312–15,” *Isis*, 42 (1951), 38–40.
7. C.P.E. Nothaft, “On Some Early European Measurements of the Eccentricity of the Solar Orbit (1308–1314),” *Journal for the History of Astronomy*, 55 (2024), 143–55.
8. F.S. Pedersen, *The Toledan Tables: A Review of the Manuscripts and the Textual Versions With an Edition*, 4 vols. (Copenhagen: Reitzel, 2002), vol. 4, p. 1512 (MA11). On the background, see C.P.E. Nothaft, “Geographic Longitude in Latin Europe During the Twelfth and Thirteenth Centuries,” *Archive for History of Exact Sciences*, 78 (2024), 29–65.
9. On medieval Andalusi zījes, see J. Samsó, *On Both Sides of the Strait of Gibraltar: Studies in the History of Medieval Astronomy in the Iberian Peninsula and the Maghrib*. Handbook of Oriental Studies, Section One, 144 (Leiden: Brill, 2020), pp. 683–764.
10. For the relevant tables and parameters, see Pedersen, *op. cit.* (Note 8), pp. 1542–66 (PA11–PC45).
11. Critical edition in: F.S. Pedersen, “Scriptum Johannis de Sicilia super canones Azarchelis de tabulis Toletanis,” pt. 1, *Cahiers de l’Institut du Moyen Âge Grec et Latin*, 51 (1986), pp. 1–128; pt. 2, *ibid.*, 52 (1986), pp. 1–268.
12. F.S. Pedersen, “Anonymous Parisian Astronomer of 1290,” pt. 1, *Cahiers de l’Institut du Moyen Âge Grec et Latin*, 72 (2001), pp. 169–269; pt. 2, *ibid.*, 73 (2002), pp. 61–166.
13. Pedersen, *op. cit.* (Note 11), pt. 1, pp. 8–11.
14. J.-P. Boudet, “La science des étoiles dans la librairie de Charles V,” in J. Ducos and M. Goyens (eds), *Traduire au XIV^e siècle: Evrart de Conty et la vie intellectuelle à la cour de Charles V* (Paris: Champion, 2015), pp. 379–401 (394). The entry (no. 559) concerns an “Almagesti Johannis de Cicilia,” while another (no. 750) mentions the commentary on the Toledan canons: “Scripta Johannis de Cicilia super canonez Azarchachelliz, Tabulas Tholetanas”.
15. John of Sicily, *Scriptum super canones Azarchelis*, J284(m), 285(u), ed. Pedersen, *op. cit.* (Note 11), pt. 2, pp. 134–5.

16. John of Sicily, *Scriptum super canones Azarchelis*, J15, ed. Pedersen, *op. cit.* (Note 11), pt. 2, p. 7.
17. Sources that may have inspired John's mention of Theon of Alexandria include: al-Battānī, *De scientia astrorum*, trans. Plato of Tivoli, c. 39, in *Continetur in hoc libro: Rudimenta astronomica Alfragani. Item Albategnius astronomus peritissimus de motu stellarum* (Nuremberg: Petreius, 1537), fol. 52r; *Almagesti minor* 5.21, ed. H. Zepeda, *The First Latin Treatise on Ptolemy's Astronomy: The Almagesti minor (c. 1200)* (Turnhout: Brepols, 2018), p. 420; Ca158, ed. Pedersen, *op. cit.* (Note 8), vol. 1, p. 288; al-Bīṭrūjī, *De motibus celorum*, trans. Michael Scot, c. 10.16, ed. F.J. Carmody (Berkeley, CA: University of California Press, 1952), p. 101.
18. Samsó, *op. cit.* (Note 9), pp. 11–12, 764–795; D.A. King and J. Samsó, "Astronomical Handbooks and Tables from the Islamic World (750–1900): An Interim Report," *Suhayl*, 2 (2001), pp. 9–105 (60–2). For the wider background, see D.A. King, "On the History of Astronomy in the Medieval Maghrib," in *Études philosophiques et sociologiques dédiées à Jamal ed-Dine Alaoui* (Fez: Département de Philosophie, Sociologie et Psychologie, 1998), pp. 27–61, repr. as ch. 6 in King, *Islamic Astronomy and Geography* (Farnham: Ashgate Variorum, 2012); J. Samsó, "Andalusian Astronomy in 14th Century Fez: *Al-Zij al-Muwāfiq* of Ibn 'Azzūz al-Qusanfīnī," *Zeitschrift für Arabisch-Islamischen Wissenschaften*, 11 (1997), pp. 73–110, repr. as ch. 9 in Samsó, *Astronomy and Astrology in al-Andalus and the Maghrib* (Aldershot: Ashgate, 2007).
19. On Ibn al-Zarqālluh's theoretical innovations and their adoption by later Andalusī and Maghribī astronomers (including Ibn Ishāq), see Samsó, *op. cit.* (Note 9), pp. 577–682; Samsó, "Astronomical Observations in the Maghrib in the Fourteenth and Fifteenth Centuries," *Science in Context*, 14 (2001), pp. 165–78, repr. as ch. 12 in Samsó, *Astronomy and Astrology in al-Andalus and the Maghrib* (Aldershot: Ashgate, 2007); M. Comes, "À propos de l'influence de l'al-Zarqālluh en Afrique du Nord: l'apogée solaire et l'obliquité de l'écliptique dans le *zīj* d'Ibn Ishāq," in *Actas del II Coloquio Hispano-Marroquí de Ciencias Históricas "Historia, Ciencia y Sociedad"*, Granada, 6–10 noviembre de 1989 (Madrid: Agencia Española de Cooperación Internacional, Instituto de Cooperación con el Mundo Árabe, 1992), pp. 147–59, repr. as ch. 4 in M. Rius Piniés and S. Gómez Muns (eds), *Homenaje a Mercè Comes: Coordenadas del Cielo y de la Tierra* (Barcelona: Universitat de Barcelona, 2014); M. Comes, "The Accession and Recession Theory in al-Andalus and the North of Africa," in J. Casulleras and J. Samsó (eds), *From Baghdad to Barcelona: Studies in the Islamic Exact Sciences in Honour of Prof. Juan Vernet*, 2 vols. (Barcelona: Instituto "Millás Valicrosa" de Historia de la Ciencia Árabe, 1996), vol. 1, pp. 349–64, repr. as ch. 6 in *Homenaje*; M. Comes, "Some New Maghribī Sources Dealing with Trepidation," in S.M. Razaullah Ansari (ed.), *Science and Technology in the Islamic World* (Turnhout: Brepols, 2002), pp. 121–41, repr. as ch. 8 in *Homenaje*.
20. A. Mestres, "Maghribī Astronomy in the 13th Century: A Description of Manuscript Hyderabad Andra Pradesh State Library 298," in J. Casulleras and J. Samsó (eds), *From Baghdad to Barcelona: Studies in the Islamic Exact Sciences in Honour of Prof. Juan Vernet*, 2 vols. (Barcelona: Instituto "Millás Valicrosa" de Historia de la Ciencia Árabe, 1996), vol. 1, pp. 383–443; A. Mestres, "Materials andalusins en el *zīj* d'Ibn Ishāq al-Tūnisī" (PhD Dissertation, University of Barcelona, 1999). See also J. Samsó and H. Mielgo, "Ibn Ishāq al-Tūnisī and Ibn Mu'ādh al-Jayyānī on the Qibla," ch. 6 in J. Samsó (ed.), *Islamic Astronomy and Medieval Spain* (Aldershot: Variorum, 1994).
21. J. Vernet, *Contribución al estudio de la labor astronómica de Ibn al-Bannā'* (Tétouan: Editora Marroquí, 1951); J. Vernet "La supervivencia de la astronomía de Ibn al-Bannā' ," *Al-Qanṭara*, 1 (1980), pp. 447–51; M. Comes, "Deux échos andalus à Ibn al-Bannā' de Marrākush," in *Le Patrimoine Andalous dans la culture Arabe et Espagnole* (Tunis: Université de Tunis,

- Centre d'Études et de Recherches Économiques et Sociales, 1991), pp. 81–94, repr. as ch. 5 in M. Rius Piniés and S. Gómez Muns (eds), *Homenaje a Mercè Comes: Coordenadas del Cielo y de la Tierra* (Barcelona: Universitat de Barcelona, 2014); J. Samsó and E. Millás, "Ibn al-Bannā', Ibn Ishāq and Ibn al-Zarqālluh's Solar Theory," ch. 10 in J. Samsó (ed.), *Islamic Astronomy and Medieval Spain* (Aldershot: Variorum, 1994); J. Samsó and E. Millás, "The Computation of Planetary Longitudes in the *Zīj* of Ibn al-Bannā'," *Arabic Sciences and Philosophy*, 8 (1998), pp. 259–86, repr. as ch. 8 in J. Samsó, *Astronomy and Astrology in al-Andalus and the Maghrib* (Aldershot: Ashgate, 2007); Samsó, *op. cit.* (Note 9), pp. 768, 781–92.
22. E.S. Kennedy, "The Astronomical Tables of Ibn al-Raqqām a Scientist of Granada," *Zeitschrift für Geschichte der Arabisch-Islamischen Wissenschaften*, 11 (1997), pp. 35–72; J. Samsó, "Lunar Mansions and Timekeeping in Western Islam," *Suhayl*, 8 (2008), pp. 121–61 (125–8); J. Samsó, "Ibn al-Raqqām's *al-Zīj al-Mustawfī* in MS Rabat National Library 2461," in N. Sidoli and G. Van Brummelen (eds), *From Alexandria, Through Baghdad: Surveys and Studies in the Ancient Greek and Medieval Islamic Mathematical Sciences in Honor of J.L. Berggren* (Berlin: Springer, 2014), pp. 297–328; Samsó, *op. cit.* (Note 9), pp. 768–71; M. Díaz-Fajardo, "*Al-Zīy al-Mustawfī* de Ibn al-Raqqām y los apogeos planetarios en la tradición andaluso-magrebí," *Al-Qanṭara*, 26 (2005), pp. 19–30; J. Casulleras, "The Rising and Setting of the Stars in the Astronomical Tables of Ibn al-Raqqām al-Andalusī," *Archives internationales d'histoire des sciences*, 62 (2012), pp. 43–54.
23. MS Vienna, Österreichische Nationalbibliothek, 2452, fols. 10v–12r. See Kennedy, *op. cit.* (Note 22), pp. 66–7; F. Sezgin, *Geschichte des arabischen Schrifttums*, vol. 10, *Mathematische Geographie und Kartographie im Islam und ihr Fortleben im Abendland: Historische Darstellung* (Frankfurt/Main: Institut für Geschichte der arabisch-islamischen Wissenschaften, 2000), p. 231; F. Sezgin, *Geschichte des arabischen Schrifttums*, vol. 13, *Mathematische Geographie und Kartographie im Islam und ihr Fortleben im Abendland: Autoren* (Frankfurt/Main: Institut für Geschichte der arabisch-islamischen Wissenschaften, 2007), pp. 394–8.
24. MS Florence, Biblioteca Riccardiana, 866, fols. 12v–13r.
25. MSS Florence, Biblioteca Riccardiana, 866, fol. 15r; Vienna, Österreichische Nationalbibliothek, 2452, fol. 14r.
26. I hope to return to this material in a future publication.
27. See above, Note 5.
28. On the use of Ibn Ishāq's tables by King Alfonso's astronomers, see Samsó, *op. cit.* (Note 9), pp. 836–9, 844–7. On the diffusion of Alfonsine astronomy to other parts of Latin Europe, see L. Fernández Fernández, "The *Libro de las tablas alfonsies*: New Documentary and Material Sources," in R.L. Kremer, M. Husson, and J. Chabás (eds), *Alfonsine Astronomy: The Written Record* (Turnhout: Brepols, 2022), pp. 21–55. On the wider background, see K. Kennedy, *Alfonso X of Castile-León. Royal Patronage, Self-Promotion and Manuscripts in Thirteenth-Century Spain* (Amsterdam: Amsterdam University Press, 2019).
29. D. Juste, "The Alfonsine Tables Mentioned in 1304," *Journal for the History of Astronomy*, 54 (2023), pp. 213–9.
30. On the latter translation, see D. Juste, "Haly Abenrudian, *Glosa super Quadripartito Tholomei* (update: 19.02.2024)," *Ptolemaeus Arabus et Latinus. Works*, <<http://ptolemaeus.badw.de/work/47>>.
31. Juste, *op. cit.* (Note 29), p. 217. On Peter of Limoges's prominent role in the astrological "scene" of late-thirteenth-century Paris, see D. Juste, "Bate's *Nativitas* in Context," in C. Steel, S. Vanden Broecke, D. Juste and S. Sela (eds), *The Astrological Autobiography of a Medieval Philosopher: Henry Bate's Nativitas (1280–81)* (Leuven: Leuven University Press, 2018), pp. 65–85 (68–74).

32. The letter is edited in R.A. Gauthier, "Notes sur les débuts (1225–1240) du premier 'averroïsme'," *Revue des sciences philosophiques et théologiques*, 66 (1982), pp. 321–74 (323–4). See also C. Burnett, "The Statements of Medieval Latin Translators on Why and How They Translate Works on Science and Philosophy from Arabic," in D. Gutas (ed.), *Why Translate Science? Documents from Antiquity to the 16th Century in the Historical West (Bactria to the Atlantic)* (Leiden: Brill, 2022), pp. 445–87 (454, 470–71, 483). On King Manfred's patronage, see P. de Leemans (ed.), *Translating at the Court: Bartholomew of Messina and Cultural Life at the Court of Manfred, King of Sicily*, *Mediaevalia Lovaniensia, Series I: Studia*, 45 (Leuven: Leuven University Press, 2014).
33. For a listing of thirteenth-century translations and translators from Arabic, see A.A. Akasoy, A. Fidora, and C. Burnett, "Übersetzungen aus dem arabischen und hebräischen ins Lateinische," in A. Brungs, V. Mudroch, and P. Schulthess (eds), *Die Philosophie des Mittelalters*, vol. 4, *13. Jahrhundert* (Basel: Schwabe, 2017), pp. 130–43.
34. On this work, see J. Chabás and B.R. Goldstein, "Andalusian Astronomy: *Al-Zij al-Muqtabis* of Ibn al-Kammād," *Archive for History of Exact Sciences*, 48 (1994), pp. 1–41; J. Chabás and B.R. Goldstein, "Ibn al-Kammād's *Muqtabis* Zij and the Astronomical Tradition of Indian Origin in the Iberian Peninsula," *Archive for History of Exact Sciences*, 69 (2015), pp. 577–650; B.R. Goldstein and J. Chabás, "Ibn al-Kammād's Star List," *Centaurus*, 38 (1996), pp. 317–34; J.L. Mancha, "On Ibn al-Kammād's Table for Trepidation," *Archive for History of Exact Sciences*, 52 (1998), pp. 1–11; J. Chabás, *Computational Astronomy in the Middle Ages: Sets of Astronomical Tables in Latin* (Madrid: CSIC, 2019), pp. 77–102; Samsó, *op. cit.* (Note 9), pp. 610–17, 735–51.
35. Description and edition of extracts in J.M. Millás Vallicrosa, *Las traducciones orientales en los manuscritos de la Biblioteca Catedral de Toledo* (Madrid: CSIC, 1942), pp. 231–47.
36. J. Samsó, "Ibn Ishāq and the Alfonsine Tables," *Journal for the History of Astronomy*, 50 (2019), pp. 360–65 (363). See also Samsó, *op. cit.* (Note 9), pp. 844–9; J. Chabás and B.R. Goldstein, "New Approaches and Parameters in the Parisian Alfonsine Tables," *Suhayl*, 18 (2020–2021), pp. 51–68 (63–6). On the debate concerning the origins of the Alfonsine Tables, see N.M. Swerdlow, "Essay Review: Alfonsine Tables of Toledo and Later Alfonsine Tables," *Journal for the History of Astronomy*, 35 (2004), pp. 479–84; C.P.E. Nothhaft, "A New Series on Alfonsine Astronomy," *Journal for the History of Astronomy*, 54 (2023), pp. 113–8.
37. The main study is J. Chabás and B.R. Goldstein, "Early Alfonsine Astronomy in Paris: The Tables of John Vimond (1320)," *Suhayl*, 4 (2004), pp. 207–294. For other publications on Jean Vimond's tables, see J. Chabás and B.R. Goldstein, "John Vimond and the Alfonsine Trepidation Model," *Journal for the History of Astronomy*, 34 (2003), pp. 163–70; J. Chabás and B.R. Goldstein, *The Alfonsine Tables of Toledo* (Dordrecht: Springer, 2003), pp. 267–77; Chabás, *op. cit.* (Note 34), pp. 133–46.
38. Chabás and Goldstein, "Early Alfonsine Astronomy" *op. cit.* (Note 37), pp. 220–21, 231–3, 242–3.
39. Samsó, *op. cit.* (Note 9), pp. 654–61, 774–8.
40. Chabás and Goldstein, "Early Alfonsine Astronomy" *op. cit.* (Note 37), pp. 236–56. See also J. Chabás and B.R. Goldstein, "Computing Planetary Positions: User-Friendliness and the Alfonsine Corpus," *Journal for the History of Astronomy*, 44 (2013), pp. 257–76 (262–5); B.R. Goldstein and J. Chabás, "Continuity and Change: The Planetary Equation Tables of John Vimond and Nicolaus Copernicus," *Physis*, 58 (2023), pp. 61–83.
41. Mestres, "Maghribī Astronomy" *op. cit.* (Note 20), pp. 415–8; Samsó, "Ibn al-Raqqām's *al-Zij al-Mustawfi*" *op. cit.* (Note 22), pp. 316–9.
42. Chabás and Goldstein, "Early Alfonsine Astronomy" *op. cit.* (Note 37), pp. 250–51; Chabás and Goldstein, "Computing Planetary Positions" *op. cit.* (Note 40), pp. 264–5; cf. Samsó and Millás, "The Computation" *op. cit.* (Note 21), pp. 278–85; Samsó, *op. cit.* (Note 9), pp. 785–92.

43. The table is edited from these witnesses in Pedersen, *op. cit.* (Note 8), vol. 3, pp. 1228–30 (DB41).
44. David Juste, “MS Paris, Bibliothèque nationale de France, lat. 7198” (update: 20.04.2019), *Ptolemaeus Arabus et Latinus. Manuscripts*, <<http://ptolemaeus.badw.de/ms/100>>.
45. Mestres, “Maghribī Astronomy” *op. cit.* (Note 20), p. 413; Díaz-Fajardo, *op. cit.* (Note 22), pp. 26–7; Samsó, “Ibn al-Raqqām’s *al-Zīj al-Mustawfi*” *op. cit.* (Note 22), p. 312. The *Muqtabas zīj* of Ibn al-Kammād uses a different rate of apogeal motion and, accordingly, cannot have been the source for these Latin tables. See Chabás and Goldstein, “Andalusian Astronomy” *op. cit.* (Note 34), p. 28; Chabás and Goldstein, “Ibn al-Kammād’s *Muqtabis Zīj*” *op. cit.* (Note 34), pp. 602–603.
46. Pedersen, *op. cit.* (Note 8), vol. 4, pp. 1484–5 (KA21). See D.A. King, “Some Early Islamic Tables for Determining Lunar Crescent Visibility,” in D.A. King and G. 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, NY: New York Academy of Sciences, 1987), pp. 185–225 (197–207); Mestres, “Maghribī Astronomy” *op. cit.* (Note 20), p. 437.
47. D. Juste, “MS Vatican, Biblioteca Apostolica Vaticana, Pal. lat. 1414” (update: 10.03.2022), *Ptolemaeus Arabus et Latinus. Manuscripts*, <<http://ptolemaeus.badw.de/ms/239>>.
48. MS Madrid, Biblioteca nacional de España, 10023, fols. 52v–54r.
49. Some numerical differences between the tables in both manuscripts were already noted by Chabás and Goldstein, “Ibn al-Kammād’s *Muqtabis Zīj*” *op. cit.* (Note 34), pp. 614–5, 619–24, 626–30. However, their analysis ignores the more salient textual differences between their respective canons and table headings.
50. Chabás and Goldstein, “Ibn al-Kammād’s *Muqtabis Zīj*” *op. cit.* (Note 34), p. 628.
51. On the background, see E.S. Kennedy and N. Faris, “The Solar Eclipse Technique of Yahyā b. Abī Maṣṣūr,” *Journal for the History of Astronomy*, 1 (1970), pp. 20–38 (21–4).
52. Mestres, *Materials andalusins*, *op. cit.* (Note 20), pp. 82–3; Chabás and Goldstein, “Ibn al-Kammād’s *Muqtabis Zīj*” *op. cit.* (Note 34), pp. 619, 623.
53. Samsó, *op. cit.* (Note 9), p. 624.
54. On this and other cases of “corrected” values of the *motus* of the eighth sphere around 1300, see C.P.E. Nothaft, “Criticism of Trepidation Models and Advocacy of Uniform Precession in Medieval Latin Astronomy,” *Archive for History of Exact Sciences*, 71 (2017), pp. 211–44 (219–26).
55. See Nothaft, *op. cit.* (Note 7), for more details.
56. Samsó, *op. cit.* (Note 9), pp. 627–9, 793–4, 837.
57. J. Chabás, “Aspects of Arabic Influence on Astronomical Tables in Medieval Europe,” *Suhayl*, 13 (2014), pp. 23–40 (40).