Aestimatio
Sources and Studies in the History of Science

Nicholaus de Heybech of Erfurt, Table Maker and Copyist

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Volume 4, 2023

URI: https://id.erudit.org/iderudit/1112794ar
DOI: https://doi.org/10.33137/aestimatio.v4.42935

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Publisher(s)

Institute for Research in Classical Philosophy and Science

ISSN

1549-4470 (print)
1549-4497 (digital)

Explore this journal

Cite this article

Chabás, J. & Goldstein, B. (2023). Nicholaus de Heybech of Erfurt, Table Maker and Copyist. *Aestimatio*, *4*, 1–21. https://doi.org/10.33137/aestimatio.v4.42935

Article abstract

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Nicholaus de Heybech of Erfurt, Table Maker and Copyist

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DOI: 10.33137/aestimatio.v4.42935 *Aestimatio* ns 4 (2023) std01: 1–21

Abstract

Nicholaus de Heybech (fl. 1384–1394) is the author of a clever and compact solution to a major challenge for medieval astronomers: finding the time from mean to true syzygy. His table and associated canon for that purpose are now found in 30 manuscript copies, which means that this table was one of the most widely diffused single tables in Alfonsine astronomy. In this article, we present two different and hitherto unnoticed tables by Nicholaus de Heybech for determining mean syzygy, which nicely complement the table that is already known, and we gather the information available on another aspect of his activity beyond table making, as a copyist of texts and tables mainly in mathematical astronomy.

About the Authors

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BERNARD R. GOLDSTEIN, university professor emeritus in the Dietrich School of Arts and Sciences of the University of Pittsburgh, has been collaborating with José Chabás for close to three decades. Among their joint publications are *The Alfonsine Tables of Toledo* (Dordrecht, 2003); *Essays on Medieval Computational Astronomy* (Leiden/Boston, 2015); and “The Medieval Moon in a Matrix: Double Argument Tables for Lunar Motion”, *Archive for History of Exact Sciences* 73 (2019) 335–359.

Keywords John of Lignères, John of Murs, John of Saxony, Parisian Alfonsine Tables, precision, syzygy

A major computational challenge for medieval astronomers was to find the time from mean to true syzygy, that is, the time between a mean conjunction or opposition (when the mean Sun and mean Moon are 0° or 180° apart, respectively) and a true conjunction or opposition (when the true Sun and true Moon are 0° or 180° apart, respectively). Indeed, this is a necessary step in the computation of the circumstances of any eclipse, a subject addressed by many astronomers. The Alfonsine astronomer Nicholaus de Heybech of Erfurt (fl. 1384–1394) offered a clever and elegant solution to this difficult problem by means of a single table, which is examined in section 1, below.[1] The scant information on Nicholaus de Heybech as a table maker can now be supplemented: in addition to his table and canon for true syzygies, he is also the author of two tables for mean syzygies hitherto unidentified. These two tables, which are the subject of section 2 [p. 7 below], nicely complement his table on the time from mean to true syzygy. Finally, in section 3 [p. 13 below], we gather the information available on his work as a copyist of astronomical tables, which gives us a better appreciation of Nicholaus de Heybech's activity as a table maker.

1. Table for determining the time interval from mean to true syzygy

Nicholaus de Heybech's approach consisted first in distributing the time interval from mean to true syzygy, Δt, into two terms, one for the Sun and another for the Moon, with an interpolation scheme to link their roles:

$$\Delta t = \frac{c_s}{v_m(t) - v_s(t)} - \frac{c_m}{v_m(t) - v_s(t)},$$

where c_s and c_m are the solar equation and the total lunar equation, respectively, and $v_m(t)$ and $v_s(t)$ are the lunar and solar velocity, respectively. Second, for each term, two expressions are derived—one for the minimum and one for maximum values of the velocities—and interpolation is used for intermediate values.

[1] For an overview of Nicholaus de Heybech, see Thorndike 1948. For a detailed analysis and recomputation of this table as well as a transcription and translation into English of the canon associated with it, see Chabás and Goldstein 1992.

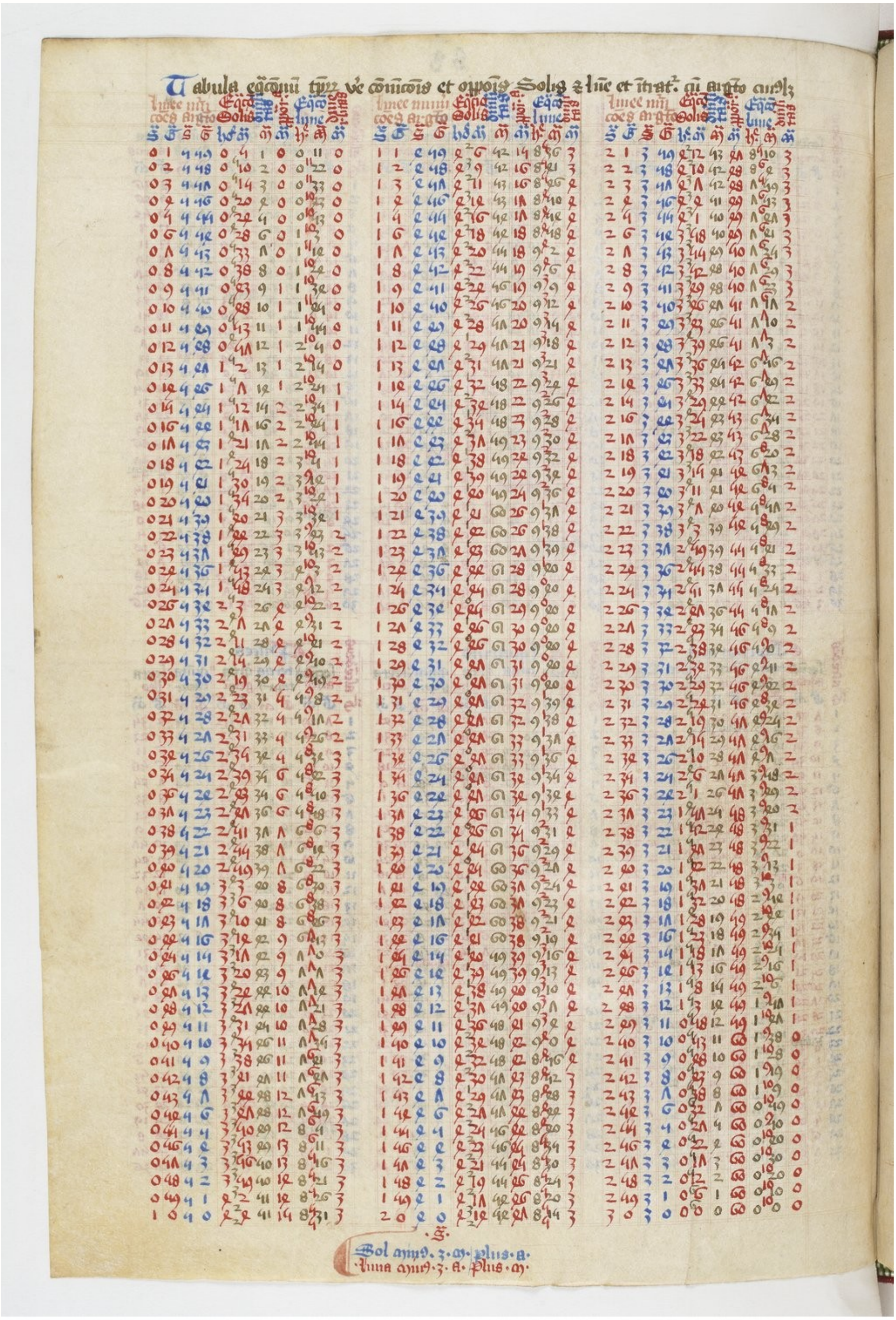


Plate 1. Nicholaus de Heybech's table for true syzygies in Paris, Bibliothèque nationale de France, lat. 14481, 88v

The table is displayed in six columns, including one double column for the argument, which is given at intervals of 1°, from 1° to 3,0° (= 180°), and from 3,0° to 5,59°, that is, using signs of 60° [see Plate 1, p. 4 above].

The columns that depend on the argument here are headed from I to V. The entries in all columns are given in hours and minutes, except for column III, where the entries are given in minutes.

For determining the solar term, the two expressions involving minimum and maximum velocities are called *equatio solis* (column I) and *diversitas equationis solis* (column II) in the manuscripts. The entries in column I are derived from the expression

$$\frac{c_s}{min(v_m) - \overline{v}_s},$$

and those in column II from the expression

$$\frac{c_s}{min(v_m) - \overline{v}_s} - \frac{c_s}{min(v_m) - \overline{v}_s},$$

where $\overline{v}_s$ is the mean solar velocity and v_m is the lunar velocity in longitude. For recomputation, the best results (zero residuals in almost 80% of the entries, with the rest being either −1 minute or +1 minute) are obtained with $\overline{v}_s$ = 0;2,27,51°/h and the values found in the table of John of Genoa for lunar velocities, based in Ptolemy's complete lunar model:

$$min(v_m) = 0;29,37,13°/h, \text{ and}$$

$$max(v_m) = 0;36,58,54°/h.$$ [2]

Analogously, for determining the lunar term, the two expressions involving minimum and maximum velocities are called *equatio lune* (column IV) and *diversitas equationis lune* (column V) in the manuscripts. The entries in column IV are derived from the expression

$$\frac{c_m}{v_m(\overline{a}) - max(v_s)},$$

and those in column V from the expression

$$\frac{c_m}{v_m(\overline{a}) - max(v_s)} - \frac{c_m}{v_m(\overline{a}) - min(v_s)},$$

where v_s is the solar velocity and $v_m(\overline{a})$ is the mean lunar velocity in anomaly. For recomputation, the best results (zero residuals in almost 70% of the entries, with the rest being either −1 minute or +1 minute) are obtained by

[2] Goldstein 1992, 3–17. For a recomputation of John of Genoa's table, see Chabás and Goldstein 2025.

applying a shift of 6° to the anomaly and where $v_m(\overline{a})$ is taken from John of Genoa's velocity table, as well as its maximum and minimum values:

$$max(v_s) = 0;2,33,40°/h, \text{ and}$$

$$min(v_s) = 0;2,22,30°/h.$$

In Table 1, entries in the columns labeled C have been computed with the value for lunar velocity in the same row in the column to the left, and entries in the column labeled IV are those of Nicholaus de Heybech in column IV of his table. Comparing the computed values with those in Nicolaus' text indicates that a shift of 6° was applied to the mean anomaly, for which we have no explanation.

$\overline{a}$	$v_m(\overline{a})$	C	$v_m(\overline{a}+6)$	C	IV
30	0;29,59,31	5; 0,43	0;30, 8,34	4;59, 5	4;59
60	0;31, 2,55	8;36,10	0;31, 2,55	8;31,22	8;31
90	0;32,39,45	9;47,49	0;33, 8,31	9;38,36	9;40
120	0;34,35,24	8;20,10	0;34,58,23	8;14,16	8;15
150	0;36,13,37	4;43,26	0;36,28,15	4;42,22	4;42

Table 1. Recomputation of selected values in column IV for $\overline{a}$ and $\overline{a}+6$

Finally, column III is for interpolation. It is labeled *minuta proportionalia* in the manuscripts, where the argument is either the true anomaly of the Sun κ or the true anomaly of the Moon α, and its entries are derived from the expression

$$c_3 = \frac{D - d(\overline{a})}{D - d},$$

where $D = 60 + e$ and $d = 60 - e$ are the distances of the Sun at apogee and perigee of an eccentric model, respectively, e is the eccentricity, and $d(\overline{a})$ is the distance of the Sun from the observer at mean anomaly $\overline{\kappa}$. Although probably calculated for the solar model, the entries c_3 were also used for the Moon, since the differences between the results for a solar eccentricity of 2;16 and a lunar eccentricity of 5;10 are small. The two values for the eccentricities considered here correspond to the maximum equations of the Sun and the Moon in the Parisian Alfonsine Tables. For recomputation, we used mean anomaly as the argument, not true anomaly.

Then, if c_i is an entry in columns I–V, the time interval Δt between mean and true syzygy is given by the following equation:

$$\Delta t = c_1(\overline{\kappa}) - c_2(\overline{\kappa}) \cdot c_3(\overline{a}) - \left[c_4(\overline{a}) - c_5(\overline{a}) \cdot c_3(\overline{\kappa})\right].$$

Associated with this table is a short canon beginning *Tempus vere coniunctionis et oppositionis solis et lune per tabulas a magistro nicholao de heybech de erfordia compositas invenire*, explaining the use of the table [see Chabás and Goldstein 1992, 280–281, 286–287]. Heybech's method for determining true syzygies had a considerable success, probably because it consisted of a single table, in contrast to other procedures available at the time, and a short canon explaining how to use it. This table and its canon appear in a great many manuscripts, and they are even found twice in one of them: Bernskastel-Kues, Cusanusstiftbibliothek, 211 [see p. 18 below].

We have found that this table was used in constructing a number of other tables compiled in the late Middle Ages in the framework of Alfonsine astronomy: the *Tabulae resolutae* for Salamanca by Nicholaus Polonius (*ca* 1460);[3] *ha-Ḥibbur ha-Gadol* (The Great Composition) by Abraham Zacut (1452–1514), originally in Hebrew from which the tabular material was later published in Latin as *Almanach perpetuum*; the *Tabule verificate* for Salamanca also by Abraham Zacut; the so-called Tables in Castilian with 1460 as epoch; and possibly the table for finding true syzygy by Wenzel Faber of Budweis (d. 1518).[4] According to Kremer, Heybech's table was also used in the 16th century to compute mean syzygies by means of paper instruments, called syzygy instruments, developed by Johannes Stöffler (1452–1531), Johannes Schöner (1477–1547), and Sebastian Münster (1489–1552) [Kremer 2011].

2. Tables for mean syzygies

The two tables for mean syzygies that we have identified as authored by Nicolaus de Heybech are extant in at least two manuscripts:

- Cologne, Historisches Archiv der Stadt, Best. 7020 (W*) 178, 29r–v [MS C]
- Vatican, Biblioteca Apostolica Vaticana, Pal. lat. 1412, 115r–116r [MS V].

[3] Recently, S. A. Sroka has identified Nicholaus Polonius with the astronomer and physician trained in Paris Nicholaus de Tuchów (privately communicated).

[4] See Chabás and Goldstein 2000, esp. 24, 28–29, 39; Kremer 2003; Goldstein and Chabás 2008 and 2018.

Neither of them contains a copy of the table for determining the time of true syzygies.

2.1 *The first table for mean syzygies* is for the months of the year. Almost the same title is found in both manuscripts: *Tabule medie coniunctionis et oppositionis et quartorum aspectuum solis et lune in mensibus* (C, 29r) and *Tabule medie coniunctionis et oppositionis et quartorum aspectuum solis et lune in mensibus ex ordinaria* (V, 115r). As the title indicates, this table provides information about the four phases (quarters) of the Moon, here called aspects: new Moon (conjunction), first quarter, full Moon (opposition), and third quarter. The information for each phase is presented in a row, so that four rows represent each month in a year, for a total of 48 rows [Plate 2, p. 9 below]. Two rows are added for half of a 13th month, one for conjunction and another for first quarter. This is indeed a comprehensive and unusual way of treating mean syzygies: it may be of interest here to recall that Nicholaus' compatriot and predecessor, John of Saxony, addressed the issue of the quarters of the Moon in chapter 24 (*Tempus quarti aspectus solis et lune invenire*) of his widely diffused canons to the Parisian Alfonsine Tables, beginning *Tempus est mensura*.

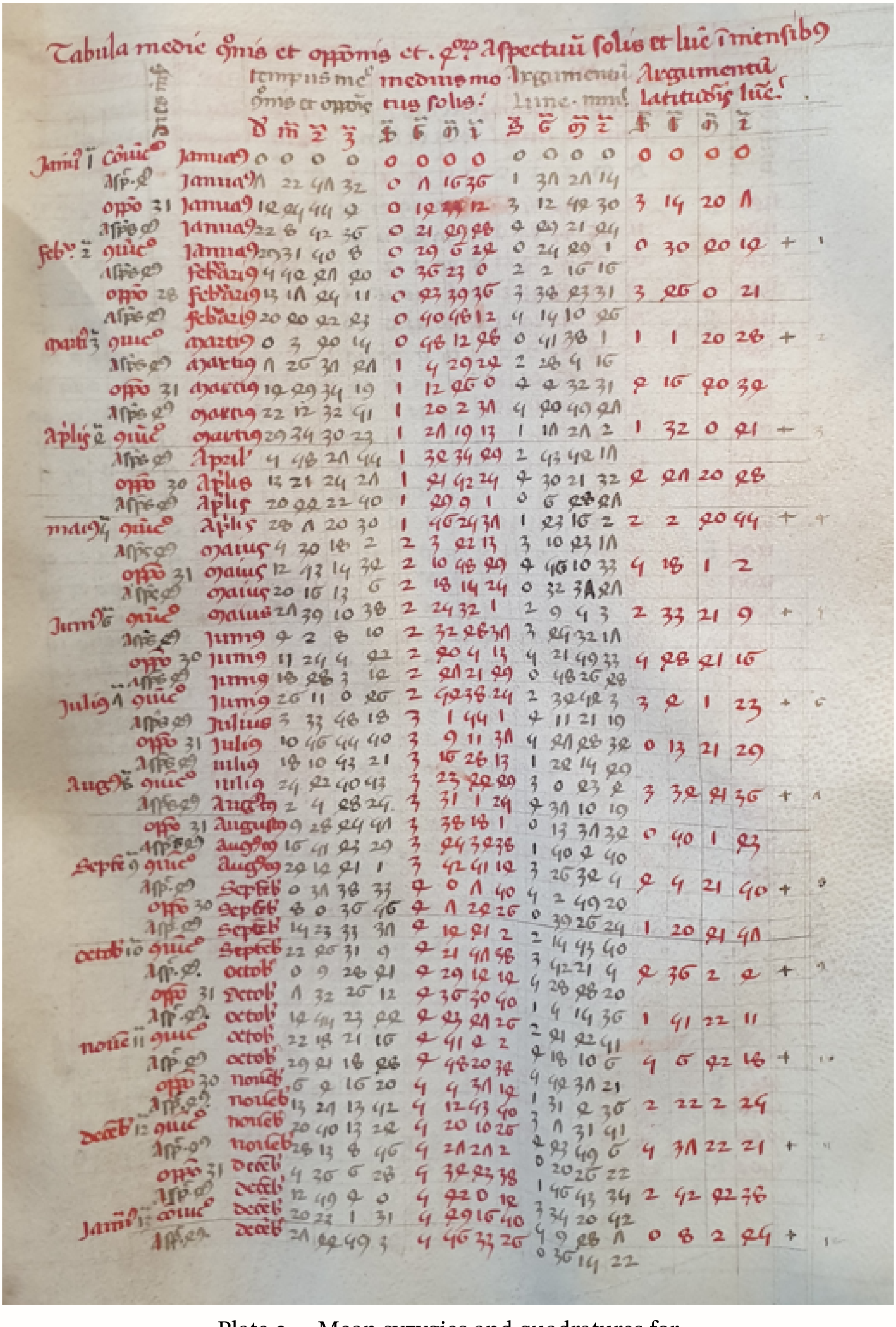
For each quarter, we are given the usual four quantities: time (month, day, minutes, seconds, and thirds of a day), mean motion of the Sun (signs of 60°, degrees, minutes, and seconds), mean lunar anomaly (also to seconds), and mean argument of lunar latitude (also to seconds). We note that the time in days is given in full sexagesimal form and, thus, that the first sexagesimal place corresponds to minutes of a day (1/60 day), and so on.[5] An uncommon characteristic is that all entries in the first row (first conjunction of January) are zero, indicating that the entries in this table give accumulated values. For the first nonzero conjunction the entries are:

Time: January 29;31,50,8d
Mean motion of the Sun: 29;6,24°
Mean lunar anomaly: 25;49,1°
Mean argument of lunar latitude: 30;40,14°.

The value of the mean synodic month is easily recognized. For the last conjunction, no. 13, the entries are:

Time: December 20;23,1,31d
Mean motion of the Sun: 4,49;16,50°

[5] Among astronomers adhering to complete sexagesimalization, this was the usual practice; see, e.g., Chabás and Goldstein 2025.


Tabula medie coniunctionis et oppositionis et quartorum aspectuum solis et lune in mensibus

tempus medie coniunctionis et oppositionis | medius motus solis | Argumentum lune medium | Argumentum latitudinis lune

Plate 2. Mean syzygies and quadratures for the months in a year in Cologne, Historisches Archiv der Stadt, Best. 7020 (W*) 178, 29r

Mean lunar anomaly: 5,9;48,7°
Mean argument of lunar latitude: 8;2,45°.

Both John of Murs and John of Lignères, members of the first generation of Alfonsine astronomers in Paris, have similar tables for accumulated mean syzygies, but they are restricted to only one set of values per month, which means that they have fewer rows than Nicholaus' table.[6] In the tables of the Johns and of Nicholaus, arcs are displayed to seconds. The tables of these two Alfonsine astronomers of the first generation give time in days and hours and fractions of an hour, whereas Nicholaus expresses time in days and sexagesimal fractions of a day. As for the table of John of Lignères, the usual title is *Tabula medie conjunctionis et oppositionis solis et lune in mensibus* and for that of John of Murs, the title is *Coniunctiones solis et lune ad meridiem tholeti secundum alfonsium regem Castelle* in all manuscripts consulted. Note that John of Murs inserted this reference to Toledo and to Alfonso. And indeed, in chapter 30 of the canons of the Castilian Alfonsine Tables, we are told that the tables compiled by the astronomers in the service of King Alfonso contained such a table with the same columns and for 13 consecutive syzygies as in John of Murs' table [see Chabás and Goldstein 2003, 56–58, 188–189].

Back to Nicholaus' table: it is possible to compare the entries it has in common with those in the tables of the Johns. Close comparison shows that, although very similar, the tables of the two Johns differ slightly; for example, half of the entries for the seconds in the mean motion of the Sun and the Moon are one second higher in John of Murs' table than in John of Lignères'. The impression is that both Johns depended on a previous table where the positions of the luminaries were given to thirds and that John of Murs rounded correctly to seconds, whereas John of Lignères truncated them to seconds. In all cases, Nicholaus' entries agree with those in the table of John of Murs.

When checking the entries for time in Nicholaus' table, it is readily seen that the time for December 20 is faulty in both manuscripts and that, for consistency with the rest of the entries, it should read December 20; 22,1,31d (rather than 20;23,1,31d). A precise value for the mean synodic month can be obtained from his table of mean syzygies for years. The difference between any two consecutive entries is constant, and the sexagesimal fraction of a day to be added per year, whether an ordinary year or a leap year, is 0;22,1,31,29d.

[6] For the *Patefit* of John of Murs, see Chabás and Goldstein 2009; see also Chabás 2019, 153–161. For the Tables of 1322 by John of Lignères, see Chabás and Saby 2022.

This confirms the emended value for the faulty entry noted above and yields a length of the mean synodic month of 29;31,50,7,37d, equivalent to 29d 12;44,3,3h, which is the standard Alfonsine parameter.[7]

In sum, in his first table for mean syzygies, Nicholaus de Heybech made use of the corresponding table in John of Murs' *Patefit* for conjunctions, computed the data for the other three quarters in a lunation, and used a precise sexagesimal value of the mean synodic month. In his second table, he increased the precision.

2.2 *The second table for mean syzygies* is for the years. It has two subtables, and their titles in both manuscripts explicitly indicate that they were computed for Paris by Nicholaus de Heybech of Erfurt: *Tabule medie coniunctionis solis et lune in ianuario ad annos domini yhesu Christi inferius positos ad meridianum parisiensem et est composita per Nycolaum de Erfordia* (C, 29v) and *Tabule medie coniunctionis solis et lune in ianuario ad annos domini inferius positos ad meridianum parisiensem et est composita per Nicholaum de Erfordia* (V, 116r).

The fact that this particular table for the years was computed for Paris places Nicholaus de Heybech in a precise context, that of the Parisian astronomers. Both subtables have columns for the same four quantities as the first table for mean motions. The first subtable displays entries for 24 successive years, from 1384 to 1407, whereas the second gives five entries for years from 1408 to 1504 at intervals of 24 years. In both cases, precision is enhanced with respect to the table of mean syzygies for months: time is here displayed to fourths of a day and arcs to thirds of a degree [see Plate 3, p. 12 below].

The period of 24 years in this table for syzygies is not new. In his Tables of 1322 and his *Tabule magne*, John of Lignères has a table using the same interval, the same four quantities, also computed for Paris, but with a lower precision.[8] Only year 1393 is common to John of Lignères' table compiled by Nicholaus. Although close, the entries calculated by these two astronomers differ. For John of Lignères, the first conjunction of year

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7 For a list of medieval values of the mean synodic month, see Chabás and Goldstein 2012, 140. See also Goldstein 2003.

8 See Chabás 2019, 184–185 and 200. It may also be added that to determine mean syzygies, which are associated with the Tables of 1322 and the *Tabule magne* by John of Lignères, the table is also found in the two manuscripts: Cologne, Best. 7020 (W*)178 and Vatican, Pal. lat. 1412. There are two major differences with respect to Nicholaus' table: they use signs of 30° and time is given in days, hours, and fractions of hours.

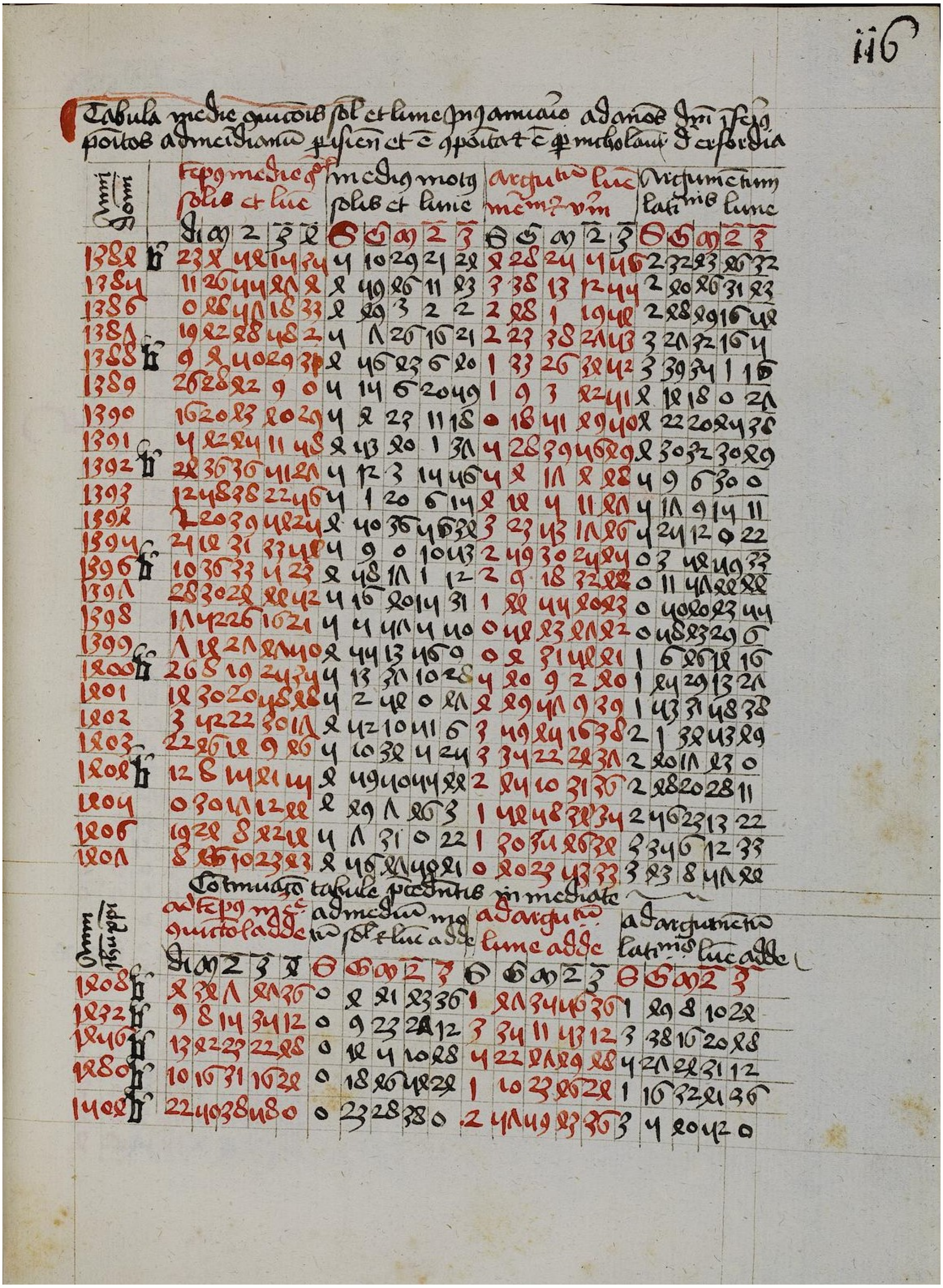

Plate 3. Mean syzygies for years in Vatican, Pal. lat. 1412, 116r

Note that for year 1480 the number of days for mean conjunction is given as 10;16..., whereas in MS C, the entry is 18;16..., which is consistent with the rest of the entries.

1393 occurred in Paris on January 12 at 23;27,21h, and for Nicholaus de Heybech it occurred in January at 12;58,38,22,56d. John's time corresponds to January 12;58,38,22,30d, differing by 26 fourths from the time computed by Nicholaus. This small difference in time generates, in turn, minor differences in the tabulated mean motions of the Sun and the Moon, even if they used the same parameters for the mean motions.

It is interesting to note that the length of the mean synodic month was generally expressed as a number mixing two different units, days and hours, thus requiring two series of operations when computing with it. Conversion into a single unit, days, was probably understood not only as a simplification but also as an opportunity to offer more precision with the same number of significant places. Consider, for example, the fraction of days in the length of the mean synodic month. With the same number of significant places, the full sexagesimal expression provides higher precision than the mixture of hours and fractions. Indeed, one minute of a day is more precise than one hour, and so on.

We conclude that, no later than 1392, Nicholaus de Heybech of Erfurt compiled tables for determining the time of mean and true syzygies for Paris as well as the corresponding positions of the luminaries, building on the work done by his Parisian Alfonsine predecessors. Nicholaus also simplified considerably the method for computing true syzygies and found clever ways to improve precision and thus enhance the accuracy of the results, without challenging, however, the building blocks set by his predecessors.

3. Manuscripts copied by Nicholaus de Heybech

Our author also engaged in another related activity: copying astronomical texts and tables. His handwriting and signature are found in five manuscripts extant in Bernskastel-Kues, Cologne, Naples, Oxford, and Princeton. Three of them contain works by him as a table maker.

Cologne, Historischer Archiv der Stadt, Best. 7020 (W*) 178 (MS C), contains an incomplete copy of the Tables of 1322 by John of Lignères (1r–17v) and the table for the semidiameters and velocities of the luminaries by John of Genoa (18r), in addition to the tables for mean syzygies by Nicholaus de Heybech (29r–v) examined here. Then follow two canons by John of Lignères, beginning *Cuiuslibet* (32r–40r) and *Priores* (40r–54v). Nicholaus de Heybech's signature is not found anywhere in the manuscript, but the handwriting is his.

Interestingly, preceding Heybech's tables, there are tables for the planetary apogees from 1380 to 1520 at intervals of 20 years and radices computed for

Paris for year 1380, complete (19r). In the heading of the table, the number 2,20,0,45 is given. It is a sexagesimal number corresponding to the decimal number 504,045, which is the number of days in 1380 years. Then follow tables for mean motions with unusual formats (19v–22v and 24r–26r) for the mean motions of the planetary apogees and access and recess in years, months, and days, and for the mean motions of the luminaries and planets in years, months, days, and hours. Signs of 60° are used everywhere. This feature and the systematic use of sexagesimal numbers may indicate that the author of these tables is also Nicholaus de Heybech.

Bernskastel-Kues, Cusanusstiftbibliothek, 213 is a short manuscript of only 62 folios mainly written in the hand of Nicholaus de Heybech.[9] The items copied by him are a *Theorica planetarum* (1r–6v), at the end of which we find his signature and a date, 1392 [Plate 4]; a set of Parisian Alfonsine Tables (20r–42v), also with his signature [Plate 5, p. 15 below]; the Tables of 1322 by John of Lignères (45r–60v); and his own table and canon for determining the time from mean to true syzygy (61r–62v), headed *Tabula equationum temporis vere coniunctionis et oppositionis solis et lune scripta atque ordinata per nycholaum de Erfordia*. We note that Nicholaus signed his name differently on folios 6v and 42v.

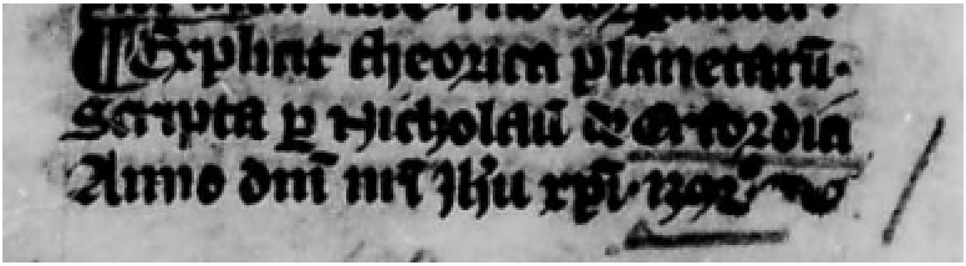

Plate 4. Bernskastel-Kues, Cusanusstiftbibliothek, 213, 6v (explicit)

We also note that on folios 43r–44r there are three separate tables, also in Heybech's hand, for the equation of time, the solar and lunar velocities at intervals of 6°, and right ascension. These three tables are actually part of the set by John of Lignères, and Nicholaus reproduced them on folios 51v, 57r, and 46v–47r, respectively.

[9] For a description of this manuscript and others that belonged to Cardinal Nicholas of Cusa (1401–1464), see Krchňák 1963.

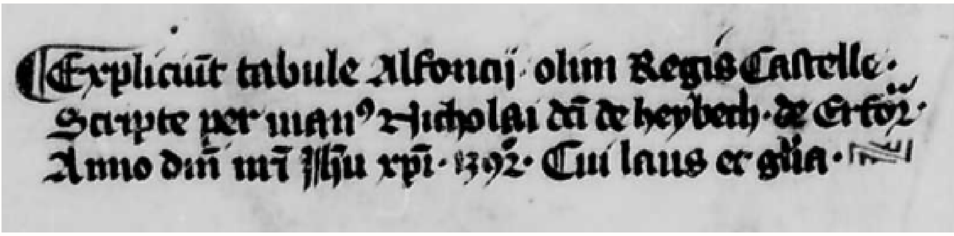
Explicit tabule Alfonsij olim Regis Castelle. Scripte per manus Nicholai dicti de heybech de Erford. Anno domini m° ihesu xpi 1392. Cui laus et gloria.

Plate 5. Bernskastel-Kues, Cusanusstiftbibliothek, 213, 42v (explicit)

The only items not copied by Nicholaus in this manuscript are on folios 7r–19v, which contain an incomplete and disordered copy of 24 canons to the Parisian Alfonsine Tables by John of Saxony, and on folio 32r–v, which contains an intercalated folio consisting of lists of planetary apogees and radices for planetary mean motions for the years 1389–1400, similar to those extant in MS C.

Naples, Biblioteca Nazionale, VIII D 31, was entirely copied by Heybech in 1392. It consists of two texts by John of Sacrobosco (1r–19v), a treatise on the quadrant by Jacob ben Makhir (20r–26r), and a *Theorica planetarum* (32r–35v). There are also three Alfonsine works: John of Saxony's ephemerides for 1336–1339, which provide daily positions of the Sun for Paris (27r–28v); canons to the Parisian Alfonsine Tables, also by John of Saxony, which begin *Tempus est mensura motus* (38r–48r); and a set of Parisian Alfonsine Tables (50r–71v) that end with the signature of Nicholaus de Heybech [see Plate 6, p. 16 below].

Princeton, University Library, Kane 51 is a short manuscript that was copied entirely by Heybech in 1394. A copy of the Parisian Alfonsine Tables (9r–30v) ends with his signature and the date when it was completed [see Plate 7, p. 17 below].

On folios 31r–46v, there is a copy of the Tables of 1322 by John of Lignères, followed by the table of the radii and velocities of the luminaries by John of Genoa (47r). Nicholaus de Heybech's table for determining the time from mean to true syzygy is on folios 49v–50r, and it is headed: *Tabula equacionum temporis vere coniunctionis et opposicionis solis et lune. Et est composita per Nicholaum dictum de heybech de Erfordia*. The corresponding canon follows on folio 50v.

Finally, Oxford, Bodleian Library, Digby 93, contains astronomical texts, such as a *Theorica planetarum*, the *Sphere* of Sacrobosco, as well as astrological treatises by al-Kindī and Māshā'allāh. On folios 94r–171v, there is

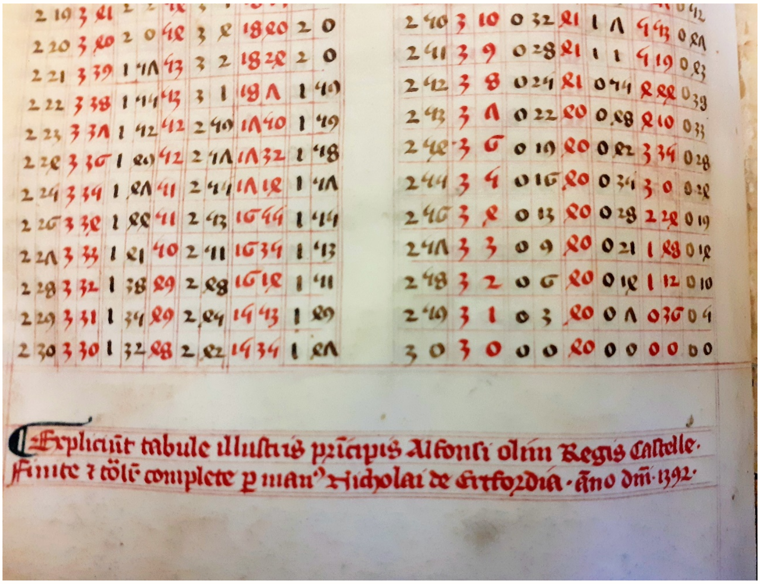

Plate 6. Naples, Biblioteca Nazionale, VIII D 31, 71v

a commentary by John of Saxony on *The Introduction to Astrology* by al-Qabīṣī (Latin: Alcabitius). According to the explicit, this text was copied by Nicholaus de Heybech: *Expliciunt scripta super Alkabicium et finita anno Domini ntri Jesu Christi 1384, in die Sancti Bartholomei circa mediam noctem, per manus Nicholai de Erfordia* (171v).

4. Conclusion

To sum up, according to the information provided by Nicholaus de Heybech himself, from 1384 to 1394 he copied quite a number of astronomical texts and tables, preserved in at least five manuscripts. On the basis of the high quality of his handwriting and the neatness of his copies, one may wonder if Nicholaus was a professional scribe. He clearly concentrated on material produced by the Parisian Alfonsine astronomers who preceded him. From what is now known, in addition to copying his own tables for syzygies (both for mean and true syzygies), he copied the set of Parisian Alfonsine Tables three times, the set of tables of 1322 by John of Lignères three times, the table of John of Genoa for the velocities and radii of the Sun and the Moon twice, and John of Saxony's ephemerides for the luminaries and the planets beginning in 1346 once. This amounts to thousands of numbers neatly written and well aligned. As for the texts he reproduced, his favorite author was no doubt John of Saxony, as Nicholaus copied John of Saxony's canons

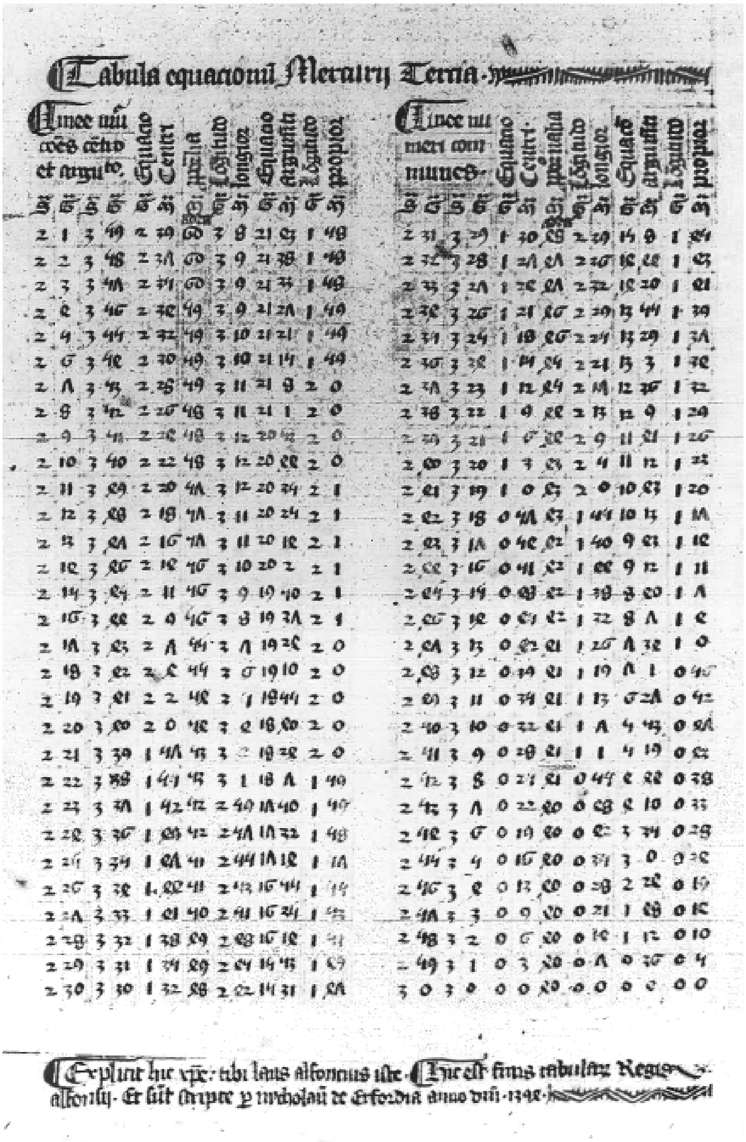

Plate 7. Princeton, University Library, Kane 51, 30v

associated with the Parisian Tables dated 1327 beginning *Tempus est mensura* twice and his long commentary on Alcabitius and two texts by John of Lignères once. The obvious conclusion is that he was well acquainted with the Alfonsine tradition in astronomy and actively participated in it. Beyond this tradition, he also copied several other astronomical texts: the *Theorica planetarum* and texts by Sacrobosco and Jacob ben Makhir.

We conclude that Nicholaus de Heybech, whose works have received little attention hitherto, was an outstanding astronomer in the late 14th century: he contributed significantly to computational astronomy by compiling his own innovative and widely diffused tables and by facilitating the dissemination of Alfonsine astronomy.

Acknowledgment The contribution of one of us (JC) was written in the framework of the European Research Council project ALFA, *Shaping a European Scientific Scene: Alfonsine Astronomy*, under the EU program Horizon 2020 (grant agreement 723085).

APPENDIX

Manuscripts containing the table and canon for finding true syzygy by Nicholaus de Heybech

Basel, Universitätsbibliothek, F II.7, 36r–37v (table), 37v (canon).

Bern, Burgerbibliothek, 454, 144v (table, incomplete), 145r–146v (canon).

Bernskastel-Kues, Cusanusstiftbibliothek,
- 211, 16r (canon), 16v, 51r–v (table); another copy on 18v (canon), 19r–20r (table).
- 212, 71v (canon), 72r–73r (table).
- 213, 61r–62r (table), 62v (canon).

Cracow, Biblioteka Jagiellońska,
- 1852, pp. 349–352 (table).
- 1865, 143v–146r (table).
- 553, 166v–167r (table).
- 609, 234v (canon).
- 610, 334r–335v (table), 335v (canon).
- 613, 31r–32v (table), 32v (canon).

Dijon, Bibliothèque municipale, 447, 62r–v (canon).

Lübeck, Stadtbibliothek, Math. 2° 1, 103r–105r (table).

Munich, Bayerische Staatsbibliothek, Clm 14111, 127v–128r (table), 128r (canon, incomplete).

Oxford, Bodleian Library, Can Misc. 499, 110v–111r (table).

Paris, Bibliothèque nationale de France,
- lat. 11252, 142v–143r (table).
- lat. 14481, 88v (table).
- lat. 7284, 48v–49v (table).
- lat. 7285, 93v–94r (canon).
- lat. 7287, 72r–73r (table), 86v–87r (canon).
- lat. 7290A, 103r–104r (table), 118r (canon).

Prague, National Library, adlig. 44.E.8, 126r (canons), 126v–127v (table).

Princeton, University Library, Kane 51, 49v–50r (table), 50v (canon).

Vatican, Biblioteca Apostolica Vaticana,
- Pal. lat. 1354, 46r (canon), 46v–47v and 49r–v (table twice).
- Pal. lat. 1376, 350r (canon), 351r–352r (table).
- Pal. lat. 1436, 87v–88r (table), 89r (canon).

Vienna, Österreichische Nationalbibliothek,
- 2440, 74v–75v (table), 76r–v (canon).
- 227, 163r–164r (table), 164v–165r (canon).

Wolfenbüttel, Herzog August Bibliothek, 2637 (Cod. Guelf. 65 Aug. 2°) , 307v–308r (table), 308v–309r (canon).

Wrocław, University Library, IV F 19, 31v–32r, 35v (table), 32v (canon).

Manuscripts containing the tables for mean syzygies by Nicholaus de Heybech

Cologne, Historisches Archiv der Stadt, Best. 7020 (W*) 178, 29r–v.

Vatican, Biblioteca Apostolica Vaticana, Pal. lat. 1412, 115r–116v.

BIBLIOGRAPHY

Chabás, J. 2019. *Computational Astronomy in the Middle Ages.* Madrid.

Chabás, J. 2025 . "Computational Practices in Alfonsine Astronomy: Hermann of Saxony's *Practica motuum planetarum*". In M. Husson, J. Chabás, and R. Kremer edd. *Alfonsine Astronomy: Computational Practices*. Turnhout. In press.

Chabás, J. and B. R. Goldstein. 1992. "Nicholaus de Heybech and His Table for Finding True Syzygy". *Historia Mathematica* 19: 265–289.

Chabás, J. and B. R. Goldstein. 2000. *Astronomy in the Iberian Peninsula: Abraham Zacut and the Transition from Manuscript to Print*. Philadelphia.

Chabás, J. and B. R. Goldstein. 2003. *The Alfonsine Tables of Toledo*. Boston.

Chabás, J. and B. R. Goldstein. 2009. "John of Murs' Tables of 1321". *Journal for the History of Astronomy* 40: 297–320.

Chabás, J. and B. R. Goldstein. 2012. *A Survey of European Astronomical Tables in the Late Middle Ages.* Leiden/Boston.

Chabás, J. and B. R. Goldstein. 2025. "Computing Solar and Lunar Velocities and Radii: The Table of John of Genoa and His Predecessors". In M. Husson, J. Chabás, and R. Kremer edd. *Alfonsine Astronomy: Computational Practices*. Turnhout. In press.

Chabás, J. and M.-M. Saby. 2022. *The Tables of 1322 by John of Lignères*. Turnhout.

Goldstein, B. R. 1992. "Lunar Velocity in the Ptolemaic Tradition". Pp. 3–17 in P. M. Harman and A. E. Shapiro edd. *The Investigation of Difficult Things: Essays on Newton and the History of the Exact Sciences.* Cambridge, UK.

Goldstein, B. R. 2003. "Ancient and Medieval Values for the Mean Synodic Month". *Journal for the History of Astronomy* 34: 65–74.

Goldstein, B. R. and J. Chabás. 2008. "Transmission of Computational Methods within the Alfonsine Corpus: The Case of the Tables of Nicholaus de Heybech". *Journal for the History of Astronomy* 39: 345–355.

Goldstein, B. R. and J. Chabás. 2018. "New Evidence on Abraham Zacut's Astronomical Tables". *Archive for History of Exact Sciences* 72: 21–62.

Krchňák, A. 1963. "Die Herkunft der astronomischen Handschriften und Instrumente des Nicholaus von Kues". *Mitteilungen und Forschungbeiträge der Cusanus-Gesselschaft* 3: 109–130.

Kremer, R. L. 2003. "Wenzel Faber's Table for Finding True Syzygy". *Centaurus* 45: 305–329.

Kremer, R. L. 2011. "Experimenting with Paper Instruments in Fifteenth- and Sixteenth-Century Astronomy: Computing Syzygies with Isothermal Lines and Salt Dishes". *Journal for the History of Astronomy* 42: 223–258.

Sroka, S. A. 2020. "Mikołaj z Tuchowa Zapomniany astronom i lekarz z XV wiekuoraz jego europejskie peregrynacje". *Roczniki Historyczne* 86: 177–185.

Thorndike, L. 1948. "Nicholaus de Heybech of Erfurt". *Isis* 39: 59–60.