Ultimately, Rottner argues that SITF is a valuable case study in “managing innovation over time and in the face of uncertainty” (p. xii). The book concludes with a chapter dedicated to key takeaways, summarized in three categories and illustrated with direct quotes from interview subjects. Rottner emphasizes the importance of nurturing relationships within teams of collaborators, challenging cultural and organizational barriers to collaboration, and creating and maintaining interfaces between working groups that make sense for the project at hand. That her book provides actionable recommendations is appropriate for her intended readership. Making the Invisible Visible is part of the Monographs in Aerospace History series from NASA’s History Division. The History Division collects and stewards historical records and supports scholarship as a public service and for the benefit of agency decision makers.

This concise, generously illustrated project history will pique many curiosities, not all of which will be satisfied by book’s end. It may, however, inspire historians to ask new and different questions about the SITF and how its history intersects with or diverges from scholarship in the history of science and technology. An extensive appendix featuring the names of dozens of contributors to SITF provides a head start for future research. A contribution to management studies and the history of astronomy, Making the Invisible Visible is a valuable reference for practitioners and historians alike.

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An astrological practitioner analyzed

An Astrologer at Work in Late Medieval France: The Notebooks of S. Belle. Helena Avelar de Carvalho (Brill, Leiden, 2021). Pp. xi 419. € 159. ISBN 9789004463370.

The present monograph originated as a PhD thesis supervised by Charles Burnett at the Warburg Institute, London. Sadly, the author (henceforth: A.) died unexpectedly before seeing the book in print. Her partner L. Ribeiro and Ch. Burnett corrected and revised the proofs and drew up the indexes. My reason for accepting the arduous task of reviewing such a book is twofold: readers ought to know that this book is important, and A. herself would, in her admirable pursuit (which those who knew her remember well) of elucidating difficult astrological documents, welcome constructive criticism of her book’s minor shortcomings, thus making it even more useful to the scholarly community.
Unlike much earlier research on the history of astrology, which explored its political, social, religious, philosophical, or broadly cultural aspects and tended to limit the study of astrological texts to theoretical manuals, A. focuses—without neglecting the aforementioned aspects and texts—on the techniques and methods employed by late medieval practitioners in their actual practice. She is rightly convinced that we cannot adequately understand their work if we do not thoroughly scrutinize the extant documents of their actual practice, no matter how technically complex or challenging they may be. A. is well prepared for this task; she has the required astronomical, philological, paleographic, historical, and prosopographical background knowledge, a vast reading experience of medieval astrological manuals, and firm mastery of the secondary literature. The object of her case study is the late 15th-century French astrologer S. Belle, “an average practitioner” (p. 383). Belle was an acquaintance or student of the better-known Conrad Heingarter and probably, like the latter, a physician (pp. 10–11, 16, 27, 159, 377). Two autograph astrological notebooks of Belle are extant in Paris and Lisbon.\(^1\) They contain, besides five theoretical texts copied by Belle and excluded from A.’s study,\(^2\) an almanac (either authored or copied by Belle) and 66 horoscopes (p. 17), mostly very short (i.e. one page for the diagram and brief explanatory text) and in Latin (but one—the longest, 14 pages—in French), and most of them nativities, that is, birth horoscopes. These 66 texts are at the center of A.’s attention and occupy about three-quarters of her book. They are partly authored by Belle and partly copied from earlier sources (esp. late 13th century). In most cases it is difficult to determine which of these two roles Belle actually played (p. 23). This is a complicating factor in A.’s choice of Belle for her case study, and she might have justified her choice by emphasizing that there is virtually no alternative, sizable medieval collection of horoscopes by one certain author from the time before 1500. Belle owned some nativities in up to four different versions (e.g. pp. 214–216, 254–257, and 352–353). His primary purpose in copying and casting horoscopes as well as (in some cases explicitly) comparing different versions of them appears to have been his desire to test various and partly conflicting techniques against the known facts of the respective (in many cases still incomplete) biographies, experiment with them, and thus to improve his own astrological skills (pp. 349 and 381).

A.’s book is organized in three parts. Part 1 (pp. 1–36) deals exhaustively with introductory and methodological matters. Part 2 (pp. 37–354) is devoted to “the horoscopes” and is articulated in subchapters on the various relevant techniques: interrogations (pp. 39–50), revolutions of the years of the world (pp. 51–94, for the years 1293, 1294, 1295), conjunctions of Jupiter and Saturn (pp. 95–125, case study for that of 1425), and nativities (pp. 126–183). The relevant horoscopes for all these techniques except the latter are few (respectively two, seven, and one); they are therefore analyzed by A. in detail, and so is (pp. 126–183) a selection of three suitably chosen longer nativities of historically unknown individuals which she compares extensively, especially with regard to what is the backbone of such texts, that is, their judgments of the astrological “houses” (pp. 142–175). The large remainder of more than 30 nativities (mostly of well-known historical individuals in 15th-century France) and five event horoscopes (four coronations and one entry of a king into a city) are the object of the last two subchapters, one (pp. 183–339) that is basically a catalogue raisonné with the (in my view misleading) title “The Collection of Horoscopes”\(^3\) and a one-to-four page commentary on each text (e.g. the native’s identity\(^4\) and biography, remarkable features of astrological technique
and presentation, conflicting sources regarding some birthdates, identification of likely historical circumstances that prompted astrological consultation, etc.), and one (pp. 340–354) which reviews noteworthy technical and methodological characteristics of the material in the immediately preceding subchapter and insights gained from its study. Part 3 (pp. 355–378) is on Belle’s almanac for the 13-year period from 1468 to 1480. The book ends with conclusions, three appendices, bibliography, and five indexes. The quality of the page layout with its many tables and color figures is excellent.

Each presentation of the 66 horoscopes opens with a redrawing of the original chart with transcription of its often abbreviated and not easily readable data, followed by a tabular list of the boundaries of the 12 astrological “houses” with the respective celestial bodies, lots, etc. therein, then a color plate of the original chart,5 and finally either an extensive discussion or a shorter commentary (as differentiated above). Quotations from Belle’s and other late medieval texts are given in English translation, with the original Latin or French texts in footnotes.

A. does not leave any stone unturned in her effort to elucidate those 66 horoscopes, especially their respective techniques (as well as occasional mistakes—probably lapsus—on the astrologer’s part, e.g. pp. 275, 279 (n. 118), 283, 286, 308). This enables her penetrating and convincing analyses of countless details, often bolstered with precious references to the respective passages in the numerous (and mostly voluminous) manuals by Greek, Arabic, and Latin astrological authorities which few other scholars have read. Her unusual attention to technical detail never distracts her from the need to contextualize her insights in a wider doctrinal and historical perspective. A. also pays close attention to Belle’s personality, his learning progress, his doubts and uncertainties, his attitude to determinism versus free will, and his caution not to offend ecclesiastical authorities or powerful individuals (this may partly account for his concealment of 13 names with a numerical encryption that is, however, easy to crack; cf. pp. 351–352). Moreover, A. shows how Belle took pains to obtain promising results in the interpretations of the nativities of his own four children (pp. 287–299 and 309–316). Particularly sensitive is her interpretation of Belle’s—apparently anguished—analysis of the chart of his first-born son Antoine who lived only 112 days (pp. 287–292). A. diagnoses a similar emotional engagement and resulting lack of astrological objectivity in Belle’s analysis of the horoscope of his later born son Nicolaus who also died young (p. 312).

On the whole, A.’s analyses of those 66 horoscopes show that Belle was neither a slavish follower of this or that manual or “school” (e.g. Ptolemy or the Arabs) nor a rebel who violates canonical features of astrological technique but rather an astrologer who knew the complex and sometimes contradictory doctrine in detail, resorted to exotic, marginal, and rare tenets when he felt the need (especially due to emotional involvement, p. 313), was open to experimental use of various techniques, and anticipated certain technical trends that would become prominent in the 16th and 17th centuries.

A.’s conceptual framework is sound and so is her methodology except for when it comes to checking astronomical data in Belle’s horoscopes. She does not recompute them with the Parisian Alfonsine Tables (henceforth PAT), used by virtually all late medieval astrologers,6 but with unnamed software based on modern planetary theory. This entails the risk of misjudging the evidence, which fortunately happens only twice. The first instance is in her chapter (pp. 95–125) on the horoscope of the triple conjunction of Saturn and Jupiter in 1425 (MS Paris, ff. 80ra–84va, either copied or authored by
Belle). After giving all three true (i.e. modern recomputed) calendrical dates (p. 99 n. 10), A. states with surprise (pp. 99 and 116) that it was not cast, as one would expect, either for the last of these three conjunctions on 26 August 1425 or for its preceding syzygy (new or full moon) but for the next following full moon in late September 1425. Belle’s conjunction chart (see A.’s diagram and figure on pp. 97–98) gives the following data (quite unusually, he specifies only three longitudes to degrees): Saturn and Jupiter in 13° SCO, Mars, Sun, and Mercury in house 1 (6° LIB—8° SCO), Venus in 14° VIR, Moon in house 7 (6° ARI—8° TAU). According to the PAT, the conjunction took place on 30 August 1425 at 18 hours 30 minutes (Toledo), that is, on 31 August 1425 at 6:30 a.m., with these data (significant discrepancies regarding Belle’s chart will be marked with exclamation marks): Saturn and Jupiter in 12° 31′ SCO, Mars in 15° 49′ LIB, Sun in 16° VIR (!), Venus in 13° 52′ VIR, Mercury in 29° 38′ LEO (!), Moon in 10° ARI. The same tables have the next full moon on 27 September at 6:53 p.m. (Toledo), with these data: Saturn (significant discrepancies regarding Belle’s chart will again be marked) in 15° 13′ SCO (!), Jupiter in 17° 41′ SCO (!), Mars in 4° 57′ SCO (!), Sun in 13° 6′ LIB, Venus in 7° 44′ VIR (!), Mercury in 8° 35′ LIB, Moon in 13° 6′ ARI. These data show that the conjunction and at least one further parameter (Venus, and probably Mars, too) were calculated correctly to the degree of longitude, while there are two gross mistakes in the longitudes of Sun and Mercury which would, however, match the next following syzygy. What happened? Since an intentional contamination of longitudes for two different dates in one chart would be absurd, both astronomically and astrologically, we are probably dealing with either computational or scribal mistakes. This conjecture gains further support from two other big mistakes pointed out by A. herself later (p. 100), but not considered here, namely that the text on the next page mentions a solar and a lunar eclipse that would both happen in October 1425, but according to the PAT they occurred on 10 and 25 November.

A.’s misinterpretation regarding the date for which the conjunction chart had been calculated may have been furthered by the fact that Belle had, a few pages earlier in the same manuscript, copied from William of Saint-Cloud’s Almanac planetarum (on this source see p. 52) the horoscope of the full moon following the Sun’s entry into Aries in 1294 (pp. 65–69); but on that occasion the text explicitly justified the totally unusual choice of the next following syzygy with reference to the fact that it occurred in closest proximity to the Aries ingress (pp. 67–68).

A second instance where the PAT should have been consulted occurs on p. 304; regarding a horoscope cast for 10 January 1496, 9:20 p.m. (for an unspecified location), A. states: “The position of Mercury is noticeably miscalculated, it should be at 21° 54′ Capricorn, not 2° 50′ Aquarius; this is possibly caused by an error in the tables he consulted.” The last thought goes in the right direction; the PAT have Mercury at 2° 39′ AQU at the given time; therefore Belle (or the source from which he may have copied) is not to be blamed for miscalculation. The huge discrepancy from the true longitude obtained with modern astronomical software is irrelevant to the analysis of a historical chart.

These two instances suggest that it might have been useful to recompute all 66 horoscopes with the PAT in order to assess their respective astronomical quality, especially of those charts that Belle probably computed personally, in the hope of learning more about his astronomical profile and gaining helpful criteria for deciding whether this or that doubtful chart was authored or copied by him. My sample examination of the four charts
of Belle’s own children, born in 1483, 1484, 1485, and 1487 (pp. 287–299 and 309–316), showed that they all match the PAT’s data closely, not surprisingly in view of the availability of Regiomontanus’s printed *Ephemerides* (1474) based on the PAT. I found the same close match in the two charts for the nativity of “Jo. d.c.l.” (born in 1437, before printed ephemerides became available) and its preceding full moon (pp. 128–134), which A. (pp. 23 and 132) convincingly argues to be equally authored by Belle. However limited these results are, they raise doubts regarding Belle’s authorship of the astronomically garbled conjunction horoscope.

A different kind of weakness emerges from the lack of a rigorous final editing by the author herself. This results in a somewhat elevated number of typos and lapsus, including misreadings and/or mistranslations of the Latin text in the heavily abbreviated and sloppily written notebooks of S. Belle. However, caution is advised because Belle’s autographs themselves are not entirely free of lapsus. Most of these inaccuracies are, fortunately, of little weight and easy to correct for readers with a solid knowledge of medieval astrology (the book is not suitable as an introduction to this field and was rightly not planned to serve as such). I noticed only one case where a whole line of thought is affected. This is in the aforementioned chapter on the conjunction of 1425 where A. wavers between two different views, namely that Belle copied the entire text (pp. 95 and 125) or that he copied some passages from the judgment of the Saturn-Jupiter-conjunction of 1365 by John of Ashenden and made a few adaptations of his own (p. 101). The question whether Belle partly authored or entirely copied the text is first raised explicitly on the last page (p. 125) where A. rightly observes that Belle takes an excessively cautious stance regarding predictions of the future based on that conjunction horoscope, which leads her to “the idea that Belle is copying from an anonymous author, contemporary to the conjunction” (p. 125). She might have bolstered this very plausible idea, which gains support from Belle’s otherwise impeccable use of the PAT (see above), with reference to the decisive argument that Belle’s Latin text regularly speaks of the conjunction of 1425 and concomitant astronomical events such as eclipses in the future tense (e.g. p. 100 n. 16–17, p. 103 n. 33, p. 104 n. 38, p. 105 n. 39–40, p. 107 n. 48), although Belle was writing in 1473 (thus his explicit on p. 95), that is, half a century after the conjunction in question. It seems that A. was initially mislead both by an unfortunate misreading of *erit* in the text’s title as *erat* (p. 99 n. 14) and by Belle’s ambiguous assertion in his explicit that the text was “written” by him personally (*scriptum per me S. Belle*, p. 111 n. 66), and that she was later, after her correct insight on p. 125, prevented from systematically reviewing this long chapter as well as scattered references to it in other chapters (esp. pp. 22 and 380) in order to ensure full coherence of her respective statements. In any case, we ought to conclude that John of Ashenden’s 14th-century judgment of the conjunction of 1365 was partly copied and partly rewritten by someone (presumably not much) before 1425, and that later Belle copied this anonymous predecessor’s text. If Belle modified or added any detail while copying (this could be ascertained only if we found his exemplar), this did not affect the overall view of the conjunction of 1425 as a future event.

Finally, in her translations A. mostly refers to the Sun, Moon, and planets with “it,” which certainly suits the modern concept of inanimate celestial bodies. To round out her otherwise empathetic rendering of the Latin original, she might have preferred the use of masculine and feminine pronouns (she does use them on pp. 70 and 386–391) because
late medieval astrology continued the ancient concept of the aforementioned celestial bodies as distinctly gendered planetary deities.

In sum, A.’s book has some imperfections, but they do not substantially affect its quality. Rather, it is instructive and inspiring to witness this noble young spirit successfully setting out “to boldly go where no one has gone before.”13 Few experts in the world have the needed expertise in the history of astrological techniques to discuss and elucidate highly specialized Latin texts like S. Belle’s. Helena Avelar de Carvalho was one of them, and I learned a lot from reading her book. It is sad to realize that we may not hope for further demonstrations of her talent.

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Notes
1. Paris, BnF n.a.l. 398; Lisbon, Arquivo Nacional da Torre do Tombo, Manuscritos da Livraria, 1711.
2. Paris, BnF n.a.l. 398, ff. 1ra–72vb, described by A., pp. 20–22. Belle “was probably responsible for the introduction to and the organization of the material” (p. 20) which he copied in February 1473 (f. 30rb).
3. This is too general and similar to the main title of Part 2.
4. See especially the original, well-argued conjectural identifications of four anonymous natives in BnF n.a.l. 398, f. 91v, on p. 326.
5. In some cases, Belle had enough with taking down the exact birthtime of this or that native without calculating the chart (nos. 1.2, 1.24, 1.40, 1.41, 1.43); such cases are presented without plates.
6. Although direct computation with the PAT is cumbersome, their use is made easy through Lars Gislén’s Excel spreadsheets Astramodels (2008), freely available online.
7. Due to the so-called 5°-rule (cf. A. p. 34), one would expect this longitude to be marked in house 2, whose cusp (i.e. boundary) is 8° SCO. The chart, however, has Mars’ symbol in house 1, which suits its position on 31 August 1425 (15° 49′ LIB).
8. Belle’s own nativity is not part of the collection.
9. Note, however, that Mercury’s longitude (13° 34′ VIR) in the latest of these four horoscopes, explicitly cast for 21 August 1487, 12:24 p.m. and designated as the nativity of filia mea Martha, was either not or not correctly derived from Regiomontanus, who has Mercury (in direct motion) reaching 13° 18′ VIR on 22 August at noon.
10. In the title on p. 128 correct the date given by the MS, “17 December, 19:54”, to 15 December, 19:54 p.m.; this matches what BnF n.a.l. 398, f. 92r, says in French, namely 16 Dec. 7:54 AM; in the diagram, ibid., delete the numeral 1 – a typo – in Saturn’s longitude 12° 28′ ARI.
11. I checked wrong or suspicious looking Latin quotations on pp. 95–125 (on the conjunction of 1425) against the digitized images of BnF n.a.l. 398, at https://gallica.bnf.fr/ark:/12148/btv1b100253669/, and found p. 99 n. 14 qui erat [the MS reads que erit], p. 100 n. 16 errorum [MS: -rem] . . . qui [MS: quidam], ibid. n. 17 Octobrem [MS: -bri] . . . sequitur [MS: -quit-], p. 103 n. 33 aliquam [MS: sic, scribal mistake for -quem] novam [MS: -um] prophetam, p. 105 n. 40 elevatur [MS: -bitur] . . . itaquem [MS: quecumque, que- is
Astronomy and enlightenment in Berlin circa 1800

Johann Elert Bode (1747–1826), der Astronom der Berliner Aufklärung: Leben und Werk in dokumentarischer Darstellung. Friedhelm Schwemin (Wehrhahn Verlag, Hannover, 2022).

Following the publication of his 2006 book Der Berliner Astronom. Leben und Werk von Johann Elert Bode (Acta Historica Astronomiae, 30), Friedhelm Schwemin has now prepared a volume, nearly twice the size, that offers expanded documentation on Johann Elert Bode. Born into a Hamburg middle-class family, Bode from the age of 17 worked in his father’s private school for young merchants and showed an early inclination toward mathematics, geography, and finally astronomy. Despite never attending a secondary school or university, Bode established himself as an author of astronomical books and essays. In 1768 he published the Anleitung zur Kenntniß des gestirnten Himmels that by 1867 would appear in nine editions. In the second (1772) edition, Bode formulated what is known today as the “Titius-Bode-Reihe” (Bode’s Law), a mathematical relation for the distances of planets from the Sun. That Bode, despite being an autodidact and amateur, had found this mathematical-astronomical relation prompted Johann Heinrich Lambert to persuade the Berlin Academy of Sciences to hire Bode as an astronomical computer. In August 1772 Bode assumed this position in Berlin with the title “Professor.” He became the Berlin astronomer, founding with Lambert the famous Berliner astronomisches Jahrbuch that he would edit until his death in 1826. Through his writings and lectures Bode became known even among non-astronomers and contributed significantly to the popularization of his science.

Schwemin clearly outlines the broad contours and biographical details of Bode’s career (pp. 19–161). He describes both family experiences and the astronomical, calendrical (Bode edited annual calendars), and journalistic (in addition to books Bode wrote for daily newspapers) activities. The book presents extensive study of published and unpublished sources, carefully organized by themes (Chapt. 3 for Bode’s work, Chapt. 5 for sources and documents, Chapt. 6 for secondary literature) and extensive quotations