‘With utmost certainty’: two late medieval pioneers of technical chronology

Abstract

This article focuses on the chronological methods developed and deployed by two little-known medieval scholars, Giles of Lessines (active in the 1260s) and Heinrich Selder (1370s), both of whom made noteworthy advances in the use of astronomy to establish dates and intervals between events in ancient history. Based on their reading of Ptolemy’s *Almagest*, both authors emphasized the importance of dated astronomical observations, such as eclipses, arguing that the recorded intervals between these observations were endowed with a unique degree of reliability. Several key examples of how they mobilized Ptolemy’s astronomical data to rectify parts of the timeline between the creation of the world and the present will be discussed. These show that the technical arguments contained in Giles’s and Selder’s writings reached a level of sophistication and accuracy that has previously only been associated with chronologers of the early modern and later periods.

Keywords

chronology; astronomy; Giles of Lessines; Heinrich Selder; Roger Bacon

Introduction

Technical chronology, 'the formal study of the dates at which events happened in ancient and medieval history',[1] is characterized by its unique blend of historical-philological and mathematical-astronomical forms of knowledge. Perhaps the most important key to its success in the modern period has been the use of solar and lunar eclipses as chronological linchpins, which have made it possible to establish historical intervals with a degree of reliability not afforded by purely text-based methods.[2] Anthony Grafton, who has done more than anybody else to put the history of technical chronology on the map, has identified several scholars from the sixteenth century who may with some justification be regarded as trailblazers in the use of this technique. An early example is the German astronomer and mathematician Petrus Apianus, who discussed the historical utility of eclipses in his celebrated *Astronomicum Caesareum* (1540), dedicated to Emperor Charles V.[3] Apianus's idea was taken several steps further by the Jena professor Paulus Crusius, whose posthumously published *Liber de epochis seu aeris temporum et imperiorum* (1578) was to

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[1] I here follow a usage of the term established by the landmark works of Anthony Grafton (see the following two notes). The quote is taken from his 'A Sketch Map of a Lost Continent: The Republic of Letters', *Republics of Letters* 1, no. 1 (1 May 2009), 13, http://arcade.stanford.edu/rofl/sketch-map-lost-continent-republic-letters (accessed May 20, 2019).

[2] The two most important monographs on chronology in the early modern period are Anthony Grafton, *Joseph Scaliger: A Study in the History of Classical Scholarship*, vol. 2, *Historical Chronology* (Oxford: Clarendon Press, 1993), and Jed Z. Buchwald and Mordechai Feingold, *Newton and the Origin of Civilization* (Princeton, NJ: Princeton University Press, 2013). See also Anthony Grafton, 'Joseph Scaliger and Historical Chronology: The Rise and Fall of a Discipline', *History and Theory* 14 (1975): 156–85. The early history of eclipse-based dating is discussed in Grafton, 'Some Uses of Eclipses in Early Modern Chronology', *Journal of the History of Ideas* 64 (2003): 213–29.

[3] Anthony Grafton, 'Petrus Apianus Draws up a Calendar', *Journal for the History of Astronomy* 42 (2011): 55–72.

have a significant, if unacknowledged, influence on Joseph Justus Scaliger's discipline-defining *Opus de emendatione temporum* (1583).[4]

One question that can still be raised in light of these findings is how much further back the idea of merging history with mathematical astronomy might possibly be traced. Is technical chronology an invention of the early modern period or can we identify significant medieval antecedents?[5] The present article seeks to provide an answer to this question by introducing two forgotten medieval European writers on technical chronology, whose activities can be dated respectively to the 1260s and 1370s. I shall argue that their unpublished works provide clear evidence that a substantial part of the astronomical toolkit available to Apianus, Crusius, and Scaliger had already been discovered and successfully deployed some two to three centuries earlier, by scholars who were chiefly concerned with the chronology of the Old Testament and the dates of the life of Jesus Christ.

The use of eclipses in Giles of Lessines's *Summa de temporibus*

The first author I wish to consider is Giles of Lessines, a Dominican philosopher and astronomer of the second half of the thirteenth century who appears to have been based in Paris.[6] Apart from writing on topics as diverse as usury, comets, and the unity of the

[4] Grafton, *Joseph Scaliger* (n. 2), 109–39; Grafton, 'Some Uses' (n. 2), 225–27. See also Grafton, 'Mercator Maps Time', in *Nature Engaged: Science in Practice from the Renaissance to the Present*, ed. Mario Biagioli and Jessica Riskin (Basingstoke: Palgrave Macmillan, 2012), 187–204.

[5] The question of medieval antecedents was first raised in C. Philipp E. Nothaft, *Dating the Passion: The Life of Jesus and the Emergence of Scientific Chronology (200–1600)* (Leiden: Brill, 2012).

[6] Martin Grabmann, *Mittelalterliches Geistesleben: Abhandlungen zur Geschichte der Scholastik und Mystik*, vol. 2 (Munich: Hueber, 1936), 512–30; Olga Weijers, *Le travail intellectuel à la Faculté des arts de Paris: textes et maîtres (ca. 1200–1500)*, vol. 2 (Turnhout: Brepols, 1996), 62–64; C. Philipp E. Nothaft, 'Origen, Climate Change, and the Erosion of Mountains in Giles of Lessines's Discussion of the Eternity of the World (*c.*

substantial form, he also laboured in the vineyard of historical and technical chronology, producing a monumental *Summa de temporibus* in three books (1260–64). The third of these, dealing with *computus* and the astronomical foundations of time reckoning, was published more than 90 years ago, albeit not under Giles's name.[7] By contrast, the more historically oriented books I and II remain largely unknown even to specialists.[8]

The first book concentrates on the number of years between the creation of the world and the incarnation of Jesus Christ, a period for which the Old Testament served as a significant chronological guide. What makes Friar Giles's approach to this time interval especially interesting is the way his emphasis rested not so much on any specific results as on the many pitfalls and uncertainties inherent in the written record. Perhaps the most distressing problem a Christian chronologer had to face was the existence of two main versions of the Old Testament: the Hebrew Masoretic text, which in the eyes of Latin Christians was represented by Jerome's Vulgate, and the Greek Septuagint. The latter differed from the

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1260)', *The Mediaeval Journal* 4 (2014): 43–69; Nothaft, *Scandalous Error: Calendar Reform and Calendrical Astronomy in Medieval Europe* (Oxford: Oxford University Press, 2018), 136–43.

[7] Robert Steele, ed., *Opera hactenus inedita Rogeri Baconi*, vol. 6, *Compotus Fratris Rogeri* (Oxford: Clarendon Press, 1926), 1–198.

[8] The only copy known of the *Summa de temporibus* to contain all three books appears in MS Bologna, Biblioteca Universitaria, 1845, fols. 1r–88v, which is the version I shall cite in what follows. An alternative version of the work, which heavily revises and expands bk. 2, but omits all of bk. 3, appears in MSS Arras, Bibliothèque municipale, 674 (722), fols. 3r–123r, and Paris, Bibliothèque nationale de France, lat. 15268, fols. 211r–243v. For editions of bk. 1, pt. 3, ch. 1, and bk. 1, pt. 3, ch. 7, see Nothaft, 'Origen' (n. 6), 55–60, and C. Philipp E. Nothaft, 'Climate, Astrology and the Age of the World in Thirteenth-Century Thought: Giles of Lessines and Roger Bacon on the Precession of the Solar Apogee', *Journal of the Warburg and Courtauld Institutes* 77 (2014): 35–60, at 55–8. For a summary of bk. 1, pt. 3, ch. 3, see Joseph Ziegler, 'Engelbert of Admont and the Longevity of the Antediluvians c. 1300', in *Summa doctrina et certa experientia: studi su medicina e filosofia per Chiara Crisciani*, ed. Gabriella Zuccolin (Florence: SISMEL, 2017), 313–36, at 333–4.

former in many numerical details, to the extent that, on Friar Giles's count, the Greek translation ended up adding 1374 to the Vulgate's tally of years between Creation and Christ.[9] This strange chronological chasm invited a range of different hypotheses: did the Seventy Translators responsible for the Greek text raise the number of years on purpose, perhaps in order to win pagan converts who would have considered the age of the world implied by the Hebrew original unrealistically low? Had they been informed by the Holy Spirit to include extra years and periods their Hebrew predecessors had omitted? Or was it all just the result of scribal corruption?[10]

The carelessness of scribes—as well as mendacity, ignorance, or imprecision on the part of authors and compilers—also seemed to lurk behind the countless disagreements between profane historical sources. Among the examples Giles considered worth highlighting were the many divergent opinions as to the starting point of the Olympic era and the year when Romulus founded the city of Rome. According to G. Iulius Solinus (*De mirabilibus mundi* 1.28), the Olympiads were counted from the 408th year since the fall of Troy, in which Iphitos, king of the Eleans, restored the Games first instituted by Hercules. The Venerable Bede, who here followed the chronicle of Eusebius of Caesarea, spoke of an interval of only 405 years, while Orosius's history placed the date of Rome's foundation in the sixth Olympiad as well as in the 414th year since Troy's fall, thereby implying an interval of no more than 394 years. Solinus (1.27) was able to proffer many further opinions regarding the

[9] Giles documents the additional years contained in the Septuagint in *Summa de temporibus*, bk. 1, pt. 1, ch. 8–9, fols. 7vb–9ra. His main source for this numerical information appears to have been Bede, *De temporum ratione*, ch. 66, ed. Charles W. Jones = Corpus Christianorum Series Latina 123B (Turnhout: Brepols, 1977), 465–81. For a lucid modern study of the different biblical chronologies, see Jeremy Hughes, *Secrets of the Times: Myth and History in Biblical Chronology* (Sheffield: JSOT Press, 1990).

[10] Giles discusses these and other possible causes in *Summa de temporibus*, bk. 1, pt. 3, ch. 4, fols. 14vb–15rb.

Olympic date of Rome's foundation, most of which differed from Orosius: a certain Cincius had preferred the twelfth Olympiad, Q. Fabius Pictor the eighth. Eratosthenes and a host of other historians (Apollodorus, Nepos, and Lucius) placed Rome's first year in the second year of the seventh Olympiad, Pomponius Atticus and Cicero in the third year of the sixth, whereas Solinus himself (1.28) claimed that the city had been founded 32 years after the first Olympic Games, at the beginning of the seventh Olympiad.[11] Was every historiographical source fraught with this kind of uncertainty? Giles thought there were exceptions to the rule. Books written on the science of the stars sometimes provided their own sets of chronological intervals

> some of which are endowed with utmost certainty [*certissimae*], namely those which are determined by reckoning from securely established points in time [*que a temporibus notis per artem resolutionis vel compositionis determinantur*], as is the case with those [intervals] that start from observations made at the time of some famous ruler, or closest to him by a span of years known with certainty [*secundum certitudinem annorum*]. And according to this one finds in astronomical books with utmost certainty the intervals from the time of Nabuchodonosor to Alexander and from Alexander to Caesar Augustus and onwards to other rulers or securely

[11] Ibid., bk. 1, pt. 3, ch. 5, fol. 15va–b. Giles's sources are C. Iulius Solinus, *Collectanea rerum memorabilium* 1.27–28, ed. Theodor Mommsen, 2nd ed. (Berlin: Weidmann, 1895), 7–8; Orosius, *Historiae adversum paganos* 2.4.1, ed. Carl Zangenmeister = Corpus Scriptorum Ecclesiasticorum Latinorum 5 (Vienna: Gerold, 1882), 88; Bede, *De temporum ratione*, ch. 66, ed. Jones (n. 9), 479. See also Eusebius, *Chronicon (tr. Hieronymi)*, ed. Rudolf Helm (Berlin: Akademie-Verlag, 1956), 86a, and Alan E. Samuel, *Greek and Roman Chronology* (Munich: Beck, 1972), 189–94, 249–53.

established points in time at which some observations were made by some trustworthy philosophers.[12]

From the examples Giles went on to cite,[13] it becomes transparent that he was here thinking first and foremost of Ptolemy's *Almagest*, in which astronomical observations were regularly timed according to a rigid 'canon' of regnal years that stretched from ancient Babylon to Ptolemy's own time during the reign of the Roman emperor Hadrian.[14] Giles, who knew the *Almagest* in Gerard of Cremona's twelfth-century Arabic-to-Latin translation, could read there in book III that 424 Egyptian years (of 365 days each) separated the beginning of the reign of the Babylonian king Nabuchodonosor from the death of Alexander the Great, while

[12] *Summa de temporibus*, bk. 1, pt. 2, ch. 3, fol. 9va: 'Ex scientia autem philosophorum astrologorum inveniuntur etiam alie collationes a predictis, quarum quedam sunt certissime, ille scilicet que a temporibus notis per artem resolutionis vel compositionis determinantur, ut sunt ille que inchoantur a considerationibus acceptis in tempore alicuius principis famosi vel proximo illi secundum certitudinem annorum. Et secundum hoc inveniuntur certissime in libris astronomorum tempora a tempore Nabugodonosor usque ad Alexandrum et ab Alexandro usque ad Cesarem Augustum et ulterius usque ad alios principes vel tempora nota in quibus facte sunt aliqua considerationes per aliquos philosophos autenticos'. As becomes clearer from Giles's terminology in bk. 2, pts. 2–3, the expression *per artem resolutionis vel compositionis*, which I have left untranslated, here refers to the calendrical conversions that become necessary when working with astronomical tables.

[13] Ibid., fol. 9vb. See also the various eras mentioned in bk. 1, pt. 3, ch. 6, fol. 16ra–vb, and bk. 3, pt. 1, ch. 21, fols. 60vb–61vb. The latter chapter appears in Steele, ed., *Opera* (n. 7), 83–6.

[14] On time-reckoning in the *Almagest*, see Ptolemy, *Almagest*, trans. G. J. Toomer, rev. ed. (Princeton, NJ: Princeton University Press, 1998), 9–14; Olaf Pedersen, *A Survey of the Almagest*, rev. ed. (New York: Springer, 2011), 124–8, 461–3; Leo Depuydt, '"More Valuable than All Gold": Ptolemy's Royal Canon and Babylonian Chronology', *Journal of Cuneiform Studies* 47 (1995): 97–117.

294 more such years had passed between Alexander's death and the reign of Augustus.[15] What made these and other intervals recorded in the *Almagest* unassailable in Giles's estimation was the way observations recorded for particular dates during the years of particular regnal eras had been used, oftentimes centuries after the event, by Ptolemy and his successors to derive astronomical models of astonishing accuracy. Astronomical books, he argued, depended on years in the past being 'noted down with utmost certainty' (*certissimae annotati*), as otherwise 'the rules and principles they contain would not be valid for the future'.[16] The predictive success of astronomical theories hence guaranteed the accuracy of the underlying chronology, and *vice versa*.

Giles's effort to build a robust timeline from the world's beginning to his present day offered him two opportunities to put this methodological insight into practice. The first presented itself early on in book I, in which the Dominican scholar wrestled with the difficult task of rectifying biblical chronology and synchronizing it with profane history. Synchronization of this sort was indispensable, seeing as the chronology of the Bible was continuous only down to the destruction of the First Temple. After this event, it began to blur and dissolve rather rapidly, starting with the period known as the Babylonian Captivity. In Giles's time, it was widely, though not universally, accepted that this period of captivity had ended when Cyrus the Great, king of the Persians, conquered Babylon and allowed the Jews to return to Jerusalem. From late antique Christian chronographers such as Julius Africanus

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[15] Ptolemy, *Almagest* 3.7, trans. Toomer (n. 14), 168. For the Latin text see *Almagestum Cl<audii> Ptolemei*, ed. Petrus Liechtenstein (Venice: Liechtenstein, 1515), fol. 34r, and the bibliographical information presented at https://ptolemaeus.badw.de/work/3 (accessed May 20, 2019).

[16] *Summa de temporibus*, bk. 2, pt. 3, ch. 2, fol. 26vb: 'Quia autem collectio annorum ex libris hystoriographis non habet certitudinem […] ideo firmitatem invenire cupientes aliquam prospeximus in libris philosophorum astronomorum, in quibus anni debent esse certissime annotati de preterito, alias regule et principia eorum nullam haberent firmitatem de futuro'.

and Eusebius of Caesarea it was known that the Persian hegemony lasted a total of 230 years. After the defeat of Darius III at Gaugamela, Alexander of Macedon ruled for six years and died 323 years before Christ's birth, providing a total of 323 + 6 + 230 = 559 years between Cyrus and Christ.[17] All that was left to do, or so it seemed, was to connect these 559 years to the biblically derived interval from the Creation to the end of the First Temple, by finding out how many years had intervened between the temple's destruction by the Babylonians and the accession of Cyrus.

At first glance, the *Almagest* promised to be just the right tool to solve this puzzle. After all, the Vulgate text (2 Kings 25:1, 8) dated the destruction of Jerusalem to the 19th year of a Babylonian ruler named Nabuchodonosor, which was the same name so often invoked in Ptolemy's calculations. According to the passage mentioned above, 424 years had elapsed between the beginning of Nabuchodonosor's reign and the end of Alexander's reign. Subtracting 236 years, the standard interval from Cyrus to Alexander's death, left Giles with 424 – 236 = 188 years from Nabuchodonosor to Cyrus. Even if one took into account that Jerusalem was conquered late into Nabuchodonosor's reign, this left close to 170 years for what should have been the period of Babylonian Captivity—a captivity that lasted only 70 years according to various biblical passages (Jeremiah 25:9, 11–12; 29:10; 2 Chronicles 36:20–22) and countless patristic commentators.[18] Giles realized that there were two different ways to explain this startling discrepancy. One was to say that Ptolemy counted the 424-year interval from some other person named Nabuchodonosor, not the one mentioned in the Old Testament, but a namesake who had ruled over Babylon a century earlier, and who for some reason was unknown to historians. The alternative was to bite the bullet and accept that the interval from Cyrus to Alexander's death was in fact a century longer than commonly

[17] Ibid., bk. 1, pt. 1, ch. 7, fols. 6va–7vb.

[18] See ibid., bk. 1, pt. 1, ch. 6, fols. 4va–6va, where Giles also discusses other sources and scenarios.

believed (336 rather than 236 years). Giles realized that this scenario could be accepted only if one was prepared to believe that the interval for the period of Persian rule recorded by authorities such as Eusebius had somehow been truncated by unreliable scribes

> as is frequently the case. And this is nevertheless a difficult thing to assert and believe, considering that many and great authors put these years down not just as a sum, but also in parts, [which] add up to no more than 236 [years].[19]

Had the Babylonian Captivity been the only chronological problem to intersect meaningfully with Ptolemy's data, the dividends paid by Giles's insight that astronomy could be used to ground history might have looked disappointingly meagre. Fortunately, securing the number of years from Creation to Christ was just one major challenge a medieval chronologer had to confront. Another set of questions was posed by the dates that marked the earthly life of Jesus Christ as well as the by number of years between Christ's incarnation or birth and the immediate present. While the common practice of counting the years from the incarnation of the Lord could seem to render this latter problem trivial, not everybody in Giles's time believed that the originator of this era, the sixth-century monk Dionysius Exiguus, had gotten his numbers right. The problem was a computistical one: according to a widely held ecclesiastical tradition Christ died on 25 March, which in the year of the crucifixion should have coincided with Friday and the full moon of Passover. Yet this assumption clashed with

[19] Ibid., fol. 6ra: 'Quod duobus modis dissolvi potest. Uno modo, quod dicamus Ptolomeus accepisse annos ab alio rege dicto Nabugodonosor, qui centum annis regnaverit fere ante illum de quo scriptura sacra meminit quod ipse destruxit Iherusalem, quod tamen non potuimus ex aliqua hystoria invenisse. Alio modo, quod dicamus a principio regni Cyri usque ad mortem Alexandri fuisse trecentos et triginta sex annos et quod invenitur in hystoriographis quod ducenti fuerunt et triginta vicio scriptorum sit detruncatum, sicut frequenter accidit. Et hoc tamen difficile est dicere et credere, cum multi et magni auctores huiusmodi annos non tantum summatim ponant, sed per partes; colligant tantum CC et XXXVI'.

the tables and algorithms Latin computists used to calculate the age of the Moon and day of the week and, by extension, the date of Easter. If the framework of the Easter *computus* was accepted, it turned out that none of the years that would have been historically plausible as containing the crucifixion showed the expected combination of calendrical data.[20]

A bold solution to this conundrum had been proposed in the eleventh century by a computist named Gerland, who dismissed the common Passion date on 25 March and instead latched onto a minority tradition assigning this event to 23 March. On this assumption, it became possible to date the crucifixion to AD 42, which could be rendered historically plausible by shifting the date of the nativity forward from 1 BC or AD 1 to AD 8.[21] Friar Giles was aware of Gerland's proposal, but had no confidence in the underlying method. Could one truly assume, as Gerland had done, that Dionysius Exiguus had committed a mistake by fixing the *Annus Domini* the way he did? Giles made an effort to sift the available chronographic evidence for the year of Christ birth and its place in Roman history, but in the end the number of discrepancies he encountered made him despair of finding the answer by the conventional approach of adding up the years found in his sources.[22] Instead of trusting the fallible records of historians, no matter how saintly they may have been, Giles founded his own argument on the insight that

[20] Nothaft, *Dating* (n. 5), 69–112.

[21] Giles discusses the problem and Gerland's solution to it in *Summa de temporibus*, bk. 2, pt. 2, fols. 24va–26rb. See also Alfred Lohr, ed., *Der Computus Gerlandi* (Stuttgart: Steiner, 2013), 143–56; Peter Verbist, *Duelling with the Past: Medieval Authors and the Problem of the Christian Era, c. 990–1135* (Turnhout: Brepols, 2010), 147–71.

[22] *Summa de temporibus*, bk. 2, pt. 3, ch. 2, fols. 26va–27vb.

> if the magnitudes and hours of some bygone eclipses that happened at the time of Christ—or not long before or after— are known, it is also possible to know with utmost certainty the number of years from those eclipses to the present hour.[23]

As the Dominican scholar went on to demonstrate in an intricate, yet lucid discussion, it was possible to fix the dates of Emperor Hadrian (AD 117–38) by reference to a triple of lunar eclipses recorded in the *Almagest* (4.6).[24] The first of these was a total eclipse Ptolemy had observed in the 17th year of Hadrian's reign. It reportedly reached its mid-point about 45 minutes before midnight between two dates that Ptolemy identified as the 20th and 21st of Pauni in the Egyptian calendar. The true position of the Sun at this moment had been 13;15° Taurus. In exploiting this information, Giles was aided by the so-called *Toledan Tables*, a set of astronomical tables from eleventh-century al-Andalus, which were based on the Arabic lunar calendar (of 354 or 355 days per year) and the era of the Hijra, with a start on 15 July AD 622.[25] In order to apply this system of time reckoning to earlier centuries, Giles chose to reduce the Toledan Tables to a new epoch date, 9 August AD 1, which lay exactly 640 Arabic lunar years before the Hijra.[26] Calculating forward the years and months, Giles found eclipses that exactly matched Ptolemy's description on the following dates:

Eclipse 1 (17th year of Hadrian): 5/6 May AD 133

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[23] Ibid., bk. 2, pt. 3, ch. 3, fol. 27vb: '[N]otis aliquibus eclypsibus preteritis quantum ad quantitatem et horam circa tempora Christi nativitatem, vel ante vel post non multum elongantia, et numerum annorum ad hanc horam ab illis eclypsibus possibilie est certissime sciri'.

[24] Ptolemy, *Almagest* 4.6, ed. Liechtenstein (n. 15), fol. 42r–v = trans. Toomer (n. 14), 198.

[25] See the edition by Fritz S. Pedersen, *The Toledan Tables: A Review of the Manuscripts and the Textual Versions with an Edition*, 4 vols. (Copenhagen: Reitzel, 2002).

[26] Tables to aid conversions between Arabic and Christian years were standardly included in the *Toledan Tables*, but also in *Summa de temporibus*, bk. 3, pt. 3, ch. 1–3, fols. 79ra–81rb, ed. in Steele, *Opera* (n. 7), 151–9.

Eclipse 2 (19th year of Hardian): 19/20 October AD 134

Eclipse 3 (20th year of Hadrian): 5/6 March AD 136.[27]

Minor slips in calendrical conversion led Giles to place the first two eclipses one day too early, but this could hardly diminish the solidity of the result thus achieved. His calculations gave him the confidence to assert that there were exactly 1128 years between the start of the 17th year of Hadrian's (as counted from 1 January) and the end of AD 1260, which appears to have been Giles's year of writing. This only left the first 132 years of the Dionysiac era in need of further consideration. A crucial hint was provided by Eusebius and Orosius, who agreed in placing Christ's birth in the 42nd year of Augustus.[28] After a careful collation of the regnal years recorded in these late antique sources as well as in Isidore of Seville's *Etymologies* with the relevant data contained in the *Almagest* (3.7), Friar Giles arrived at the conclusion that 132 years were indeed the right interval to comprise the final 15 years of Augustus and the first 16 years of Hadrian together with the reigns of all the intervening emperors. Thanks to Ptolemy's eclipses, or so it seemed, Dionysius's era had been successfully vindicated against its critics.[29]

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[27] *Summa de temporibus*, bk. 2, pt. 3, ch. 3, fols. 27vb–29ra. A significantly different presentation of this argument appears in bk. 2 of the second recension of Giles's *Summa*, as found in MSS Arras, Bibliothèque municipale, 674 (722), fols. 48r–51v; Paris, Bibliothèque nationale de France, lat. 15268, fols. 223ra–vb. Giles here calculates backwards from a solar eclipse observed in Paris on Sunday, 5 August 1263.

[28] Eusebius, *Chronicon (tr. Hieronymi)*, ed. Helm (n. 11), 169; Orosius, *Historiae adversum paganos* 7.2.14, ed. Zangenmeister (n. 11), 437.

[29] *Summa de temporibus*, bk. 2, pt. 3, ch. 3, fol. 29ra–va. Giles's chronological demonstration contains a few imprecisions, which kept him from realizing that Eusebius's chronicle counts 134 years for the interval in question and thus places the nativity in 2 BC. See Eusebius, *Chronicon (tr. Hieronymi)*, ed. Helm (n. 11), 169–201.

Biblical and profane chronology in Heinrich Selder's *Tractatus*

The methodological innovations Giles of Lessines introduced in his *Summa de temporibus* were by no means completely lost on his contemporaries. A clear instance where they fell on fertile ground can be found in the famous *Opus maius* written ca. 1267 by the Franciscan friar Roger Bacon. Although Bacon never mentions Friar Giles by name, some striking parallels in content and even wording leave no doubt that a whole section in the *Opus maius* dedicated to the uses of technical chronology in biblical exegesis was shaped in part by Bacon's reading of the first two books of Giles's *Summa*.[30] Yet while Bacon's remarks on the subject show that he had fully grasped the importance of Ptolemy's *Almagest* as a chronological resource and the utility of eclipses in rendering chronology more accurate,[31] there are no hints in his work that he ever expanded on Giles's insights in this area, by trying to find new avenues for eclipse-based historical dating.

A very different story emerges from studying an anonymous fourteenth-century treatise on the chronology of Jesus Christ (*Tractatus de tempore dominice annunciationis, nativitatis et passionis*), whose author practiced chronology on a technical level that even surpassed the one attained by Giles of Lessines.[32] The person responsible for this intriguing

[30] These parallels were first pointed out by Ferdinand M. Delorme, 'De auctore Compoti sub nomine Rogeri Baconis recenter editi', *Antonianum* 14 (1939): 313–22. See also Nothaft, 'Climate' (n. 8).

[31] For a key passage in the *Opus maius* mentioning eclipses and Ptolemy, see note 63 below. A fuller discussion of Roger Bacon's thoughts on chronology appears in Nothaft, *Dating* (n. 2), 155–201, which was written without knowledge of Giles's work or Bacon's dependence on it.

[32] The only full copy of the *Tractatus* known to date is MS Munich, Bayerische Staatsbibliothek, Clm 18298, fols. 1r–34v. Excerpts from the text appear in MS Vatican City, Biblioteca Apostolica Vaticana, Pal. lat. 1354, fols. 33r, 96v, 166v, 241va–243va. A critical edition of the *Tractatus* together with a thorough study of its authorship and content is currently in preparation.

text worked in the diocese of Augsburg and can in all likelihood be identified with Heinrich Selder, a Swabian astronomer who obtained a master's degree from the University of Paris in 1378.[33] According to a remark Selder makes towards the end of his *Tractatus*, he already began composing this work in 1371,[34] but another passage makes it clear that he was still working on it on 20 December 1378, the day on which his cousin gave birth to a boy.[35] The existing version of the text was evidently finished some time before the date of a Jupiter-Saturn conjunction expected for 10 April 1385.[36]

Of the three main chapters that make up Selder's *Tractatus*, the first was there to investigate Christ's nativity, by establishing its date in the Julian calendar, day of the week, and corresponding regnal year of the relevant Roman emperor. The second chapter moves on to the date of his conception, while the third deals at some length with the date and year in which Christ died on the cross and rose from the dead. At the very end, Selder adds a discussion of the respective age at which the Virgin Mary gave birth to Jesus and was assumed into heaven, two questions for which he mainly relies on the visions of the twelfth-century nun Elisabeth of Schönau.[37] In pin-pointing the date of Christ's nativity (Saturday, 25 December 1 BC), Selder was not content with merely establishing the parallel year in Roman

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[33] See C. Philipp E. Nothaft, '*Vanitas vanitatum et super omnia vanitas*: The Astronomer Heinrich Selder and a Newly Discovered Fourteenth-Century Critique of Astrology', *Erudition and the Republic of Letters* 1 (2016): 261–304, at 262–79.

[34] *Tractatus*, ch. 3, pt. 2, fol. 31ra.

[35] Ibid., ch. 2, fol. 28va–b.

[36] Ibid., ch. 1, pt. 2, prop. 16, fol. 12ra–b.

[37] See ibid., ch. 3, pt. 3, fols. 33vb–34va, where Selder cites the full text of the *Visio Elisabeth, quam vidit de resurrectione beate virginis matris domini*, ed. in F. W. E. Roth, *Die Visionen der hl. Elisabeth und die Schriften der Aebte Ekbert und Emecho von Schönau* (Brünn: Verlag der Studien aus dem Benedictiner- und Cistercienser-Orden, 1884), 53–5.

imperial chronology, which on his count was the 43rd rather than the 42nd year of Augustus.[38] In fact, he quickly moved on to discuss seventeen further chronological propositions, each of which concerned the retrospective number of years between Christ's nativity and a significant date or epoch from earlier history.[39] According to Selder's chronological demonstrations, some of them highly intricate, Jesus Christ was born in

1. the 179th year of Judah Maccabee's leadership
2. the 324th year from Alexander's death
3. the 515th year since the completion of the Second Temple
4. the 521st year of King Darius I
5. the 66th prophetic week of Daniel
6. the 589th year since the Babylonian Captivity
7. the 721st year of King Mardokempad (*Mardocheus*).
8. the 747th year of King Nabuchodonosor
9. the 752nd year since the foundation of Rome
10. the fourth year of the 194th Olympiad
11. the 1016th year since the construction of the First Temple in the fourth year of King Salomon
12. the 1185th year since the fall of Troy
13. the 1496th year since the Exodus from Egypt
14. the 2001st year since Abraham's birth
15. the 2542nd year since the confusion of languages
16. the 3073rd year since the Flood
17. the 5313th year since Adam's creation

[38] This conclusion is established in *Tractatus*, ch. 1, pt. 1, fol. 1ra–vb.

[39] See the listing provided ibid., ch. 1, pt. 2, fols. 1vb–2ra.

Only three of Selder's epochs—those numbered 9, 10, and 12—fell entirely outside the biblical framework that otherwise dominated his treatise. In the case of the first Olympic Games and the era based on them, the inclusion would have been easy to justify given their use in important chronographic sources such as the Eusebian chronicle, where the Olympiads, from their inception in 776 BC, provide the sole continuous count of years. It is nevertheless intriguing to see Selder spend several hundred words elucidating the historical and mythological background of the Olympic Games, based on sources such as Solinus's *De mirabilibus mundi*, Godfrey of Viterbo's *Pantheon*, and certain scholia to Horace's *Odes*.[40] That the Swabian astronomer harboured at least a passing interest in Greek and Roman antiquity is further suggested by his discussions of the foundation of Rome and the fall of Troy. For the former, he incorporated a lengthy quotation from Solinus detailing Romulus's ancestry and the positions of the planets on the day he founded Rome (21 April). These positions had allegedly been calculated by Lucius Tarutius of Firmum, an 'astrologer of outstanding merit' (*nobilissimus mathematicorum*), but the details transmitted by Solinus made no apparent sense. Contrary to what Tarutius's horoscope seemed to demand, Mercury never receded from the Sun by more than 30 degrees, nor was Venus elongated by more than 50 degrees. Selder concluded that Tarutius was not such a brilliant astrologer after all, or that the letter of Solinus's remarks had somehow been corrupted.[41]

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[40] *Tractatus*, ch. 1, pt. 2, prop. 10, fol. 6va–b.

[41] See Solinus, *Collectanea rerum memorabilium* 1.17–18, ed. Mommsen (n. 11), 5–6, and Selder's reaction in *Tractatus*, ch. 1, pt. 2, prop. 9, fol. 6rb: 'Ex hoc sequitur quod Lucius Tharrucius non fuit mathematicorum nobilissimus vel littera Solini est corrupta'. Solinus states that Tarutius placed Saturn, Mars, Venus, and Mercury in Scorpio, but the Sun in Taurus, which is astronomically absurd. The best explanation for this state of affairs is that the horoscope was originally cast for 4 October 754 BC, but the longitude of the Sun later adjusted to match 21 April, Rome's official 'birthday' during the Imperial period. Selder's second explanation is hence on the right

When it came to drawing chronological information from ancient books, no other source provided Selder with more powerful ammunition than Ptolemy's *Almagest*. Of particular value was the aforementioned passage from the end of book III, where Ptolemy established the epoch of the Sun's mean motion by relating the autumn equinox observed in the 17th year of Hadrian to the regnal eras of Nabuchodonosor and Augustus as well as to the death of Alexander the Great.[42] Rather than simply copying this information, Selder took care to verify that Ptolemy's chronological statements were consistent with his own astronomical models. Using the computational tables included in the *Almagest*, he was able to confirm that the Sun had reached the point on the ecliptic equivalent to the autumn equinox 879 years, 66 days, and 2 hours after the start of the era of Nabuchodonosor, exactly as Ptolemy had claimed. If converted into the Julian calendar and Christian era, this came out as 25 September AD 132, which thus became the appropriate fixed point from which to interpret the remaining eras mentioned in the text.[43] The death of Alexander, for instance, could now be established as having occurred 323 years before Christ's birth, or in 324 BC. To Selder, it was important to convey that this was not just another interval of years taken from ancient chronicles, but chronological information of a higher and purer quality. Theorizing on this in somewhat different terms than Giles of Lessines had done before him, he addressed his reader as follows:

> But you might say: 'On what grounds should I believe Ptolemy more than others, seeing that I have neither knowledge of this nor evidence?' I say that [the reason for

track, although the error predates Solinus. See Anthony T. Grafton and Noel M. Swerdlow, 'The Horoscope of the Foundation of Rome', *Classical Philology* 81 (1986): 148–53; Stephan Heilen, 'Ancient Scholars on the Horoscope of Rome', *Culture and Cosmos* 11 (2007): 43–68.

[42] See note 15 above.

[43] *Tractatus*, ch. 1, pt. 2, prop. 2, fol. 2rb.

> believing him] is because the mathematicians and astrologers of old, when they examined and observed in their days some eclipse or solstice or equinox or something of this sort, also wrote down in their books the years of the kings or emperors under whom they made these observations. Similarly, they noted down the months, days, and hours and also their locations in the heavens, according to signs, degrees, and minutes, and in this form left them to posterity. Those who came after them, when they observed in their own times in a similar manner some eclipse or something of this sort, most assiduously investigated the time that intervened between two observations, and they did this based on the daily rates of motion of the mobile heavens [*ex dietis celestium mobilium*], and this way they found the intervening time with precision.[44]

Of all the observations Ptolemy transmitted in his *Almagest*, the most ancient were a triple of lunar eclipses astronomers had recorded during the first two years of the reign of Mardokempad (Marduk-apla-iddina II), who usurped the throne of Babylon in 721 BC.[45] In

[44] *Tractatus*, c. 1, pars 2, prop. 2, fol. 2rb–va: 'Sed diceres unde plus credam Ptholomeo quam aliis cum hoc mihi non constet nec habeam evidentiam. Dico quod ex hoc quia priores mathematici et astrologi considerantes et observantes in diebus suis aliquam eclipsim vel solsticium vel equinoctium vel aliquod huiusmodi scripserunt in libris suis et annos regum vel imperatorum, sub quibus talia consideraverunt, similiter menses et dies ac horas et eciam loca eorum in celo quantum ad signa gradus et minuta annotantes ita posteris reliquerunt. Posteri consimiliter observantes eclipsim aliquam vel aliquod huiusmodi suis in temporibus inquisierunt studiosissime tempora intermedia inter duas observations, et hoc ex dietis celestium mobilium, et ita precise tempora intermedia invenerunt'.

[45] Ptolemy, *Almagest* 4.6, trans. Toomer (n. 14), 191–2. Ptolemy placed the second of these eclipses 27 Egyptian years, 17 days, and 11 1/6 hours after the beginning of the era of Nabuchodonosor (747 BC), which made it easy for Selder to determine the year relative to Christ's birth. See *Tractatus*, ch. 1, pt. 2, prop. 7, fol. 5vb, quoting Ptolemy, *Almagestum* 4.8, ed. Liechtenstein (n. 15), fol. 43v = trans. Toomer (n. 14), 204–5.

Gerard of Cremona's translation of the *Almagest*, this ruler appeared as *Mardocheus*, which was exactly identical with the way the Latin Vulgate rendered the name of Esther's uncle Mordechai (Esther 2:5). Selder rightly disregarded this similarity and instead drew the same conclusion as modern scholars, equating the *Mardocheus* of the *Almagest* with the Babylonian king Merodach Baladan, son of Baladan, who is commemorated in the Old Testament for having sent letters and gifts to the Judean king Hezekiah when hearing about the latter's recovery from grave illness (2 Kings 20:12; Isaiah 39:1).[46] Finding this precious link between Ptolemy's eclipses and the Bible also gave Selder an opportunity to reflect on a curious miracle reported in 2 Kings (20:8–11) and Isaiah (38:7–8), where God gives Hezekiah a sign by making the shadow on the 'sundial of Ahaz' go back by ten degrees. Although Selder did not deny the reality of this miracle or that it resulted from a reversal of the Sun's path, he could not help noticing that the astronomical record showed no trace of it ever occurring. Indeed, if one used astronomical tables composed long after Hezekiah's time to calculate back to the eclipses Babylonian astrologers had observed at the start of Merodach Baladan's reign, and hence before the miracle, the result showed no significant deviation. For a pious man like Selder, the only possible conclusion was that God had 'preserved the celestial spheres in the [regular] order of their motions', such that after the Sun's backward motion in an easterly direction and subsequent return towards the west, 'they would be found in their places as if this reversal had never happened'.[47]

[46] *Tractatus*, ch. 1, pt. 2, prop. 7, fol. 5vb.

[47] Ibid., ch. 1, pt. 2, prop. 7, fols. 5vb–6ra: 'Et vide quod Deus speras celestes ita conservavit in ordine suorum motuum, ut post reversionem solis ab occidente in oriens super terra et rursum ab oriente in occidens invenirentur in locis suis ac si numquam fuisset reversio talis facta. Nam eclipsis illa de qua iam diximus est observata ab astrologis in Babilone ante miraculum et per tabulas motuum celestium postea compositas invenitur eorum veritas que narravi'.

Another ancient Near Eastern ruler mentioned both in the *Almagest* and in the Hebrew Scriptures was Darius I, king of the Persians, whose 20th and 31st year of rule had each been the occasion of a lunar eclipse. As in the case of Mardokempad/Mardocheus, Ptolemy dated these eclipses relative to the era of Nabuchodonosor, which put Selder in a position to conclude that Darius's reign had started in 521 BC.[48] A collation of this result with trusted chronographers such as Freculf, the ninth-century bishop of Lisieux, convinced him that this was the same Darius during whose reign the restoration of the temple in Jerusalem was resumed and completed (1 Esdras 6:15).[49] Thanks to Ptolemy, Heinrich Selder had thus gained what promised to be a reliable entry wedge into both Persian and Hebrew chronology. It prepared him to embark on the most complex and verbose chronological demonstration contained in the first chapter of his *Tractatus*, which was reserved for the prophecy of the Seventy Weeks contained in the book of Daniel (9:24–27), a problem of enduring popularity in both medieval and early modern exegetical literature. Most commentators agreed that the seventy 'weeks of years' invoked in this prophecy had to be understood as comprising 7 × 70 = 490 years, but neither the starting and end points of this messianic countdown nor the nature of the years involved were clearly defined by the biblical text.[50]

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[48] See Ptolemy, *Almagestum* 4.9, ed. Liechtenstein (n. 15), fol. 44r–v = trans. Toomer (n. 14), 206–9, cited in *Tractatus*, ch. 1, pt. 2, prop. 4, fol. 2va–b. As before, Selder made sure to check the date of the eclipse against astronomical tables, finding full agreement with Ptolemy's statements (ibid., fol. 2vb: 'et ego inveni ita fuisse sicut dicit Ptholomeus').

[49] Freculf of Lisieux, *Historiae* 1.7.19, ed. Michael I. Allen = Corpus Christianorum Continuatio Mediaevalis 169A (Turnhout: Brepols, 2002), 431, ll. 49–50.

[50] *Tractatus*, ch. 1, pt. 2, prop. 5, fols. 2vb–5va. For the background, see Franz Fraidl, *Die Exegese der Siebzig Wochen Daniels in der alten und mittleren Zeit* (Graz: Leuschner & Lubensky, 1883); Katharina Bracht and David S. Du Toit, eds., *Die Geschichte der Daniel-Auslegung in Judentum, Christentum und Islam* (Berlin: de Gruyter, 2007).

A widespread approach to the conundrum, one aimed towards making the prophecy fit with Christian soteriology, had been established in the early third century by the chronographer Julius Africanus, who claimed that the 490 years had to be interpreted as lunar years and could hence be scaled down to 475 solar years. If these 475 years were counted from the month of Nisan in the 20th year of Artaxerxes, in which Nehemiah received permission to rebuild the walls of Jerusalem (Nehemiah 2:1), the end point could be made to coincide more or less neatly with the year Christ's crucifixion.[51] One of the goals Selder pursued in his detailed discussion of Daniel's prophecy was to check this theory, which in medieval Europe was associated primarily with the Venerable Bede (d. 735),[52] for its chronological and astronomical plausibility. Based on Ptolemy's eclipses, he was in a position to conclude that the 20th year of Artaxerxes most likely overlapped with the 301st year of the era of Nabuchodonosor (448/7 BC), the start of which he dated—with near-perfect accuracy—to 12 December in the Julian calendar.[53] According to the calendar known to medieval Jews, the lunisolar conjunction that preceded the month of Nisan in this year fell on Tuesday, 3 April, 13 hours and 363 *ḥalakim* (363/1080 of an hour) after previous sunset. Selder deduced from the same calendar that 490 lunar years comprised 173,639 days and 21 hours, which in turn were equivalent to 475 Julian years and ca. 147 days. If these were added to 1 Nisan in the 301st year of Nabuchodonsoor, the end-point of the calculation was a date in

[51] See Julius Africanus, *Chronographiae* F93, ed. Martin Wallraff et al. = Die Griechischen Christlichen Schriftsteller der ersten Jahrhunderte, N.F. 15 (Berlin: de Gruyter, 2007), 276–87; Fraidl, *Die Exegese* (n. 50), 45–50.

[52] Bede, *De temporum ratione* 9, 66, ed. Jones (n. 9), 304–10, 486; Bede, *In Ezram et Nehemiam* 3, ed. D. Hurst = Corpus Christianorum Series Latina 119A (Turnhout: Brepols, 1969), 342–3. See Fraidl, *Die Exegese* (n. 50), 102–5.

[53] *Tractatus*, ch. 1, pt. 2, prop. 5, fols. 3vb–4ra. The correct equivalent for 1 Thoth in the 302nd year of Nabuchodonosor would have been 13 December 448 BC.

AD 29, which coincided not with the crucifixion, but with the approximate time of Christ's baptism and the start of his public ministry.[54]

A far more severe error had been committed by those who followed a rabbinic Jewish tradition that reduced more than two centuries of Persian hegemony over Israel to just 52 years and, in doing so, assumed that the entire period from the start of the Babylonian Captivity to the destruction of the Second Temple by Titus (AD 70) could be comprised within 490 years.[55] One Christian exegete who followed this rabbinic chronology at least in part was Nicholas of Lyra (ca. 1270–1349), whose immensely influential *Postilla litteralis* on the whole Bible expounded a view according to which Daniel's Seventy Weeks had to be counted down from the fifth year of Zedekiah, who ruled over the kingdom of Judah at the time when Nabuchodonosor besieged and destroyed Jerusalem (Jeremiah 28:1).[56]

Ptolemy's eclipses offered Selder the key to a convincing refutation of this interpretation. If King Darius I's reign began in 521 BC and the Babylonian Captivity came to its end in Darius's second year (Zechariah 1:1, 12), the first year of the Captivity could be dated as far back as 521 + 68 = 589 BC,[57] which carried the implication that rabbinic authors such as Rashi had underestimated the interval between Jerusalem's two major destructions by

[54] Ibid., fol. 4ra–vb. In Africanus's original chronology, the 475 years ran from 445 BC to AD 31. See Alden A. Mosshammer, 'The Christian Era of Julius Africanus with an Excursus on Olympiad Chronology', in *Julius Africanus und die christliche Weltchronistik*, ed. Martin Wallraff (Berlin: de Gruyter, 2006), 83–112.

[55] See Mitchell First, *Jewish History in Conflict: A Study of the Major Discrepancy between Rabbinic and Conventional Chronology* (Northvale, NJ: Aronson, 1997).

[56] See Fraidl, *Die Exegese* (n. 50), 140–7; Mark Zier, 'Nicholas of Lyra on the Book of Daniel', in *Nicholas of Lyra: The Senses of Scripture*, ed. Philip D. W. Krey and Lesley Smith (Leiden: Brill, 2000), 173–93, at 180–7.

[57] *Tractatus*, ch. 1, pt. 2, prop. 6, fol. 5va.

more than 170 years.[58] Another important conclusion to be drawn from this chronological linchpin was that the Nabuchodonosor mentioned in the *Almagest*, who began to rule in 747 BC, could impossibly be the same king whose troops captured Jerusalem in 589 BC, which was supposed to be the 19th year of his reign.[59] A problem that had been left undecided by Giles of Lessines in 1260 was thus solved with conviction a century later by Heinrich Selder, who would have been pleased to hear from sixteenth-century chronologers such as Joseph Scaliger that the Greek text of the *Almagest* commemorated not the biblical Nebuchadnezzar II, but an earlier Babylonian king named Nabonassar (Ναβονάσσαρος).[60]

Concluding remarks

For the purposes of an astronomically grounded chronology the reign of Nabonassar was clearly something of a watershed, seeing that the *Almagest* recorded no epochs or observations that preceded him. According to Giles of Lessines, some authors had been bold enough to go back much further, counting years from the Flood or even from the world's Creation, but there was no reason to assume that these tallies were endowed with any certainty. Where such chronological assertions were not simply based on the intervals found in Scripture, they had been derived conjecturally, by calculating back to some planetary configuration that seemed appropriate on astrological grounds. Chronological certainty, however, was found only if one was prepared to start from the time of Nabuchodonosor, 'the

[58] Ibid., ch. 1, pt. 2, prop. 6, fol. 5va–b. See also ibid., ch. 1, pt. 2, prop. 5, fols. 3va, 4rb, 5rb–va, for Selder's criticism of Nicholas of Lyra.

[59] Ibid., ch. 1, pt. 2, prop. 8, fol. 6ra: 'Et notandum quod non est idem Nabuchodonosor qui cepit Ierusalem et ille super quem computat Ptholomeus, sed inter eos fluxerunt anni 140, ut patet volenti querere ex dictis'.

[60] On the sixteenth-century debate concerning Nabonassar's identity, see Grafton, *Joseph Scaliger* (n. 2), 123–33, 269, 283, 302–4.

first and great king of the Chaldaeans'.[61] This is not to say that Giles was completely opposed to taking an astrological approach. Far from it, the first book of his *Summa de temporibus* culminated in a speculative analysis of the different results obtainable for the year of Creation if one assumed that the solar apogee had been in its most beneficial position when the Sun was first set in motion.[62] His reader Roger Bacon continued to count planetary conjunctions, next to eclipses, among the phenomena an astronomer might use to endow chronology with greater certainty.[63] Yet more evidence for the mingling of astrology and chronology comes from the early fourteenth century, when the English Benedictine scholar Walter Odington engaged in an attempt to derive the age of the world from 360-year planetary cycles. His argument was later criticized by John Ashenden, author of the gargantuan *Summa iudicialis de accidentibus mundi* (1347/48), who nevertheless took the position that astrologers were ideally situated to reconstruct the chronology of the most remote past, and who used material

[61] *Summa de temporibus*, bk. 1, pt. 2, ch. 3, fol. 9va–b: 'Alie vero partes collectionum sunt coniecturales et non ita certe, propter hoc quod non inveniuntur scripte alique consideraciones in temporibus illis antiquis a quibus inchoantur, ut ille que sunt a diluvio et ille que sunt ab inicio mundi. Acceperunt tamen quidam ex ipsis philosophis huiusmodi annos, quidam per revelationes auditas a nostris scripturis, in quibus tempora omnia ab inicio mundi usque ad diluvium et post diluvium sunt annotata, quidam vero ex eis non contenti huiusmodi scripturis etiam per artem revolutionis, qua volebant invenire omnes planetas in locis suis oportunioribus in tempore sue creacionis, alia tempora et alios annos creationi mundi attribuerunt. Ea autem que certa sunt apud artem huiusmodi inveniuntur tantum a tempore Nabugodonosor primi et magni regis Caldeorum'.

[62] Ibid., bk. 1, pt. 3, ch. 7, fols. 16vb–18va, ed. in Nothaft, 'Climate' (n. 8), 55–8.

[63] Roger Bacon, *Opus maius*, ed. John Henry Bridges, vol. 1 (Oxford: Clarendon Press, 1897), 189: 'Sed diversitas haec non potest certificari, nisi per aliquam radicem certam. Nulla vero scientia potest hic invenire nec habet unde cogitet de tanta certitudine nisi astronomia, cujus est considerare revolutiones certas et ratas eclipsium et conjunctionum planetarum et caeterarum revolutionum coelestium, stante ordine naturae'. On the place of astrology in Bacon's treatment of chronology, see Nothaft, *Dating* (n. 5), 171–8.

supplied by the Alfonsine Tables and the Arabic astrologer Abū Maʿshar (787–886) to calculate back to the world's creation.[64]

In Heinrich Selder's *Tractatus*, which came three decades after Ashenden's *Summa*, this close link between astrology and chronology was not just severed: it was openly contested. An opportunity for Selder to display his negative attitude towards astrology was offered by the biblical Flood, the beginning of which had been placed on 17 February 3102 BC by Abū Maʿshar and other Arabic sources. In contrast to Odington and Ashenden, who had both treated this date as reliable, the Swabian astronomer made it clear that it conflicted with the letter of Scripture, which on his reading pointed to a deluge in May 3073 BC. A more serious issue than this difference of a few decades, however, was Abū Maʿshar's suggestion that the watery cataclysm described in the Book of Genesis had begun as a natural event, triggered by a great conjunction of Jupiter and Saturn. Selder invested several pages in exposing the absurdities inherent in this naturalistic doctrine, but his disagreements with conjunctionistic theories of history went much deeper than any specific attempt at dating or explaining biblical events. As he went on to signal in a lengthy excursus, the whole art of divination by the stars was not only baseless in philosophical terms, but in fact a satanic invention designed to mislead and corrupt human beings.[65]

For all the vitriol that Selder was willing to direct at judicial astrology and its practitioners, it clearly did not detract from his profound appreciation for the role

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[64] These two authors are discussed in C. Philipp E. Nothaft, 'Walter Odington's *De etate mundi* and the Pursuit of a Scientific Chronology in Medieval England', *Journal of the History of Ideas* 77 (2016): 183–201; Laura Ackerman Smoller, 'Astrology, the Flood, and the Challenges of History in Late Medieval Europe', in *Les temps des astronomes: l'astronomie et le décompte du temps de Pierre d'Ailly à Newton*, ed. Édouard Mehl and Nicolas Roudet (Paris: Les Belles Lettres, 2017), 103–20, at 108–11.

[65] *Tractatus*, ch. 1, pt. 2, prop. 16, fols. 9va–24vb. See Nothaft, '*Vanitas vanitatum*' (n. 33), 285–304.

astronomical observations and calculations could play in supporting chronological hypotheses. Here was an area where his thoughts were in unison with those entertained a century earlier by Giles of Lessines. The methodological breakthrough that manifests itself in both their works appears to have come about independently, as a result of their careful reading of Ptolemy's *Almagest*, where the nexus between astronomy and history was left implicit, but ready to be exploited by those willing to connect the dots. In unleashing the chronological potential of Ptolemy's eclipses and putting it to practical use, Giles and Selder were able to come up with impressive solutions to long-standing problems. In some cases, as with Selder's dating of the destruction of the First Temple or the reign of Darius I, the conclusions put forward in these medieval sources were barely different from those arrived at by sixteenth-century luminaries such as Scaliger.[66]

In light of these similarities, it is all the more disturbing to realize that neither Giles of Lessines nor Heinrich Selder exerted any discernible influence on their early modern successors.[67] The reasons for this lack of communication across the centuries are presumably complex and variegated, ranging from changes in learned culture and institutional contexts to discontinuities wrought by the print revolution. Whatever the explanation may be, the story of technical chronology, as it can be told at present, seems to be characterized by a rupture

[66] See Joseph Justus Scaliger, *Opus novum de emendatione temporum* (Paris: Nivelle, 1583), 219–20; Grafton, *Joseph Scaliger* (n. 2), 284–5.

[67] Here it may be worth noting that the chronological sections of Selder's *Tractatus* were closely studied by Johannes Keck, who was a monk at Tegernsee Abbey from 1442 to 1446. This is evident not only from Keck's annotations to the text in MS Munich, Bayerische Staatsbibliothek, Clm 18298, fols. 1r–34v, but from his own chronological calculations, as preserved ibid., fols. 35r–36v (*Calculatio annorum ab origine mundi usque ad Christi nativitatem*), and in MSS Munich, Bayerische Staatsbibliothek, Clm 18931, fols. 1r–9r; Munich, Bayerische Staatsbibliothek, Clm 18739, fol. 218r.

between the fourteenth and the sixteenth century, with the result that, in an important area such as eclipse dating, Renaissance scholars were forced to reinvent the wheel.