

**Reforming the Calendar at the University of Salamanca ca. 1468:
Pedro Martínez de Osma and his *Disputatio de anno...***

C. Philipp E. Nothaft
University College, London

1. *Introduction*

“To keep in balance the movements of the heavenly bodies, the fixed position of their orbits and their quivering movements,” writes Pierleone Casella in his eulogy on the famed clockmaker Juanello Turriano, “is a task of Atlas and a labour of Hercules” (Gombrich 1987, 231).¹ During the sixteenth century, this Herculean labour became a major preoccupation for dozens of learned men throughout Europe, as they sought to contribute to the Catholic Church’s ongoing efforts to construct an astronomically accurate calendar that would successfully tie the date of Easter back to the phenomena (vernal equinox and full moon) on which it was originally based. As is well known, these efforts culminated in the Gregorian reform of the calendar, which was promulgated in 1582 with the papal bull *Inter gravissimas*.² In Turriano’s native Spain, the institution to partake most heavily in the discussion that preceded this reform was the University of Salamanca, which twice submitted to Rome its expert assessments, in 1515 and 1578.³ Unbeknownst to most who have written on the subject, these two reports were not the first time the Salmantican academy produced an entry in the rich literature on calendar reform. Half a century earlier, in 1468, the theologian Pedro Martínez de Osma had already joined ranks with a proposal that has been preserved in a *Disputatio de anno in quo possimus dicere Dominum fuisse passum et de quibusdam erratis in kalendario*. Thanks to a recent edition by José Labajos Alonso and an accompanying Castilian translation by Pablo García Castillo, this noteworthy text has finally become available to a wider audience.⁴ With the present article, I would like to supplement this edition of the tract with a study and explication of some of its contents, hoping that it can make a modest contribution to current research on Pedro de Osma’s intellectual biography as well as the history of science and learning in fifteenth-century Castile. Besides addressing the text’s transmission and context, the following discussion will primarily focus on three aspects that strike me as particularly salient: (1) Pedro de Osma’s reasoning behind the reform plan proposed in the

¹ The Latin original reads: “Coelestium motus, statusve orbium, eosve trepidos contemplationis sustinentia aequare, Herculis quidem labor, et Athlantis opus est” (Casella 165).

² See the studies by Kaltenbrunner; Marzi; Heilbron; and the articles assembled in Coyne, Hoskin, and Pedersen.

³ These assessments are studied and edited in Carabias Torres. For Turriano’s own contribution, see Fernández Collado and Turriano.

⁴ Labajos Alonso 2010a, 354-83. As far as I am aware, the only scholar to have dealt with this text before was Olivier de Solan Bethmale in his unpublished thesis “Les propositions de réforme du calendrier au XVe siècle” (Paris, École nationale des chartes, 1998). See the summary in Solan 1998.

Disputatio, (2) his text's relation to the writings of his teacher and predecessor Alfonso de Madrigal, and (3) his remarkably pronounced use of the Jewish calendar.

2. *Pedro Martínez de Osma*

In his own day, Pedro Martínez de Osma (ca. 1424-80) enjoyed widespread recognition as one of the foremost scholars and thinkers of the Spanish kingdoms. His most famous student Antonio de Nebrija (1441-1552) later wrote that he was considered second only to “el Tostado” (Alfonso Fernández de Madrigal, bishop of Ávila, d. 1455) when it came to excellence in learning of all kind.⁵ In spite of this reputation, the details of Osma's life and career are oftentimes sketchy.⁶ He first appears in the university records in 1444 as a newly elected member of the illustrious Colegio Mayor de San Bartolomé. Having attained the *Magister artium* degree in December 1457, he started to lecture in moral philosophy until 1463, when he received the chair of *prima de teología*, one of the most important theological teaching posts on the Iberian Peninsula, which he held until his emeritation in 1478. His work as a philosopher and theologian was characterized by a vigorous support for the Thomistic Aristotelianism that had been inaugurated at Salamanca by his teacher Alfonso de Madrigal (the aforementioned “el Tostado”), but also by proclivities towards the new humanism of the day.⁷ Both tendencies are clearly reflected in his commentaries on three major Aristotelian texts, all written during his tenure as a teacher of moral philosophy: the *Metaphysics* (ca. 1457),⁸ the *Ethics* (ca. 1460),⁹ and the *Politics* (ca. 1460/63).¹⁰ For the latter two texts, he already based himself on the recent re-translations from Greek made by Leonardo Bruni (ca. 1370-1444).

It is not this philosophical output, however, that has retained Pedro de Osma a modicum of fame, but his unfortunate involvement with the Inquisition in 1478/79, which led to the condemnation and public incineration of a treatise he had written some years prior on the subject of confession and the absolution of sin. In this and other writings, Osma had introduced a distinction between penitence as natural and penitence as ecclesiastical sacrament, which threatened to erode the basis of the

⁵ “Quanto ingenio & eruditione fuerit Magister Petrus oxomiensis: nemo est qui ignoret: cum post Tostatam illum ex Salmanicensi scholastico Episcopum Abulensem omnium iudicio apud nos fuerit nostra etate in omni genere doctrinae facile princeps” (Antonio de Nebrija, fol. 5r-v). Further eulogies are cited in Labajos Alonso 1992, 11.

⁶ The most comprehensive biographical summary is Labajos Alonso 1992, 15-86. See previously Marcos Rodríguez 1955, Frías Balsa 1979a and 1979b.

⁷ Andrés Martín; Santiago-Otero 1988; Labajos Alonso 1995; Cebeira Moro 2004; Flórez Miguel; Fuertes Herreros 2004 and 2011.

⁸ Edition: Labajos Alonso 1992. See further Frías Balsa 1980; Labajos Alonso 1994.

⁹ Editions: Labajos Alonso 1996; Cebeira Moro 2002. See further Acosta Rodríguez.

¹⁰ The commentary on the *Politics* has only been preserved in a version reworked and redacted by his student and successor Fernando de Roa (ed. Labajos Alonso 2006). In addition, there is a briefer *Summa* of the *Politica* (ed. García y García and Muñoz Delgado). See further Elías de Tejada y Spinola, 135-50.

indulgence system practiced by his Church at the time. Ecclesiastical opposition against these teachings was so effective that not a single manuscript containing Osma's writings on confession has survived. The verdict against his ideas was repeated in 1479 by a synod that convened at Alcalá de Henares at the behest of Pope Sixtus IV, which led to Osma's formal revocation on 29 June 1479.¹¹ The measures taken against the Salmantican professor were also officially confirmed by the Pope himself in the bull *Licet ea* (9 August 1479), with the consequence that Pedro de Osma's name to this day appears in official collections of the Catholic Church's doctrinal decisions.¹²

For most of the nineteenth and twentieth centuries, Pedro de Osma's reputation in modern scholarship was largely confined to this late episode in his life, leaving the rest of his academic career in relative obscurity. It is only in recent decades that scholars have started to look beyond his views on confession and indulgences and give serious attention to the entirety of his written work, which stretches from the 1450s to the 1470s. A watershed in research on Osma's intellectual biography came in 1980 with the publication of a special issue of *Celtiberia* (ed. Goñi Gaztambide), dedicated exclusively to the man and his oeuvre. Three years earlier, Klaus Reinhardt had already published a detailed study of Osma's commentary on the Athanasian Creed (*Quicumque vult*), written in 1472, which is significant for being the first theological work ever printed in Spain.¹³ Since 1977, several further editions and translations of works both known and newly discovered have appeared in print, offering glimpses at a philosophical and theological thinker whose importance went far beyond his condemnation.¹⁴ A particularly rich series of contributions to this research has been made by José Labajos Alonso, who recently supplemented his editions of the three aforementioned Aristotle commentaries with a collection of Osma's *Escritos académicos*. Apart from the *Disputatio* to be discussed below, this volume contains the first complete publication of a unique collection of theological treatises and sermons that was discovered in 1930 by Friedrich Stegmüller in a manuscript from the Capitular Library in Oviedo (cod. 35).¹⁵ As a result of this scholarly activity, there is at present only one major preserved work by Pedro de Osma to still lack any printed edition: his treatise on ecclesiastical music, found in MS Naples, Biblioteca Nazionale,

¹¹ On the trial and its ramifications, see now Labajos Alonso 2010b. See also Paulus; Stegmüller, 225-40; Werbeck 1959, 32-33; Marcos Rodríguez 1976; López de Salamanca and Martínez de Osma; Lawrance, 25-31; Werner, 330-34; Iannuzzi.

¹² Denzinger, 235-36, 381, 383 (nos. 724-33, 1535, 1542).

¹³ Reinhardt 1977. See also Reinhardt 1976; Marcos Rodríguez 1979-80; Labajos Alonso 1992, 46-47.

¹⁴ See most recently Labajos Alonso 2012 and Alonso Baelo, who offers an extensive bibliography.

¹⁵ See Stegmüller, 207-14. Selected texts from the codex have previously appeared in the following places: Villota Elejalde; Reinhardt, Barcala Muñoz and Horacio Santiago Otero 1980; Santiago Otero 1987, 181-83; Reinhardt and Santiago Otero 1987. Spanish translations of two texts were published by Fuertes Herreros and Panchón Cabañeros 2004 and 2005.

VIII.C.19, fols. 256v-64v, where it is followed by a Castilian version of the same text.¹⁶

3. *Textual transmission*

The *Disputatio de anno in quo possimus dicere Dominum fuisse passum et de quibusdam erratis in calendario* is a brief treatise in two parts, which correspond to the two subjects mentioned in the title: the year and date of Christ's Passion and the errors of the ecclesiastical calendar. It is still extant in two manuscripts of the Vatican Library, both copied in the sixteenth century: lat. 6198, fols. 149r-62r, and lat. 6301, fols. 46r-56v (parallel foliation: 395r-404v). In Vat. lat. 6301, the text is preceded by a title leaf, which explicitly mentions Pedro de Osma's name and rank as master of theology (*Disputatio de anno passionis Christi et erratis in calendario. Compilata a Petro Martino de Osma Theologiae Magistro*). This is confirmed by a colophon at the end of the text (fol. 56v), which states that the present treatise was *ad honorem Christi et utilitatem ecclesie a Petro Martino de Osma in artibus et in theologia magistro compilata*. These important designations of authorship are missing from Vat. lat. 6198, where the text is transmitted anonymously. A collation of both manuscripts shows relatively little scribal variation, although Vat. lat. 6198 is clearly the inferior witness and may have well been copied directly from Vat. lat. 6301.¹⁷

The very first line of the *Disputatio*, "From the foregoing, another question arises..." (*Ex predictis oritur alia questio...*), informs us quite unambiguously that the *Disputatio* did not originate as a self-contained text, but must be regarded as an excerpt from a more voluminous work, the remaining parts of which seem to be no longer extant.¹⁸ Among the "foregoing" content in this larger work was a *questio principalis de conficiendo in fermentato vel azimo*, to which Osma refers at a later point.¹⁹ This *questio*, which is said to appear "above" (*supra*), but is not part of the present *Disputatio*, was apparently a discussion of whether the Eucharist should be celebrated with leavened or unleavened bread (i.e. the 'Greek' vs. the Roman custom) – an issue closely related to the chronology of the Last Supper and hence to the content of the first half of Osma's *Disputatio*.²⁰

¹⁶ See Miola, 79-80; Lecea, 41-46; Kristeller, 113. This treatise is recorded as lost by Labajos Alonso 1992, 45.

¹⁷ Labajos Alonso's recent edition does not take account of Vat. lat. 6198 (it is not even mentioned) and is thus merely a transcription of Vat. lat. 6301. Since this transcription is deficient in many places, I shall cite passages from the *Disputatio* according to the manuscript itself rather than the printed edition. The page breaks in the original manuscript are indicated in Labajos Alonso's edition, making it easy for readers to compare both transcriptions. For the complete text of part II, see the appendix below.

¹⁸ Vat. lat. 6301, fol. 46r: "Ex predictis oritur alia questio a pluribus ventilata sed a nemine, ut ego puto, terminata, de anno in quo Dominus Noster Ihesus Christus pro nobis fuerit crucifixus."

¹⁹ Ibid., fol. 49v: "Tertio posset obici contra predicta, quia, ut dictum est supra in questione principali de conficiendo in fermentato vel azimo, in eo anno in quo Dominus fuerat passus festum azimorum non fuerat celebratum a Iudeis sexta feria, sed feria septima."

²⁰ For the background, see most recently Schabel 2011.

Another important hint regarding the works's original context comes from a reference in ch. 3 of the first part, where Osma promises that one of his claims –regarding Jesus's age at his death– is proved “down below, in distinction 44, chapter 1.”²¹ The subject matter discussed matches perfectly with book IV, dist. 44, ch. 1 of Peter Lombard's *Sentences*, which must hence be the text referred to.²² Does the present *Disputatio* therefore stem from a commentary on the *Sentences*, which Osma would have produced in his capacity as lecturer in theology? Thanks to Friedrich Stegmüller, it is known that Osma authored a *glossa* on the *Sentences*, which was preserved in a manuscript from the Capitular Library in Zaragoza (cod. 12-42, fols. 113rb-65vb). Unfortunately, this manuscript, which only reached up to book II, dist. 42, has since disappeared and its contents may thus be lost forever.²³ In any case, the *Disputatio*'s date can be securely located between January and April 1468, since it was evidently written before Easter Sunday of that year, which fell on 17 April.²⁴

4. *The Disputatio in context*

To this day, the date of Easter is defined as the Sunday following the first full moon that falls on or after the vernal equinox on 21 March. In ecclesiastical tradition, this calendrical rule was associated with the decision of the fathers of the Council of Nicaea (325), despite the fact that no such decree seems to have been passed. It was generally believed that the sanction of the first ecumenical council also extended to the 19-year cycle used by the medieval Church to calculate the dates of the moveable feast days. This cycle, first used by the patriarchs of Alexandria in the third/fourth century, was predicated on the assumption that the new and full moons would return to the same days in the Julian calendar after every 19 years, equalling $19 \times 365.25d = 6939.75d$. These were in turn equated with 235 lunar months, leading to an average value of 29.530851d, which exceeded the astronomically correct value of 29.530589d by ca. 22 seconds. As a result of this discrepancy, the tabulated moons lagged behind the observable ones at a rate of roughly one day in 308.5 years. In a similar vein, the astronomical date of the vernal equinox was steadily drifting away from 21 March and towards the beginning of the year. The rate of error was here one day in ca. 128 years, owing to the fact that one average Julian calendar year of 365.25d was about 11 minutes longer than a tropical solar year of 365.2422d.

By the twelfth century, medieval computists (i.e. practitioners of the *computus*, the art of Easter reckoning) had become aware of the problem and started to sketch ways towards its solution, which, however, was only achieved with the Gregorian calendar

²¹ Ibid., fol. 49r: “Secunda vero pars probatur infra, distinctione quadragesima quarta, capitulo primo, ubi traditur Dominum fuisse passum anno trigesimo tertio sue etatis.”

²² Petrus Lombardus, *Sent.* IV, d. 44, c. 1 (ed. Migne 1855, 945-46).

²³ See Reinhardt 1977, 68n27; Labajos Alonso 1992, 46.

²⁴ This becomes clear from Vat. lat. 6301, fols. 51v-52r, where Osma designates 1468 as the *annus praesens*, but marks Easter Sunday of that year as a date in the future (“celebrabitur XVII die Aprilis”). 1468 is also mentioned as the *annus praesens* on fol. 46v.

reform of 1582. A major turning point in this development came in the fifteenth century, when the problem of the calendar for the first time became the object of serious legislative efforts. The most significant of these was made at the Council of Basel (1431-49) during the years 1434 to 1440, which saw the matter being discussed by a specially created expert commission. A prominent role in the commission's work was played by Nicholas of Cusa (1401-64), who authored a treatise *De reparatione kalendarii* and presented his and the commission's findings in an official report to the council in March 1437. Some of the details of these proceedings are known only from the monumental *Historia generalis concilii* written by Juan de Segovia (1393/95-1458), one of Pedro de Osma's predecessors as theology professor in Salamanca, who noted that the reform initiative foundered due to the adverse political conditions created by the conflict between Pope Eugene IV and the Baslean council.²⁵ Meanwhile, the discrepancies between the calendar and astronomical reality continued to grow. The situation was deemed unacceptable by many prominent observers, including the astronomer Johannes Regiomontanus, who was convened to Rome by Pope Sixtus IV in order to develop a solution to the problem, but died soon after his arrival, in 1476. In an appendix to his famed printed *Kalendarium* of 1474, he showed that no less than 30 out of the 55 Easter Sundays from 1477 to 1531 could be expected to fall on the technically wrong date, in some cases by as many as 35 days.²⁶ These errors were certainly alarming, especially since they threatened to turn the Church into a laughingstock for unbelievers. Pedro de Osma echoed the opinions of many other writers, both before and after him, when he wrote that it

is ridiculous and no small shame for our prelates to say that it is the first day of the moon, when it is really the third or fourth, and that the closest Sunday to Passover is called the second, fourth or fifth. For the infidels deride the governors of the Church, because they act like they are ignorant and do not act according to their intention and what the Canon law prescribes, which is to be deplored.²⁷

At the same time, however, his discussion of the calendar problem was not undertaken completely for its own sake, but had the character of a supplement to the first part of his *Disputatio*, which dealt with a major problem of historical chronology: the year when Jesus was died on the cross. The obvious link between these two topics was provided by the feast of Easter, whose date was based on the chronological

²⁵ Juan de Segovia, 708-10 (c. 8.19). See further Honecker; Sudmann, 261-72; Müller.

²⁶ Kaltenbrunner, 367-74; Zinner, 125-30, 151-55.

²⁷ Vat. lat. 6301, fol. 54v: "Est autem rediculum [sic!] et non parva prelati verecundia dicere quod luna fuisset prima quando est tertia vel quarta et quod post Fase dominica proxima dicatur secunda, quarta vel quinta. Derident enim infideles ecclesie gubernatores quasi hoc ignari, non facientes id quod agere intendunt, nec forte a canone; quod dolendum est." Further remarks of this kind are discussed in Nothaft 2014a.

circumstances of the crucifixion and resurrection, as described by the four canonical Gospels. In order to determine the date of this feast on a yearly basis, the ecclesiastical calendar made use of the aforementioned 19-year cycle, which had been constructed in late antiquity for this purpose. As a result of this entanglement, the realization that this calendar cycle failed to perform its task properly had to have certain repercussions on the historical question of the Passion date, whilst discussions of the Passion date could in turn raise furthergoing questions about the calendar as a chronological tool.²⁸ The interlacement of both issues is already tangible in the *Compotus emendatus* of Reinher of Paderborn (1171), which one can perhaps be counted as the first proper treatise on calendar reform.²⁹ While Reinher started with the problem of Easter and suggested that the Church should revert to the astronomically more accurate reckoning used by the Jews (see below), which he then applied to the problem of the crucifixion date, the *Disputatio* takes the opposite approach. It is presented first and foremost as an examination of the year in which the crucifixion may have happened, which raises additional points that are subsequently addressed in a separate discussion of the errors of the calendar. An author close to Osma's time who likewise addressed both issues simultaneously was Hermann Zoest, a Cistercian monk from Münster in Westphalia, who collaborated alongside Nicholas of Cusa in the calendrical expert commission at the Council of Basel. In order to defend and explicate the reform decree elaborated by this commission, Hermann penned a treatise entitled *Phaselexis* (1435/37), which also incorporated a brief astronomical discussion of the crucifixion date.³⁰ Equal weight to both topics was later given in the astoundingly voluminous *Paula de recta Paschae celebratione* (1513) by Paul of Middelburg, the learned bishop of Fossombrone, who dealt with the reform of the calendar in 14 chapters, followed by another 19 chapters on the chronological problems surrounding Jesus's life.³¹

That the issues addressed in the *Disputatio* were of considerable interest to learned audiences in the late Middle Ages is further evidenced by the fact that they occasionally featured as the topic of public discussions. From the early fourteenth century, we have the example of Nicholas Trevet, who determined a *quaestio* on the date of the Passion during a disputation that took place at the University of Oxford in ca. 1303.³² Closer to Osma's own time, we know of a quodlibetal disputation presided over in 1444 by the *Magister artium* Heinrich of Runen at the University of Erfurt, which dealt with the question of whether or not Easter should still be dated in accordance with the faulty ecclesiastical calendar.³³ Judging from the repeated references to *questiones* and *questiones sabbatine* that had been "recently discussed in public," there had been a similar event at Osma's own university shortly before the

²⁸ For a full account of the medieval discussions of this problem, see Nothaft 2012b

²⁹ Editions by Wijk and Herold. On Reinher and further examples, see Nothaft 2012b, 128-201.

³⁰ See now Nothaft 2013.

³¹ Kaltenbrunner, 375-86; Nothaft 2012b, 225-40.

³² Edited and discussed in Nothaft 2012c.

³³ Edited and discussed in Solan 1999.

Disputatio was put into writing.³⁴ These references hence make it fairly clear that the *Disputatio* summarizes –and justifies– a set of propositions that Osma had defended in the context of some type of university disputation in the very recent past.

There is here a striking parallel to Pedro de Osma's teacher Alfonso Fernández de Madrigal, whose views on chronology had caused a scandal when he presented them in a public disputation at the papal curia in Siena in 1443.³⁵ Madrigal's opinions on the Passion date are extensively recorded in a *Defensorium* that he wrote in the same year in order to combat those who called for a condemnation of his theses, which also touched upon confession and the forgiveness of sin –the very subject that would get Pedro de Osma into trouble some decades later.³⁶ With regard to the chronology of Jesus, his controversial claim was that the only way to safeguard all known facts about the crucifixion and make them fit with the astronomical record was to move its date to Friday, 3 April AD 33, which was a startling departure from the traditionally held 25 March.

Osma's own take on the crucifixion date, as detailed in the first part of his *Disputatio*, was more conservative. He acknowledged that it seemed impossible to square the Gospel data, according to which Jesus died on a Friday during full moon between the 30th and 50th year of his life, with the supposition, held by many Church fathers, that the day of his Passion was 25 March. At the same time, however, he was quite critical of Alfonso de Madrigal's position, who is mentioned only as "a certain master from our Spanish nation."³⁷ Osma's main gripe with this master, whose name he perhaps admitted out of respect, was that, according to his own reckoning, Jesus (being born on 25 December AD 1) would have only been 31 years old on 3 April AD 33, which conflicted with the patristic consensus that he lived to the age of 32 or 33. He closed his discussion by stating that his rejection of Madrigal's crucifixion date was also shared by a certain member of the Hieronymite order, about whose identity nothing further seems to be known. Osma underlined his reproach for Madrigal's opinion by writing that the latter never responded to this criticism.³⁸

³⁴ Vat. lat. 6301, fol. 47v: "[...] que fuerunt verba secunde questionis de nuper in publicum disputatis." Ibid., fol. 48r: "...que fuerunt verba tertie questionis sabbatine." Ibid., fol. 49r: "[...] que fuerunt verba quarte questionis sabbatine [...] que fuerunt verba quinte questionis de nuper in publicum disputatis." Ibid., fol. 56r: "[...] que fuerunt verba ultime questionis huius disputationis."

³⁵ On this affair, see Nothaft 2012b, 203-12. On Alfonso de Madrigal, see further Castillo Vegas; Fernández Vallina 1988 and 2011; Belloso Martín; Recio and Cortijo Ocaña.

³⁶ As Stegmüller, 224, notes, however, these propositions were far more moderate than those later upheld by Osma.

³⁷ Vat. lat. 6301, fol. 50v: "Ex supradictis facile potest videri deceptio cuiusdam magistri de nostra Hispanica natione, qui tenebat Christum fuisse passus III die Aprilis anno XXXIII sue etatis, quando litera dominicalis fuerat D et ciclus XV. Sed certe deceptus est ille magister, putans annos incarnationis, qui, ut patet ex secundo documento, inceperant ante incarnationem et nativitatem, esse annos etatis Christi, qui ab eius nativitate inceperant."

³⁸ Ibid., fol. 51v: "His rationibus opponebat contra prefatam positionem unus religiosus de ordine sancti Ieronimi, ad quem prenomiatus magister adhuc vivens nihil responderat."

5. *Pedro de Osma's reform plan*

Any successful attempt to correct the ecclesiastical calendar had to presuppose some estimate of the rates of error that made the equinoctial and lunar dates recede towards the beginning of the year. As a result, a scholar writing on the subject could normally be expected to take a stand on certain elementary questions of mathematical astronomy, such as the precise length of the synodic lunar month, which marked the recurrence of the moon's phases, or the tropical solar year, which was usually measured from one vernal equinox to the next. Viewed from this angle, Pedro de Osma's *Disputatio de anno* was actually written at a fairly auspicious time for an undertaking of this kind, seeing how the 1460s and 1470s were a period of heightened astronomical activity at the University of Salamanca and its surroundings, culminating in the work of the Salamancan-born Jewish astronomer Abraham Zacut (1452-1515).³⁹ In Zacut's day, the gold standard of Western computational astronomy was still largely represented by the parameters and models of the so-called Alfonsine Tables, which had been compiled two centuries earlier by the astronomers at the court of King Alfonso X of Castile and León (1252-84). During the fifteenth century, these tables circulated in a variety of different configurations and adaptations, one of which was known as the *Tabulae resolutae*, a user-friendly version with a reduced number of individual tables, whose main purpose seems to have been the calculation of almanachs, ephemerides, and calendars. When Osma became a professor of theology (1463), these *Tabulae resolutae* had in fact only recently been imported to Salamanca from Cracow, where they had been the subject of university lectures since the middle of the century. The man responsible for their introduction, a man from Poland known as Nicolás Polonio, was incidentally the first professor to occupy the Salmantican chair of astronomy/astrology, which he held from ca. 1460-64. In order to assist his students in their use, he adapted the Cracowian *Tabulae resolutae* to the meridian of Salamanca and furnished them with a new set of explanatory canons.⁴⁰ Polonio may have also been the guiding hand behind the *Tabulae verificatae*, a set of 21 tables for the calculation of eclipses, which were again all calculated for the coordinates Salamanca and have an epoch on 1 January 1461.⁴¹ He was followed in office by Juan de Salaya, who held the chair of astronomy from 1464 to 1469 and would thus have been part of the faculty when Pedro de Osma discussed the errors of the calendar in his *Disputatio* in 1468. Later on, in 1481, he participated in the production of a Castilian translation of Abraham Zacut's Hebrew *Hibbur ha-gadol*, an extensive set of

³⁹ Chabás and Goldstein 2000. See also Chabás 2006.

⁴⁰ Dobrzycki 1987; Chabás 1998 and 2002. The canons are published in Porres de Mateo and Chabás. Tables of a similar kind to the *Tabulae Resolutae* were also produced in Castilian. See Chabás and Goldstein 2000, 37-47.

⁴¹ Chabás and Goldstein 2000, 23-36.

astronomical tables and canons, which was again mostly based on Alfonsine parameters.⁴²

These parameters were also accepted by Osma's teacher and predecessor Alfonso de Madrigal, who included a reference to the tables of 'King Alphonso' in his *Defensorium* of 1443, suggesting that they offered the right tools for those eager to calculate the date of the crucifixion of Jesus.⁴³ The *Defensorium* concluded with a series of chapters on the calendar, in the course of which Madrigal exposed the numerous errors that could be found in old and contemporary *kalendaria*, which often gave wrong dates for the solstices and equinoxes, the positions of the sun in the zodiac, daytime lengths, the historical date of creation, and other parameters.⁴⁴ These complaints are noteworthy, since Madrigal is supposed to have written a complete treatise on the errors of the calendar, which was cited among his writings by Rainer Bovosius, but is now apparently lost.⁴⁵ A vague idea of its contents can probably be gleaned from his preserved Castilian commentary on the chronicle of Eusebius, a massive work in five volumes, which includes a chapter on the history and purpose of the Julian leap-day, also known as the *bissexus*. At one point in his discussion, Madrigal gauges the true length of the solar year as 365d 5h 49m 16s, which is identical to the Alfonsine value. The implied error is 1d/134y, but Madrigal, somewhat carelessly, rounds up to 1d/140y.⁴⁶ This estimate, however, is not fully consistent with his subsequent remarks on the date of the winter solstice, which according to el Tostado presently fell on 12 or 13 December. Based on the incorrect assumption that Christ's birth on 25 December had coincided with the winter solstice in his time, he inferred that the solstices and equinoxes had shifted by 12 or 13 days since the beginning of the Christian era. Although Madrigal did not spell the result out, the obvious implication of these data was that the error rate of the Julian calendar was not 1d/140y, but a day in ca. 120 to 111 years, depending on whether the shift over the past ca. 1450 years had been 12 or 13 days.⁴⁷

Alfonso de Madrigal's terse remarks on the calendar in his *Eusebio* are a good indicator that the business of determining the error that beset the ecclesiastical calendar could be approached in two different, but complementary, ways: one could (a) simply extrapolate the error rate from the currently known length of the tropical

⁴² Edited by Cantera Burgos, 97-182.

⁴³ Alfonso de Madrigal 1728, 107b-08a (c. 15). On the use of the Alfonsine Tables in Spain, evidence for which is spotty for the first two centuries of their existence, see Chabás 2000, 381-91. See in general Chabás and Goldstein 2003, 292-300, on the extant manuscripts of Alfonsine Tables from Spain.

⁴⁴ Alfonso de Madrigal 1728, 151-64 (c. 86-97).

⁴⁵ See the list of "Opusculorum, quae hactenus inventa non sunt," in Alfonso de Madrigal 1596, unpaginated preface.

⁴⁶ Alfonso de Madrigal 1506, fol. 122va (c. 86). On this work, see Keightley 1977 and 1986.

⁴⁷ Alfonso de Madrigal 1506, fol. 122vb. See also Alfonso de Madrigal 1728, 163b-64a (c. 97). The correct date of the solstice in AD 1 would have been 23 December. For astronomical and calendrical calculations present in this paper, I have relied on Raymond Mercier's program Kairos 4.0 (<http://www.raymondm.co.uk>).

year and lunar month; or (b) one could attempt a deduction based on historical assumptions about the dates of the equinoxes, solstices, and new moons, which could in turn be compared to present observations to determine the average error rate. It is the latter approach that clearly prevails in Pedro de Osma's discussions of the solar and lunar calendars. He started the second part of his *Disputatio* with a point he had already briefly addressed in his discussion of the date of Christ's Passion: the new moons could presently be found to fall four days earlier compared to where they were located in the calendar in the first century, when Jesus was crucified.⁴⁸ According to Osma, the reason for this discrepancy was that each 19-year cycle (which lasts 6939.75d) was 1/19d longer than the equivalent number of lunar months, leading to a recession of 1d in 360y.⁴⁹

| Year in the cycle | Calendrical new moon | True conjunction dates | |
|-------------------|----------------------|------------------------|----------|
| | | AD 1463-81 | AD 19-37 |
| I. | 23.03. | 20.03. | 25.03. |
| II. | 12.03. | 08.03. | 13.03. |
| III. | 31.03. | 27.03. | 31.03. |
| IV. | 20.03. | 16.03. | 21.03. |
| V. | 09.03. | 06.03. | 10.03. |
| VI. | 28.03. | 24.03. | 28.03. |
| VII. | 17.03. | 13.03. | 18.03. |
| VIII. | 05.04. | 01.04. | 06.04. |
| IX. | 25.03. | 21.03. | 26.03. |
| X. | 14.03. | 09.03. | 15.03. |
| XI. | 02.04. | 28.03. | 02.04. |
| XII. | 22.03. | 17.03. | 22.03. |
| XIII. | 11.03. | 07.03. | 11.03. |
| XIV. | 30.03. | 25.03. | 29.03. |
| XV. | 19.03. | 15.03. | 19.03. |
| XVI. | 08.03. | 04.03. | 09.03. |
| XVII. | 27.03. | 23.03. | 28.03. |
| XVIII. | 16.03. | 11.03. | 16.03. |
| XIX. | 04.04. | 30.03. | 04.04. |

Table 1

⁴⁸ Vat. lat. 6301, fol. 46v.

⁴⁹ Ibid., fol. 51v: "Nunc autem pro inceptorum complemento videndum est de erratis in calendario. Sunt enim tria errata, ex quibus sequuntur quedam alia: primum circa novilunia, que inveniuntur a propriis locis fere quatuor diebus retrocesisse. Causa autem illius rei fuerat quia noviluna post XIX annos non redeunt, ut supra ponitur, ad priora loca precise. Remanent enim retro fere XIX parte unius diei. Et ita in CCCLX fere annis retrocedunt fere die una. Et sic a primo anno incarnationis vel nativitatis usque ad tempora nostra invenies coniunctiones solis et lune retro abiisse in calendario fere diebus quatuor."

The merits of Osma's assessment can be judged from Table 1 above.⁵⁰ It shows that the true conjunctions of sun and moon in his own day fell, on average, five days earlier than they did in the first century. The discrepancy compared to the new moon dates inscribed into the ecclesiastical calendar was somewhat smaller, being closer to four days. While this essentially vindicates Osma's claim that the new moons had receded by four days since antiquity, his interpretation of this fact was still problematic, because he mistakenly assumed that the ecclesiastical calendar, although now out of step with astronomical reality, accurately displayed the new moon dates as they fell in the first century AD, at the time of Jesus and the 'primitive Church'.⁵¹ If we take this as referring to ca. AD 30, i.e. the approximate time of the crucifixion, we get an interval of ca. 1440y between the time when the calendar was still in perfect shape and Osma's *annus praesens* 1468. Given an observable discrepancy of four days, this implies exactly the error rate of 1d/360y that Osma specified in his text, since $1440 = 4 \times 360$. This is in turn almost identical to 1/19d per 19-year cycle ($19 \times 19y = 361y$), making the whole thing easy to memorize.

The main problem with this argument was that it relied on an unreliable historical assumption that took no account of the estimates for the length of the mean synodic month that were available in Osma's day. Such estimates included the value implicit in the Alfonsine tables, namely, 29;31,50,7,37,27,8,25d, as well as 29;31,50,8,20d and 29;31,50,8,9,20d, which could both be found in medieval copies of Ptolemy's *Almagest*.⁵² These sexagesimal values all came reasonably close to the astronomically accurate 29.530589d, but were shorter than the mean value implied by the ecclesiastical 19-year lunar cycle, i.e. 29.530851d. By contrast, Osma's estimate, according to which each 19-year cycle was 1/19d too long, implied a value of 29.530627d. This explains why he underestimated the error of the lunar calendar, leading him to propose a rate of 1d/360y where numerous other medieval and contemporary authors cited 1d/304y.⁵³

In order to expose the consequences of this error, Osma used the *annus praesens* 1468 as his main example. In this year, the ecclesiastical lunar calendar showed a new moon on 28 March, with the resulting paschal full moon falling on Sunday, 10 April. This meant that Easter Sunday had to be postponed until the following Sunday, 17

⁵⁰ The conjunction dates were extracted from Fred Espenak's "Six Millennium Catalog" of moon phases, hosted by NASA: <http://eclipse.gsfc.nasa.gov/phase/phasecat.html>.

⁵¹ Vat. lat. 6301, fols. 46v-47r: "Tertium documentum de his promittendis est quod tempore Christi immo et temporibus ecclesie primitive noviluna, id est coniunctionis solis et lune, fiebant in eis locis ubi secundum lunarem ciclum sunt in calendario situate. [...] Ab hac tamen veritate ecclesia illis temporibus raro vel namquam reperitur deviasse ultra diem naturalem, hodie vero reperiuntur novilunia retrocessisse ab eis locis fere quatuor diebus, de cuius causa et emendatione postea videbitur."

⁵² See Goldstein 2003, for details.

⁵³ For the estimate of 1d/304y, see Kaltenbrunner, 302, 306, 324, 330-31, 337, 343-44, 350, 353, 382-83, 389, 396, 401, 404-05, 407. See also North, 98, who aptly remarks on "the fearful monotony" with which this estimate was accepted during the centuries and decades previous to the Gregorian reform.

April. By contrast, the actual conjunction, as reflected by the Jewish calendar (see Table 3 below), fell on 24 March, meaning that the astronomically licit date for Easter Sunday would have been 10 April. In order to fix this problem, Osma suggested that the new moons of the lunar cycle should be set back by four days. In order to maintain the accuracy of the lunar cycle, it was also called upon to implement a further one-day correction after every 360 years.⁵⁴ At a later stage of his discussion, he dealt with the effects his reform suggestions would have on the placement of the Golden Number in the Julian calendar as well as on other calendrical parameters. He discussed these issues in relation to the *ars manualis*, by which he means the art of making calendrical calculations, especially in relation to the date of Easter, by using the fingers on one's hands.⁵⁵ In one of the examples used, the middle joint (*media junctura*) and the 'root' (*radix*) of the left thumb serve as place holders for the first and second day of March, while 3 March is always found at the root of the index finger, after which the count continues upwards. Onto each of these joints, one can project the corresponding Golden Number, which designates the year in the 19-year cycle in which the day in question is the seat of a new moon. In the traditional, unreformed, calendar, the correlations would be as follows:

| | | | | | |
|------|----------|-------|----------|------|----------|
| III | 1 March | XIII | 11 March | | 21 March |
| | 2 March | II | 12 March | XII | 22 March |
| XI | 3 March | | 13 March | I | 23 March |
| | 4 March | X | 14 March | | 24 March |
| XIX | 5 March | | 15 March | IX | 25 March |
| VIII | 6 March | XVIII | 16 March | | 26 March |
| | 7 March | VII | 17 March | XVII | 27 March |
| XVI | 8 March | | 18 March | VI | 28 March |
| V | 9 March | XV | 19 March | | 29 March |
| | 10 March | IV | 20 March | XIV | 30 March |

Table 2

Osma explicitly writes that, if the defect of the lunar calendar was cured by setting the lunar cycle back by four days, the Golden Numbers XIX and VIII, previously assigned to 5 and 6 March, now had to be written next to 2 and 3 March. This is a puzzling statement, because it implies a correction of only three days.⁵⁶

⁵⁴ Vat. lat. 6301, fols. 51v-52r.

⁵⁵ The use of fingers and phalanges as counting aids was very widespread in late medieval computistical treatises, as reflected by titles such as *Computus chiometralis* and *Computus manualis*. See the editions by Smith and Mütz.

⁵⁶ Vat. lat. 6301, fol. 54v: "Ultimo videndum est quemadmodum kalendario emendato possit noviter confici ars manualis dicendum quod manualis ex kalendario colligitur. Et ideo secundum quod kalendarium fuerit emendatum in uno vel in pluribus sic et ars manualis diversimode fabricabitur nam si

Naturally, a more extensive shift of lunar dates was to be envisaged, if the emendation of the lunar calendar was supplemented with a correction of the Julian year.⁵⁷ As before, such a correction presupposed a reliable estimate of the error that made the dates of the equinoxes and solstices recede over time. In the fifteenth and sixteenth centuries, the most common such estimate, based on the Alfonsine Tables, was 1d/134y, which was fairly close to the astronomically correct 1d in ca. 128 years.⁵⁸ Osma, by contrast, postulated the much more dramatic error of “roughly” (*fere*) 1d in 100y, thus overestimating the rate of the problem, whereas he had underestimated it in case of the lunar calendar.⁵⁹ Unlike the previous case, where he proposed the probably unique value 1d/360y, the present estimate had certain precedents in astronomical and computistical literature. In the thirteenth century, both Robert Grosseteste (d. 1253) and Campanus of Novara (d. 1296) had claimed that the ninth-century Arabic astronomer al-Battānī found the true solar year to be 1/100d shorter than 365.25d.⁶⁰ Closer to his own time, such an error rate was also cited by Heinrich of Runen, in the aforementioned quodlibetal disputation of 1444.⁶¹ As in the case of the lunar calendar, Osma failed to cite any source or detailed astronomical justification for this estimate. Instead, he helped himself to the baseless historical assumption that, a little more than 2,100 years ago, “at the time when the Roman calendar was constructed,” the first day of each quarter-year still coincided exactly with one of the cardinal points of the solar year. At the time of the calendar’s institution, the situation would thus have looked like this:

Winter solstice on 1 January
 Vernal equinox on 1 April
 Summer solstice on 1 July
 Autumn equinox on 1 October.⁶²

in kalendario ceteris manentibus ciclus retrotraheretur diebus quatuor in radice pollicis in annis sinistre essent collocanda XIX scripta secunda die Martii in radice vero indicis VIII.”

⁵⁷ *Ibid.*, fol. 55v.

⁵⁸ See Kaltenbrunner, 317, 330, 332, 354n, 377, 383, 388, 393, 396, 399-401, 404, 408; North, 79. Despite the ubiquity of this estimate, there was also a widely shared concern that the length of the solar year may be subject to periodic variations or that the exact duration of the solar year was not yet sufficiently known. See Dobrzycki 1983, 117-26; Solan 1999, 198-99; Müller, 214-19.

⁵⁹ Vat. lat. 6301, fol. 54r.

⁶⁰ Robert Grosseteste, *Computus correctorius* (ed. 1), ed. Steele, 215; Campanus of Novara, *Computus maior* (c. 10), ed. in *Sphera mundi*, fol. 161vb. In actual fact, al-Battānī’s estimate of the tropical year was 365;14,26d = 365.2405d, which implied an error rate of 1d/106y. See Nallino, 42, 129.

⁶¹ See Solan 1999, 219. See also Alfonso de Madrigal 1728, 152a (c. 87).

⁶² Vat. lat. 6301, fol. 54r: “Eo enim tempore quo kalendarium fuerit fabricatum, scilicet duobus milibus cum centum et aliquot annos retro, prima dies Ianuarii fuerat minima dies anni, et maxima prima dies Iulii, equinoctia vero inveniuntur fuisse, vernale quidem, prima die Aprilis, et autumnale primo die Octobri.”

Yet, according to Osma, these dates had since shifted by ca. 21 days, as could be verified by anyone “who wishes to consider this by astronomical methods” (*Qui enim voluerit secundum viam astrologicam considerare*). The obvious solution, as he himself went on to suggest, was to omit 21 days from the calendar and thus restore it to the situation at the time of Rome’s foundation.⁶³ Alternatively, one could go back just 14 days, if one rather preferred to re-locate the equinoxes and solstices to the dates they had at the time of Christ. For the vernal equinox this would have presumably meant 25 March, which was also the traditional date of Jesus’s crucifixion. Yet as Alfonso de Madrigal had correctly observed before him, the actual vernal equinox at the beginning of the Christian era had fallen on 23 March, not 25 March.⁶⁴ In both cases, it was necessary to drop another day after each century, to make sure the error does not creep into the calendar again.⁶⁵

Even if we take into account that the text reflects the arguments made at a public disputation and that Pedro de Osma may have purposely simplified astronomical and arithmetical issues for the comfort of his listeners, it cannot be denied that his remarks on the equinoxes and solstices in the Julian calendar were deficient in ways that even his contemporaries would have been able to spot. This is certainly true for his linkage of the present calendar with the early days of Rome, which completely ignored the fact that the Julian solar year had only been instituted by Julius Caesar in 46/45 BC and that the Roman calendar previous to this date had been lunar, with a common year length of only 355. This oversight is quite startling, since the history of the Roman calendar –its institution by Romulus, its first major improvement under Numa Pompilius, and the change from lunar to solar under Julius Caesar– was fairly common knowledge in the Middle Ages.⁶⁶ As matter of fact, Osma could have easily gleaned some of the relevant facts from Alfonso de Madrigal’s *Defensorium*, which contained a potted history of calendar reckoning in Rome and elsewhere. Amongst other things, Madrigal correctly stated that the Romans started with a lunar calendar,

⁶³ Ibid.: “Qui enim voluerit secundum viam astrologicam considerare inueniet quod a tempore conditoris urbis Rome, quando vel paulo postea fabricatum fuerat kalendarium, usque ad tempora nostra principia mensium retrocessunt fere diebus XXI. Iste error facile emendabitur, si principium Ianuarii cum aliis mensibus retrotrahatur diebus XXI, ita ut prima dies Ianuarii sit ubi hodie est XII dies Decembris, scilicet in solestio hiemali, et prima Iulii ubi undecima Iunii, et sic de reliquis suo modo. Hoc itaque modo potest reduci kalendarium in primarium statum.” Oddly enough, the dates for the two solstices cited here (12 December and 11 June) imply a change of only 20 days. In Regiomontanus’s *Kalendarium* of 1474 (n. 26 above), the following dates are noted as the sun’s entry into Aries, Cancer, Libra, and Capricorn: 11 March, 12 June, 14 October, 12 December. See also Alfonso de Madrigal 1728, 151b-52 (c. 87), who found the two equinoxes to presently (AD 1443) fall on 10/11 March and 10/11 September.

⁶⁴ Alfonso de Madrigal 1728, 152a (c. 87). Cf. Ginzel 1911, 285.

⁶⁵ Vat. lat. 6301, fol. 54r: “Ne autem huius error amplius eveniret, deberet principium Ianuarii cum ceteris mensibus post quotlibet centum annos retrahi dies una. Quod si menses ad eum statum in quo fuerat eo tempore quo dei filius carnem assumpsit velimus reducere, deberet mensium principia retrotrahi diebus XIII.”

⁶⁶ See, e.g., Bede, *De temporum ratione* (c. 12), ed. Jones, 319-25. Cf. Hannah, 98-130.

although he also mistakenly believed that they had switched to an ‘Egyptian’ type calendar of 365d before it was perfected by the introduction of the Julian leap day.⁶⁷

As in the case of the date of Christ’s Passion, we can thus observe that Pedro de Osma’s treatment of the calendar differed in major and rather startling ways from the ideas of his predecessor “el Tostado,” despite the fact that the latter was one of the most influential Salmantican thinkers of the period and is generally thought to have been among his most important teachers. In contrast to Alfonso de Madrigal, who availed himself of the Alfonsine Tables, Osma’s text only betrays a very limited proficiency in the subject of astronomy. Although he did pay occasional lip-service to the *via astrologica*,⁶⁸ both his discussion of the crucifixion date and the errors of the calendar eschewed the use of precise parameters (with fractions smaller than a day) or any other astronomical details and instead relied as much as possible on the arithmetic of the old 19-year cycle, which was no particularly precise instrument of lunisolar reckoning, even if reformed in the ways suggested by Osma. It may be concluded that Osma’s *Disputatio* reveals to us the problem of the calendar as seen from the viewpoint of a fifteenth-century theologian, who felt compelled to tackle this problem due to its relevance to his own field (it being connected to the date of the Passion and the computation of Easter), but lacked the astronomical skills to offer a more adequate treatment. The fact that he did not try to make up for these deficits by consulting the experts at his own university, where astronomy was being taught by Juan de Salaya, might perhaps tell us something about the disciplinary boundaries that existed between the various faculties at Salamanca and which, then as now, prevented scholars from various disciplines and sciences from communicating their results.

6. *The role of the Jewish calendar*

While the technical aspects of calendar reform may have not been Pedro de Osma’s particular forte, his text does display some considerable familiarity with the structure of the Jewish calendar, which the Salmantican theologian repeatedly invoked as a frame of reference for his calculations, both with regard to the date of Christ’s Passion and the reform of Easter reckoning. The rationale behind this deference to the Jewish reckoning is not far to seek: according to the Gospels, Jesus had died at the time of Passover, on either the 14th or 15th day in the Jewish spring month of Nisan. Easter was meant to replicate the calendrical-astronomical situation at the time of Christ’s crucifixion and resurrection, which is why it had been generally accepted since Christian antiquity that the date of Easter had to be somehow dependent on the principles by which the Jews determined their first spring month and the date of Passover. During the Middle Ages, the increasingly obvious deficits of the Alexandrian 19-year cycle, which had been created to emulate these principles, thus

⁶⁷ Alfonso de Madrigal 1728, 160b-63a (c. 92, 94-95).

⁶⁸ Vat. lat. 6301, fol. 46v, 54r. This term was also used by Alfonso de Madrigal 1728, 105b, 151b (c. 13, 87).

led certain Christian computists to look to the contemporary Jewish calendar (the same that is still in use today) as a model for the anticipated reform of Easter reckoning. In their eyes, the calendar used by their Jewish neighbours was a superior implementation of the Mosaic precepts regarding the celebration of Passover, which were thought to underlie the Christian *pascha* no less than they governed the Jewish *pesah* (or *fase*, as it is written in the MSS of the *Disputatio*). Not only did this calendar employ a very well-crafted method of calculating the mean conjunction of sun and moon, which was far more accurate and precise than what the Church had at its disposal, but it also made use of the same 19-year intercalation cycle that structured the ecclesiastical calendar (leaving aside a difference in the cycle's starting point). As a result, it was relatively easy to compare both systems and adapt elements of the Jewish calendar to the Christian one. The first computist to fully endorse this line of reasoning was the aforementioned Reinher of Paderborn, whose *Computus emendatus*, written in 1171, presented the Jewish method of calculating the mean conjunction (*molad*) as the proper way to go forward in Christian Easter reckoning.⁶⁹ One fifteenth-century author influenced by Reinher was the Cistercian monk Hermann Zoest (also mentioned above), who used the Jewish calendar as his model for necessary changes to the calendrical limits for the Easter full moon and the order of intercalation.⁷⁰

With Pedro de Osma's *Disputatio* we have a valuable testimony to the fact that the Christian study of the Jewish calendar, which during the Middle Ages occasioned whole treatises such as Robert of Leicester's *De compoto Hebreorum aptato ad kalendarium* (1294),⁷¹ was also pursued with some success on the Iberian peninsula. Similar to his two German predecessors, Reinher and Hermann, Osma was in fact very sympathetic towards the suggestion that the calculation of the dates of the moveable feast days could in the future be entirely based on the contemporary Jewish calendar. This way, it would be ensured that the Easter lunation, after whose full moon Easter Sunday was celebrated, was always identical with the actual month of Nisan, in which the Jews in his time celebrated Passover. Already in his discussion of how to remove the error of the lunar calendar, he suggested that the earliest permissible new moon for the Easter lunation should therefore be pre-poned from 8 March (in the 16th year of the 19-year cycle) to 2 March in common years and 1 March in Julian leap-years. This proposal was more or less in line with the fact that 1 Nisan in the contemporary Jewish calendar could fall as early as 1/2 March in the last year of the 19-year cycle (equivalent to the 16th year of the Jewish calendar):⁷²

⁶⁹ See n. 29 above and Nothaft 2012a.

⁷⁰ For details, see Nothaft 2013.

⁷¹ See ch. 3 of Nothaft 2014b.

⁷² Vat. lat. 6301, fol. 52r. Osma's statement was somewhat imprecise, as the *molad* Nisan could fall on 1 March even in common years, as was the case in 1481, the last year of the table above. For comprehensive introductions to the fixed Jewish calendar and its operation rules, see, e.g., Burnaby, 21-364; Ginzler, 83-115; Mahler, 479-521; Feldman, 185-210; Spier, 3-22. See also the historical study by Stern and the article by Lasker and Lasker.

| | 19-year cycle | Jewish calendar | |
|--------|---------------|-----------------|------------|
| | | AD 19–37 | AD 1463–81 |
| I. | 23.03. | 25.03. | 22.03. |
| II. | 12.03. | 14.03. | 10.03. |
| III. | 31.03. | 01.04. | 28.03. |
| IV. | 20.03. | 22.03. | 18.03. |
| V. | 09.03. | 11.03. | 07.03. |
| VI. | 28.03. | 30.03. | 24.03. |
| VII. | 17.03. | 20.03. | 14.03. |
| VIII. | 05.04. | 09.03. | 03.03. |
| IX. | 25.03. | 27.03. | 23.03. |
| X. | 14.03. | 16.03. | 10.03. |
| XI. | 02.04. | 03.04. | 30.03. |
| XII. | 22.03. | 23.03. | 19.03. |
| XIII. | 11.03. | 13.03. | 09.03. |
| XIV. | 30.03. | 01.04. | 26.03. |
| XV. | 19.03. | 21.03. | 15.03. |
| XVI. | 08.03. | 09.03. | 05.03. |
| XVII. | 27.03. | 29.03. | 23.03. |
| XVIII. | 16.03. | 17.03. | 12.03. |
| XIX. | 04.04. | 07.03. | 01.03. |

Table 3

Osma followed the same approach in his discussion of the second of three calendrical errors, which concerned the order of embolismic and common years within the 19-year lunar cycle. The rule followed by this 19-year cycle was that years 3, 6, 8, 11, 14, 17, and 19 will always be embolismic and hence include a thirteenth lunar month, whereas the other twelve years will be common. This sequence was basal to both the Christian and the Jewish version of the 19-year cycle, but differences came about because the Christian version started three years earlier. The consequences can be gleaned from the table above, which shows that the beginning of the Easter lunation in years 8 and 19 of the cycle falls a full month later than 1 Nisan in the Jewish calendar, where the years in question are common and not embolismic. Osma specifically points to the future year AD 1470, when 14 Nisan was slated to fall Friday 16. If Easter was to be truly based on the date of Passover, Easter Sunday had to be celebrated on 18 March. Yet the ecclesiastical calendar predicted that Easter in 1470 would fall on 22 April.⁷³

⁷³ Vat. lat. 6301, fol. 52v. The manuscripts and Labajo Alonso's edition (p. 372) all have 12 instead of 22 April, but this must be a scribal error.

As should be obvious, the problem could be easily solved, if the new moon of the Easter lunation was simply defined in accordance with the Jewish calendar and hence be made equal to the month of Nisan. Yet this was a controversial move, since it implied abandoning the ‘rule of the equinox’, according to which the Easter could never be celebrated before the vernal equinox, which was traditionally fixed on 21 March—a time-honoured principle that was perceived to be invested with the authority of the Nicaean Council. One scholar who was stopped short by this principle was Hermann Zoest, who took an active part in the negotiations concerning calendar reform that took place at the Council of Basel in ca. 1435-37. His suggested change of the traditional Easter limits, which would have brought the Christian lunar year in close agreement with the Jewish one, was vetoed by his colleagues, who preferred a more conservative emendation of the calendar.⁷⁴ Undaunted by such weighty objections, Osma showed himself willing to sacrifice the old Easter limits, writing that “it is of no great concern to the Church whether a year be common or embolismic, as long as our Pasch is correctly celebrated on the Sunday next after the 14th day of the first month.”⁷⁵ As a substitute for the old rule, one could simply adopt the Jewish order of intercalation, making sure that the Christians would insert an embolismic month in the same years as the Jews did. Although he was well aware that that his Church was not easily persuaded to give up long-standing custom,⁷⁶ Osma expressed a clear preference for the ‘Jewish’ option, writing that “if the Church should deign to elect [this method], all of the aforementioned errors would cease.”⁷⁷ He even showed how the Church had to modify its reckoning rules, should it decide to go through with this plan: in the ecclesiastical calendar, the position of the present year in the 19-year cycle could be determined by adding 1 to the present “year of the Lord” and then dividing the result by 19. The remainder of the calculation indicated the year in the cycle. Since the Jewish cycle began three years earlier or, what is the same, 16 years later, one therefore had to add 17 instead of 1 to the present year in order to find out if a particular year was going to be embolismic or common. The present year 1468, which

⁷⁴ His account of the discussions in Basel is preserved in ch. 8 of his treatise *Phaselexis*. See MS Oxford, Bodleian Library, Lyell 63, fols. 308rb-09rb, and Nothaft 2013.

⁷⁵ Vat. lat. 6301, fol. 52v: “Non enim multum interest ecclesie quod anni sint communes vel embolismales, dum tamen Pascha nostrum recte celebretur in proxima dominica post XIII diem primi mensis.” Osma’s preference for identifying the Easter lunation based on the Jewish calendar essentially rendered superfluous the ‘rule of the equinox’, which is why he considered a reform of the solar year to be less urgent than that of the lunar year. See *ibid.*, fol. 54v: “Est autem hoc considerandum quod huiusmodi Romanorum mensium emendatio non est tantum neccessaria quantum due precedentes mensium lunarium. Non enim multum interest ecclesie quod menses Romanorum hic vel alibi inceperat nec etiam quod festa in eis situata hic vel alibi celebrentur. Est autem rediculum et non parva prelatiis verecundia dicere quod luna fuisset prima quando est tertia vel quarta et quod post Fase dominica proxima dicatur, secunda quarta vel quinta.”

⁷⁶ *Ibid.*, fol. 53v: “Sed quia durum est asueta relinquere, et durum forte ecclesie ista recipere...”

⁷⁷ *Ibid.*, fol. 52v: Alius modus emendandi posset esse multum conveniens, quamvis non ita facilis, quem si ecclesia eligeret cessarent omnes errores prenominati, tam circa novilunia et pasce celebritatem, quam circa embolismales.”

the Jews counted as the 5228th from the creation of the world, was thus no longer the 6th, but the 3rd year of the 19-year cycle.⁷⁸ Since the Jewish calendar year began with the month of Tishri in autumn, a full adaptation of this calendar also required that the beginning of the lunar year was shifted to September, with a new moon on 20 September in the first year of the cycle.⁷⁹ The calendrical definition of Easter could be then simplified as the first Sunday after the 14th day of the seventh month of the lunar year, which became the eighth month in embolismic years (where an additional month was inserted before Nisan). All other moveable feast days, such as Quadragesima and Pentecost, could then be inferred according to their customary distance from Easter Sunday. “In order to make this happen more conveniently” (*quot ut melius fieret*), Osma even went as far as demanding that one should “insert the months of the Jews and their names into our calendar, just like ours are found in theirs.”⁸⁰

⁷⁸ Ibid., fols. 52v-53r: “Hoc autem [53r] fieret si dimitteremus ciclum Romanorum gentilium, quod in hac parte sequimur, et acciperemus ciclum Iudeorum, qui posset haberi addendo annis Christi XXVII, qui fuerunt de ciclo Iudeorum quando inceperant anni incarnationis vel nativitatis, sicut nunc additur unum quod tunc fuerat de ciclo Romanorum gentilium, et totum aggregatum divideretur per XIX. Que autem superesset haberetur pro ciclo illius anni. Et si nihil superesset, esset pro ciclo XIX, sicut si huic anno Christi in quo sumus, id est MCCCCLXXVIII, addantur XVII, erunt anni MCCCCLXXXV, qui si dividantur per XIX supererunt tria, habenda pro ciclo huius anni, sicut et apud Iudeos habentur, quia secundum eos et veritatem Hebraycam anni mundi in hoc anno sunt .V.CCXXVIII, quibus divisus per XIX supersunt tria, ut prius, habenda pro ciclo huius anni. Ex his per subtractionem poteris habere annos mundi quando inceperant anni incarnationis vel nativitatis: fuerunt enim anni .III.DCCLX, qui si dividantur per XIX supererunt XVII, habenda pro radice ad habendum per annos Christi in singulis annis ciclum Iudeorum.”

⁷⁹ Ibid., fol. 53r-v: “Et si ita esset quod ecclesia vellet recipere hanc doctrinam, deberet cyclus renovari XX die Septembris, non autem prima die Ianuarii, ut nunc fit, et esset quidem collocandus in calendario hoc modo: XX die Septembris deberet scribi unum; XXI: nihil; XXII: IX; XXIII: nihil; XXIII: XVII; et sic consequenter per totum kalendarium, excepto quod Martius, ad hoc quod inciperet sicut et Ianuarius, haberet in principio XVI posita immediatate post VIII, scripta ultima die [53v] Februarii. Nec esset curandum in hac parte de illis duodecim exceptionibus quas computiste dicunt falsificationes, nam et propter hoc numquam erit error sensibilis in celebratione festorum mobilium. Nec etiam curandum esset de Iudeis, qui quando incipit cyclus incipiunt anni suum XXII die Septembris, quia quamvis olim verum fuerit et tamen his temporibus manifestum quod quando cyclus Iudeorum est in primo puncto novilunium sit XX die Septembris. Ut autem annus lunaris perpetue in novilunio vel prope incipiet, tradenda esset regula ut post quodlibet CCCLX annos solares retrotraheretur una die principium anni lunaris, similiter in omnibus annis bissextilibus.” Osma’s statement regarding the Jewish new moon is accurate for 1446 (first year of the cycle), when 1 Tishri fell on 22 September, although the corresponding conjunction (*molad*) already fell on 21 September. Yet closer to his own time, the Jewish cycle could be observed to begin on 21 September (1465) or 20 September (1484).

⁸⁰ Ibid., fol. 55r: “Posset autem hoc facilius accipi sine ulla manu si diceretur quod calendario sic emendato Pascha nostrum deberet celebrari in proxima dominica post XIII diem mensis septimi in annis communibus vel octavi in embolismalibus, reliqua vero festa secundum distantiam prenominatam. Quod ut melius fieret deberent Iudeorum menses et ipsorum nomina interseri in calendario nostro, quemadmodum nostri reperiuntur in suo.” This indicates that Pedro de Osma had seen Jewish calendar texts that take account of the Julian months and Christian feast days. Cf. also *ibid.*, fol. 50r: “Dicendum quod menses nostri sunt inserti in calendario Iudeorum secundum novilunia huius temporis.” Exemplars of such calendars have indeed be found in Ashkenazic manuscripts, but Osma’s treatise is, to my

Pedro de Osma's remarks at various points in his *Disputatio* give the impression that the Castilian theologian was not only exceptionally appreciative of the Jewish calendar, but also quite well-informed about the details of its operation. Apart from the Hebrew names of the month, which he cites in full,⁸¹ his knowledge also extended to the way Jewish dates related to the Julian calendar, which was a technically demanding topic. In his discussion of the date of Christ's Passion in the first part of the treatise, he commented on the Easter lunation of 1467, whose beginning was 9 March according to the ecclesiastical calendar. The Jews, by contrast, are said to have started the same lunar month three days earlier, on 6 March.⁸² This is indeed accurate: the *molad* or conjunction of Nisan in AD 1467 = 5227 JE, as calculated by the fixed Jewish calendar, fell on Friday, 6 March, 9h 983p after sunset, while the actual beginning of Nisan was only on the following day. This discrepancy is due to the Jewish calendar's postponement rules (called *dehiyyot*), which prevent Passover on 15 Nisan from occurring on a Monday, Wednesday, or Friday. By implication, this rule also affects the date of 1 Nisan in the same way.⁸³ If the *molad* for Nisan falls on one of these weekdays, the beginning of the month has to be shifted to the following day, as Pedro de Osma himself reported in his discussion of the Passion date. Yet according to him, the Jews also postponed their Passover if the exact time of the full moon (*dies XV*) was calculated to fall later than 18h.⁸⁴ This is a distorted reference to a further postponement rule, known as *Jah* or *molad zaken* ("old molad"), which requires a postponement of 1 Tishri –the first day of the year– whenever the corresponding conjunction falls later than 18h on the day (this is equivalent to noon, since the Jewish day begins from sunset). Osma's association of this second rule with the 15th day of Nisan rather than 1 Tishri –and with the full rather than the new moon– is therefore quite misleading. Previous to Osma, the *dehiyyot* had been discussed at length by the famous *converso* Pablo de Santa María (or Paul of Burgos), in his massive *Additiones* to Nicholas of Lyra's biblical postills. In his commentary on Matthew 26, Pablo explained that Passover in the year of crucifixion (which he, like Alfonso de Madrigal,

knowledge, the only evidence for their availability on the Iberian peninsula. The subject of Christian elements in Hebrew calendar manuscript is currently being investigated by Justine Isserles. On the role of the Christian calendar in the life of early modern Jews and its presence in their manuscripts, see Carlebach, 115-59.

⁸¹ Vat. lat. 6301, fol. 55r: "Appellantur autem menses Iudeorum nominibus Grecis hoc modo: Tisri, Marthesuan, Quislef, Treves, Seuan, Adar, Nican, Iziar, Civaz, Tamuz, Af, Elul. Et in annis quidem embolismalibus replicatur Adar admodum diei bissextilis." It is unclear to me how Osma arrived at the absurd idea that these were Greek names.

⁸² Ibid., fol. 47r: "Inde est quod Iudei nostris temporibus in aliquot annis incipiunt primum mensem, id est primam diem primi mensis, citra septimam diem Martii, secundum quod fuerat in anno preterito MCCCCLXVII dominice incarnationis, ubi secundum Iudeos primus mensis inceperat sexta die Martii, secundum nos vero die VIII."'

⁸³ The rule, known as *lo BaDU Pesah*, is normally regarded as the corollary of another rule, which prevents the first day of the year (1 Tishri or *Rosh Hashanah*) from falling on a 1st, 4th, or 6th day of the week. For further details, see Feldman, 191-94; Stern, 166-67, 194-95.

⁸⁴ Vat. lat. 6301, fols. 48v, 49v-50r. On this rule, see Feldman, 191-93; Stern, 195-96.

took to be AD 33) had been postponed by two days due to the aforementioned two rules, but the way he discussed *molad zaken* made it look like it applied to 1 Nisan rather than 1 Tishri.⁸⁵ Some of Osma's confusion on this point may thus have been due to reading Pablo's *Additiones*.

Apart from this specific point, nothing further is known about the concrete sources of information that Osma used for the Jewish calendar or about the extent of any knowledge of Hebrew he may have had. It is quite possible, however, that his interest in this field was partly sparked by the influence of Alfonso de Madrigal, who alluded to the Jewish calendar a number of times in his *Defensorium*.⁸⁶ Moreover, while Osma's *Disputatio* does not seem to have had enjoyed a very vivid reception, it is interesting to observe that his appreciation of the Jewish calendar was to a certain extent also shared by the Salmantican doctors mentioned in the introduction above, whose advice on the calendar was sought in 1515 by Pope Leo X and King Ferdinand II. At the end of their report, they attached a brief, but comprehensive, description of the Jewish calendar, which was based around a lost set of tables for the conversion between Jewish and Julian calendar dates. In justification of this appendix, the authors remarked:

Yet if those find acceptance, who, troubled by the intricate difficulty of Easter computation, want the purity of this paschal observance to be governed by the method of the Arabic calendar, why should not [the Jewish calendar] find even greater favour (as we hope), given that the reason for this ecclesiastical custom goes back to the observance of the Jews, from which it is known to have first originated?⁸⁷

While their Latin may have been more elegant, their stance was thus fully consistent with that taken fifty years earlier by Pedro de Osma.

⁸⁵ See Nothaft 2012b, 212-22, for details.

⁸⁶ Alfonso de Madrigal 1728, 106b-7b, 161 (c. 14 and 93). See also García. It is also worth mentioning that Osma's most famous student, Antonio de Nebrija, would go on to author a number of treatises on Hebrew phonetics (the first non-Jewish Spaniard to do so). See Valle Rodríguez.

⁸⁷ "Sin illi probantur, qui Ecclesiasticae computationis scrupulosa difficultate vexati, huius Paschalis observantiae sinceritatem ex Arabici calculi ratione dirigendam esse voluerunt, cur non haec potius placitura speremus, ubi ratio Ecclesiastici cultus ad ipsam Judaicae observationis remittitur originem, unde primum noscitur defluxisse?" (Carabias Torres, 309). The tables in question have not been preserved, but it is likely that they were taken or adapted from a Latin translation of Abraham Zacut's *Hibbur ha-gadol*. See 'Appendix II' in Nothaft 2014b.

Appendix: Textual emendations and transcription

While José Labajos Alonso's decision to finally bring the *Disputatio* to light in a printed edition is very deserving, his rendering of the difficult handwriting in MS Vat. lat. 6301 is at several points marred by transcription errors that can seriously impede a proper understanding of the text. For the first half of the text (*De anno Passionis Christi*), readers may want to dispose of the following emendations:

- p. 354, last paragraph, last line: *porrigitur* for *prorrigitur*; n. 2, last line: *Crescebat* for *nesciebat* and *adiectiones* for *objectiones*.
- p. 356, second paragraph, l. 7 from bottom: *praeterea* is not in the MS; l. 6 from bottom: *curat* for *considerat*.
- p. 358, first paragraph, first line: *supputationem, de quo solum curat ecclesia* for *supputatioem. De quo solum quatuor Evangelia*; first paragraph, l. 6: *embolismalis* for *emboliamalis*; l. 4 from bottom: *fuera* for *fuera*; fourth paragraph, l. 1: *ergo* for *primo*; l. 3: insert *fuera* between *Dominus* and *passus*; l. 6: *questio* for *primo*; l. 2 from bottom: *inter* for *respondent*.
- p. 360, first paragraph, first line: *Invenitur* for *Invenis, fuisse* for *fuisse*; second paragraph, l. 1: *retentis* for *recentis*; third paragraph, l. 3: *compotistas* for *composistores*; l. 3 from bottom: *retentis* for *recentis*; third paragraph, last line: *tertie questionis* for *secundae conclusionis*; fourth paragraph, l. 4: *antiquorum doctrine* for *cum antiquorum doctrina*.
- p. 362, first paragraph, l. 4: *et qui* for *quam*, l. 7: *quia quamvis* for *quoniam*; l. 10: *octodecim* for *septemdecim*; l. 16: *fuera* for *fiera*; l. 17: *littera fuera* for *littera fuera f*; l. 22: *quintus* for *decimus*.
- p. 364, second paragraph, l. 1: *hac questione* for *ha conclusione*; l. 2: *questio* for *conclusio*; last line: *questionis* for *conclusionis*; third paragraph, l. 7: *ubi vel* for *ibi, sed*; fourth paragraph, l. 3: *talis defectus* for *relatis defectibus*; fifth paragraph, l. 1: *posset* for *potest*; *questione* for *conclusione*; l. 2: *in fermentato* for *infermentata*; *azimo* for *azimorum* l. 5–6: *sexta* for *septima*; l. 6: *octavo* for *tertio*; l. 8: *nonus* for *quartus*; final paragraph, l. 1: *que dicit* for *convenit dicere*.
- p. 366, first paragraph, l. 2: *memorati* for *numerati*; last line: *extitit* for *est*; second paragraph, l. 3: *nostri* for *non*; l. 4: *inserti* for *numerati*; third paragraph, l. 1: *compotistas* for *composistas*; l. 2: *in* not in MS; l. 3: *vulgariter* for *vulgaritatem*; l. 5: *Crescebat* for *Nesciebat*; n. 11: *trigesimus* for *trigerimus*; *aliter* for *alias*; *probavimus* for *probabimus*.
- p. 368, first paragraph, l. 18: *questione* for *conclusione*; l. 22: *ubi* for *ibi*; l. 23: *questio* for *conclusio*; l. 24: *ostendi* for *ostendere*.

What follows is my re-transcription of the second part of the text, as found in Vat. lat. 6301, fols. 51v-56v.

[De erratis in kalendario]

[Ch.1]

[51v] Nunc autem pro inceptorum complemento videndum est de erratis in kalendario. Sunt enim tria errata, ex quibus sequuntur quedam alia: primum circa novilunia, que inveniuntur a propriis locis fere quatuor diebus retrocesisse. Causa autem illius rei fuerat quia noviluna post XIX annos non redeunt, ut supra ponitur, ad priora loca precise. Remanent enim retro fere XIX parte unius diei. Et ita in CCCLX fere annis retrocedunt fere die una. Et sic a primo anno incarnationis vel nativitatis usque ad tempora nostra invenies coniunctiones solis et lune retro abiisse in kalendario fere diebus quatuor. Ex hoc fit ut frequenter Pascha nostrum celebretur non in proxima, sed in secunda dominica post Fase Iudeorum, secundum quod fuerat in anno preterito et etiam erit in hoc presenti anno MCCCLXVIII. Primus enim mensis Iudeorum secundum veritatem incipiet XXV, aut verius XXIII Martii, secundum nos vero et errorem XXVIII, et ita Pascha nostrum secundum veritatem [52r] deberet celebrari X die Aprilis, cum ibi sit proxima dominica post Fase Iudeorum. Et tamen celebrabitur XVII die Aprilis contra rationem et regulam que traditur in capitulo 'celebritatem' de consecratione, dist. III.⁸⁸ Ille autem error de retrocessione lunationum erit facile emendatus, si lunaris ciclus in kalendario modo situatus retrotrahatur ad XXVIII diem Decembris. Et sic consequenter usque ad principium Ianuarii. Hoc autem emendato, ad hoc quod omnino cesset alius error circa celebritatem Pasche, debet primus mensis Iudeorum queri non iam post septimam diem Martii, sicut ante hac fiebat, sed immediate post diem primam, et etiam in annis bissextilibus post ultimam Februarii. Descendit enim primus mensis Iudeorum ad secundam vel tertiam diem Martii universaliter in omnibus annis in quibus lunaris ciclus fuerit XIX vel VIII, ad secundam quidem quando fuerit XIX, ad tertiam vero quando fuerit VIII. Et si fuerunt anni bissextiles ad primam vel secundam. Si autem velimus non solum emendare preterita, sed etiam cavere ne amplius talia eveniret, oporteret post quotlibet CCCLX annos retrotrahere in kalendario lunarem ciclum die una, similiter et diem illam postquam primus mensis queri debet. Itaque post CCCLX annos nos esset querendus post primam diem Martii, sed post ultimam Februarii, et sic de ceteribus CCCLX annis futuris. In omnibus etiam annis bissextilibus primus mensis querendus esset inmediate post ultimam diem Februarii, aliter fieri posset ut Pascha nostrum celebraretur VIII diebus postea quam deberet. In omnibus enim annis [52v] bissextilibus, sive emendato kalendario sive non emendato, debet secundum intellectum ciclus retrahi die una et concurrenti vulgari addi⁸⁹ unum, quod tene menti.

[Ch. 2]

Est autem illud erratum magis sensibile circa annos embolismales, quando lunaris ciclus fuerit VIII vel XIX. Tunc enim Pascha nostrum celebratur post Fase Iudeorum diebus XXX et ad hoc pluribus, secundum quod erit in anno in CCCCLXX, ubi

⁸⁸ *Decretum magistri Gratiani* (pars III, dist. 3, cap. 22), ed. Friedberg 1879-81, vol. I, cols. 1358-60.

⁸⁹ Ms.: adde.

secundum Iudeos et veritatem quarta decima dies primus mensis erit XVI die Martii. Et ita secundum veritatem et regulam que traditur in capitulo prenominate 'celebritatem' de consecratione, dist. III, Pascha nostrum deberet celebrari in proxima dominica sequenti, que erit XVIII Martii, et tamen secundum errorem celebrabitur XXII.⁹⁰ die Aprilis. Venerat autem error prefatus ex hoc quod anni illi in quibus ciclus noster est VIII vel XIX apud nos sunt embolismales, apud Iudeos vero communes, quia quando ciclus noster est VIII, eorum est V, et quando noster est XIX, ipsorum ciclus est XVI. Hinc itaque fit ut tunc annus noster lunaris excedat annum Iudeorum uno mense. Posset autem huic defectum succurri dupliciter: uno modo, et facillime, si retroacto ciclo in calendario diebus quatuor, ut dictum est, quereretur primus mensis Iudeorum non iam post VII. diem Martii secundum, quod ante hac fiebat, sed immediate post primam, et in annis bissextilibus post ultimam Februarii. Non enim multum interest ecclesie quod anni sint communes vel embolismales, dum tamen Pascha nostrum recte celebretur in proxima dominica post XIII diem primi mensis.

Alius modus emendandi posset esse multum conveniens, quamvis non ita facilis, quem si ecclesia eligeret cessarent omnes errores prenominati, tam circa novilunia et pasce celebritatem, quam circa embolismales. Hoc autem [53r] fieret si dimitteremus ciclum Romanorum gentilium, quod in hac parte sequimur, et acciperemus ciclum Iudeorum, qui posset haberi addendo annis Christi XXVII, qui fuerunt de ciclo Iudeorum quando inceperant anni incarnationis vel nativitatis, sicut nunc additur unum quod tunc fuerat de ciclo Romanorum gentilium, et totum aggregatum divideretur per XIX. Que autem superesset haberetur pro ciclo illius anni. Et si nihil superesset, esset pro ciclo XIX, sicut si huic anno Christi in quo sumus, id est MCCCCLXXVIII, addantur XVII, erunt anni MCCCCLXXXV, qui si dividantur per XIX supererunt tria, habenda pro ciclo huius anni, sicut et apud Iudeos habentur, quia secundum eos et veritatem hebraycam anni mundi in hoc anno sunt .V.CCXXVIII, quibus divisus per XIX supersunt tria, ut prius, habenda pro ciclo huius anni. Ex his per subtractionem poteris habere annos mundi quando inceperant anni incarnationis vel nativitatis: fuerunt enim anni .III.DCCLX, qui si dividantur per XIX supererunt XVII, habenda pro radice ad habendum per annos Christi in singulis annis ciclum Iudeorum. Et si ita esset quod ecclesia vellet recipere hanc doctrinam, deberet ciclus renovari XX die Septembris, non autem prima die Ianuarii, ut nunc fit, et esset quidem collocandus in calendario hoc modo: XX die Septembris deberet scribi unum; XXI: nihil; XXII: IX; XXIII: nihil; XXIII: XVII; et sic consequenter per totum kalendarium, excepto quod Martius, ad hoc quod inciperet sicut et Ianuarius, haberet in principio XVI posita immedietate post VIII, scripta ultima die [53v] Februarii. Nec esset curandum in hac parte de illis duodecim exceptionibus quas computiste dicunt falsificationes, nam et propter hoc numquam erit error sensibilis in celebratione festorum mobilium. Nec etiam curandum esset de Iudeis, qui quando incipit ciclus incipiunt anni suum XXII die Septembris, quia quamvis olim verum fuerit et tamen his temporibus manifestum

⁹⁰ Ms.: XII.

quod quando ciclus Iudeorum est in primo puncto novilunium sit XX die Septembris. Ut autem annus lunaris perpetue in novilunio vel prope incipiet, tradenda esset regula ut post quodlibet CCCLX annos solares retrotraheretur una die principium anni lunaris, similiter in omnibus annis bissextilibus.

Sed quia durum est asueta relinquere, et durum forte ecclesie ista recipere, deberet similiter declarare nobis quod illa regula, que traditur in prenominato capitulo de consecratione, dist. III, non esset tenenda in annis in quibus ciclus lunaris fuerit VIII vel XIX, nec etiam in aliquot annis. Hoc tamen per medium non esset sufficiens, quia manebunt adhuc novilunia errata in calendario, que si essent emendata maneret in suis terminis prenominatum capitulum ‘celebritatem’. Nec ratio que ad illud movebar est conveniens, quia consuetudo non excusat errorem, immo, ut Gregorius nonus dicit in capitulo de consuetudine, ‘tanto error gravis, quanto diutius tentet hominem alligatum’.⁹¹ Et ideo hoc pretermisso accipiendum esset primum vel secundum remedium. Sed prelati nostri temporis nec ad hec, nec ad illa, vel alia similia ad que deberet, advertunt, quod dolendum est.

[Ch. 3]

Reperitur quoque illud erratum in nostro calendario circa principia [54r] mensium Romanorum, quos Latini sequuntur. Eo enim tempore quo kalendarium fuerit fabricatum, scilicet duobus milibus cum centum et aliquot annos retro, prima dies Ianuarii fuerat minima dies anni, et maxima prima dies Iulii, equinoctia vero inveniuntur fuisse, vernale quidem, prima die Aprilis, et autumnale primo die Octobri. Causata est autem hec varietas ex hoc quod per quantitate anni solaris accipitur plus quam fuerit secundum veritatem fere una centesima diei, et ita in centum fere annis retrocedunt principia mensium die una. Qui enim voluerit secundum viam astrologicam considerare, inveniet quod a tempore conditoris urbis Rome, quando vel paulo postea fabricatum fuerat kalendarium, usque ad tempora nostra principia mensium retrocessunt fere diebus XXI. Iste error facile emendabitur, si principium Ianuarii cum aliis mensibus retrotrahatur diebus XXI, ita ut prima dies Ianuarii sit ubi hodie est XII dies Decembris, scilicet in solestitio hiemali, et prima Iulii ubi undecima Iunii, et sic de reliquis suo modo. Hoc itaque modo potest reduci kalendarium in primarium statum. Ne autem huius error amplius eveniret, deberet principium Ianuarii cum ceteris mensibus post quotlibet centum annos retrahi dies una. Quod si menses ad eum statum in quo fuerat eo tempore quo dei filius carnem assumpsit velimus reducere, deberet mensium principia retrotrahi diebus XIII. Festa vero et quecumque alia in calendario situata possent in eis locis ubi plus permanere, vel permutorum in ea loca que suis successant locis, sicut exempli gratia festum omnium [54v] sanctorum posset celebrari prima die Novembris vel die XIII que successerat post. Est autem hoc considerandum quod huiusmodi Romanorum mensium emendatio non est tantum necessaria quantum due precedentes mensium lunarium. Non enim multum interest

⁹¹ Gregorius IX, *Decretales* (lib. I, tit. 4, cap. 11), ed. Friedberg 1879-81, vol. II, col. 41.

ecclesie quod menses Romanorum hic vel alibi inceperat, nec etiam quod festa in eis situata hic vel alibi celebrentur. Est autem rediculum et non parva prelati verecundia dicere quod luna fuisset prima, quando est tertia vel quarta, et quod post Fase dominica proxima dicatur secunda quarta vel quinta. Derident enim infideles ecclesie gubernatores quasi hoc ignari fecerunt, non facientes id quos agere intendunt, nec forte a canone, quod dolendum est.

[Ch. 4]

Ultimo videndum est quemadmodum calendario emendato possit noviter confici ars manualis. Dicendum quod manualis ex calendario colligitur, et ideo secundum quod kalendarium fuerit emendatum in uno vel in pluribus, sic et ars manualis diversimode fabricabitur. Nam si in calendario ceteris manentibus cyclus retrotraheretur diebus quatuor, in radice pollicis manus⁹² sinistre essent collocanda XIX, scripta secunda die Martii, in radice vero indicis VIII, et sic communiter. De literis autem in radice indicis deberet esse E, scriptum XVI. die Martii, in media iunctura scilicet, et sic de reliquis. De terminis vero vel radicibus festorum mobilium in radice indici pro septuagesima deberetur poni XII Ianuarii, pro quadragesima II [55r] Februarii, pro Pascha XVI Martii, pro rogationibus XX Aprilis, pro pentecoste III Maii, quia sicut Pascha ita et eius infimus terminus distare debet a terminis aliorum festorum: a primo quidem novem ebdomadis, a secundo sex, a tertio vero rogationum V, et pentecostes VII.

Si autem kalendarium sic fuerit correctum quod cyclus sit omnino innovatus, ita quod cyclus Iudeorum sit in eo collocatus secundum modum supradictum, in radice pollicis deberent esse V, in radice indicis nihil, et sic consequenter. De literis vero et de terminis festorum mobilium agendum esset secundum modum precedentem, quia utrobique esset querendus primus mensis Iudeorum post primum diem Martii, et in annis bissextilibus post ultimam Februarii.

Possent autem hoc facilius accipi, sine ulla manu, si diceretur quod calendario sic emendato Pascha nostrum deberet celebrari in proxima dominica post XIII diem mensis septimi in annis communibus, vel octavi in embolismalibus, reliqua vero festa secundum distantiam prenominatam. Quod ut melius fieret deberent Iudeorum menses et ipsorum nomina interseri in calendario nostro, quemadmodum nostri reperiuntur in suo. Appellantur autem menses Iudeorum nominibus Grecis hoc modo: Tisri, Marthesuan, Quislef, Teves, Seuvan, Adar, Nisan, Iziar, Civaz, Tamuz, Af, Elul. Et in annis quidem embolismalibus replicatur Adar admodum diei bissextilis, et ita Nican, in quo perpetue est celebrandum Pascha [55v], numeratur octavus, quamvis communiter fuerit VII, que temporibus ecclesie primitive semper finiebatur in Aprili, excepto quando cyclus erat VIII. His autem temporibus non est sic.

Et si in calendario cyclus esset retroactus diebus quatuor et principia mensium redacta in primarium statum, quod tamen ecclesie, ut supra dictum est, minus esset necessarium, in radice pollicis deberent esse IX, in radice indicis nihil, in media

⁹² Ms.: in annis

iunctura XVII, et sic de reliquis iuncturis. De literis vero in radice indicis deberet esse D, in media iunctura E, et est sic consequenter iuxta modum antiquum. De terminis autem festorum mobilium pro septuagesima esset accipiendum in radice indicis unum Februarii, pro quadragesima XXII eiusdem, pro Pascha V Aprilis, pro rogationibus decima Maii, pro penthecoste XXIII eiusdem.

Et si ciclo sic retroacto diebus quatuor principia mensium essent redacta in primum statum in quo fuerant tempore incarnationis vel nativitatis Christi, in media iunctura pollicis ponerentur VII, in radice nihil, in radicis indicis XV, et sic ulterius usque ad postremam iuncturam totius manus. De literis vero in radice indicis deberet esse D, in media iunctura E, et sic consequenter. Termini autem festorum mobilium haberi possent subtrahendo a singulis de quibus nunc diximus VII. His itaque modis posset emendari kalendarium [56r] et noviter confici ars manualis. Ex quibus, ut puto, satis manifeste potest videri quod quibusdam mutatis posset emendari kalendarium et noviter confici ars manualis, que fuerunt verba ultime questionis huius disputationis.

[Ch. 5]

Sed arguitur contra id, quod dictum est supra, quod Pascha nostrum debeat celebrari in proxima dominica post Pasche, id est post XIII diem primi mensis. Videtur enim quod debeat celebrari in proxima dominica post festum azimorum, id est post XV diem primi mensis, quia in proxima dominica post primam diem azimorum fuerat Christi resurrectio, cuius celebritas videtur solemnizari in Pascha nostro. Dicendum quod in hoc, sicut in ceteris aliis, tenenda sunt instituta ecclesie, que instituit Pascha nostrum celebrari prima die azimorum post decimam quartam diem primi mensis. Si enim expectaremus quod transiret prima dies azimorum, sequeretur quod quando ciclus esset XVI et litera dominicalis D nostrum Pascha deberet celebrari ultra XXI diem primi mensis, quod est contra id quod ecclesia semper observaverat et iubet observari in prenominato capitulo 'celebritatem'. Unde habuit originem illa regula in ecclesia satis communis: post VII diem Martii queratur luna prima et numeratis [56v] ipsius XIII diebus in sequenti dominica celebretur Pascha. Nec obstat quod his temporibus numeramus XVII, quia hoc fit ex errore et per accidens, propter hoc scilicet quod primus mensis et universaliter omnes lunationes accipiuntur in kalendario secundum errorem quatuor diebus postea quam fuerint secundum veritatem, quod iam esset ad ecclesia emendandum secundum modum suppositum. In omnibus tamen annis bissextilibus, tam in kalendario, quam in manu, ciclus deberet, et etiam debet hodie, retrotrahi secundum intellectum dies una et concurrenti vulgari addi unum, quod tene menti.

Explicit *Disputatio de anno in quo possumus dicere Dominum fuisse passum ad honorem Christi et utilitatem ecclesie* a Petro Martino de Osma in artibus et in theologia magistro compilata.

Works Cited

- Acosta Rodríguez, Juan. "Introducción de Tomás de Aquino y del maestro salmantino Pedro de Osma a sus respectivos comentarios a la 'Ética a Nicómaco'." *Revista española de filosofía medieval* 5 (1998): 237-46.
- Alfonso de Madrigal. *Tostado sobre el Eusebio*. Vol. 1. Salamanca: Hans Gysser, 1506.
- . *Commentaria in Genesim: mendis nunc sane quam plurimis diligenter expurgata*. Venice: Sessa, 1596.
- . "Defensorium trium propositionum." *Opuscula eruditissima*. Vol. 25. Venice: Balleon, 1728. 75-164.
- Alonso Baelo, Pablo Luis. "El pensamiento de Martínez de Osma: de la recepción teológica a la recepción histórico-filosófica." *Azafea* 12 (2010): 173-208.
- Andrés Martín, Melquíades. "Antiverbosismo en Pedro Martínez de Osma." *Celtiberia* 30 (1980): 131-38.
- Antonio de Nebrija. *Apologia earum rerum qui illi obijciuntur*. Granada: s.n., 1535.
- Belloso Martín, Nuria. *Política y humanismo en el siglo XV: el maestro Alfonso de Madrigal, el Tostado*. Valladolid: Publicaciones Universidad de Valladolid, 1989.
- Burnaby, Sherrard Beaumont. *Elements of the Jewish and Muhammadan Calendars*. London: Bell, 1901.
- Cantera Burgos, Francisco. *El judío salmantino Abraham Zacut: notas para la historia de la astronomía en la España medieval*. Madrid: Bemejo, 1931.
- Carabias Torres, Ana María. *Salamanca y la medida del tiempo*. Salamanca: Ediciones Universidad de Salamanca, 2012.
- Carlebach, Elisheva. *Palaces of Time: Jewish Calendar and Culture in Early Modern Europe*. Cambridge, MA: Harvard University Press, 2011.
- Casella, Pierleone. *De primis Italiae colonis, De Tuscorum origine & Republica Florentina, Elogia illustrium artificum, Epigrammata, & Inscriptiones*. Lyon: Cardon, 1606.
- Castillo Vegas, Jesús Luis. "El humanismo de Alfonso de Madrigal, el Tostado, y su repercusión en los maestros salmantinos del siglo XV." *Cuadernos Abulenses* 7 (1987): 11-21.
- Cebeira Moro, Ana, ed. *Petri Osmensis in libros Aristotelis commentarii*. Pamplona: Publicaciones Universidad de Navarra, 2002.
- . "La escuela humanista salmantina: Pedro Martínez de Osma, discípulo de El Tostado." *La corónica* 33.1 (2004): 53-65.
- Chabás, José. "Astronomy in Salamanca in the Mid-Fifteenth Century: The *Tabulae Resolutae*." *Journal for the History of Astronomy* 29 (1998): 167-75.
- . "Astronomía alfonsí en Morella a finales del siglo XIV." *Cronos* 3 (2000): 381-91.
- . "The Diffusion of the Alfonsine Tables: The Case of the *Tabulae Resolutae*." *Perspectives on Science* 10 (2002): 168-78.

- . "The University of Salamanca and the Renaissance of Astronomy during the Second Half of the 15th Century." Eds. Mordechai Feingold and Victor Navarro-Brotons. *Universities and Science in the Early Modern Period*. Dordrecht: Springer, 2006. 29-36.
- Chabás, José, and Bernard R. Goldstein. *Astronomy in the Iberian Peninsula: Abraham Zacut and the Transition from Manuscript to Print*. Philadelphia, PA: American Philosophical Society, 2000.
- . *The Alfonsine Tables of Toledo*. Dordrecht: Kluwer, 2003.
- Coyne, George V., Michael A. Hoskin, and Olaf Pedersen, eds. *Gregorian Reform of the Calendar: Proceedings of the Vatican Conference to Commemorate its 400th Anniversary, 1582-1982*. Vatican City: Specola Vaticana, 1983.
- Denzinger, Heinrich. Trans. Roy J. Deferrari. *The Sources of Catholic Dogma*. Fitzwilliam, NH: Loreto Publications, 2002.
- Dobrzycki, Jerzy. "Astronomical Aspects of the Calendar Reform." Eds. George V. Coyne, Michael A. Hoskin, and Olaf Pedersen. *Gregorian Reform of the Calendar*. Vatican City: Specola Vaticana, 1983. 117-26.
- . "The *Tabulae Resolutae*." Eds. Mercè Comes, Roser Puig and Julio Samsó. *De Astronomia Alphonsi Regis*. Barcelona: Instituto "Millás Vallicrosa", 1987. 71-77.
- Elías de Tejada y Spinola, Francisco. *Historia de la literatura política en las españas*. Vol. 3, *El reinado de los Reyes Católicos*. Madrid: Real Academia de Ciencias Morales y Políticas, 1991.
- Feldman, William Moses. *Rabbinical Mathematics and Astronomy*. 3rd ed. New York: Hermon Press, 1978.
- Fernández Collado, Angel. "Juanelo Turriano y la aportación española a la reforma del calendario gregoriano." *Toletum* 23 (1989): 151-59.
- Fernández Vallina, Emiliano. "Introducción al Tostado: de su vida y obra." *Cuadernos salmantinos de filosofía* 15 (1988): 153-77.
- . "La importancia de Alfonso de Madrigal, 'el Tostado', maestrecuela en la Universidad de Salamanca." Eds. Luis E. Rodríguez-San Pedro Bezares and Juan Luis Polo Rodríguez. *Salamanca y su universidad en el primer renacimiento: siglo XV*. Salamanca: Ediciones Universidad, 2011. 161-78.
- Flórez Miguel, Cirilo. "El humanismo cívico castellano: Alonso de Madrigal, Pedro de Osma y Fernando de Roa." *Res publica* 18 (2007): 107-39.
- Frías Balsa, José Vincente. "Pedro Martínez de Osma, catedrático del siglo XV." *Celtiberia* 29 (1979a): 65-88.
- . "Pedro Martínez de Osma: vida y obras." *Burgense* 20 (1979b): 535-64.
- . "El *Compendio Metaphisice* de Pedro de Osma: Estudio Bibliográfico." *Revista de Investigación (Colegio Universitario de Soria)* 4.1 (1980): 107-20.
- Friedberg, Emil. *Corpus Juris Canonici*. 2 vols. Leipzig: Tauchnitz, 1879-81.

- Fuertes Herreros, José Luis. "Contra el nominalismo: humanismo y renovación de la filosofía y teología en Pedro de Osma." *Revista Española de Filosofía Medieval* 11 (2004): 243-55.
- . "Pensamiento y filosofía en la universidad de Salamanca del siglo XV, y su proyección en el XVI." Eds. Luis E. Rodríguez-San Pedro Bezares and Juan Luis Polo Rodríguez. *Salamanca y su universidad en el primer renacimiento: siglo XV*. Salamanca: Ediciones Universidad, 2011. 203-40.
- Fuertes Herreros, José, and Federico Panchón Cabañeros. "Pedro Martínez de Osma: Respuesta algunos disparates de dos verbosistas de esta época." *Revista española de filosofía medieval* 11 (2004): 311-14.
- . "Pedro Martínez de Osma (1424-80): Diálogo en el que se muestra que los fundamentos de la filosofía humana, en los que se apoyan los verbosistas, generalmente fallan en la teología (ca. 1474-79)." *Revista española de filosofía medieval* 12 (2005): 243-51.
- García, Santiago. "La competencia hebraica de Alfonso de Madrigal." *La corónica* 33.1 (2004): 85-98.
- García y García, Antonio, and Vicente Muñoz Delgado. "La 'Suma' de Pedro de Osma sobre 'La Política' de Aristóteles." *Celtiberia* 31 (1981): 87-110.
- Ginzler, Friedrich Karl. *Handbuch der mathematischen und technischen Chronologie: Das Zeitrechnungswesen der Völker*. Vol. 2. Leipzig: Hinrichs, 1911.
- Goldstein, Bernard R. "Ancient and Medieval Values for the Mean Synodic Month." *Journal for the History of Astronomy* 34 (2003): 65-74.
- Gombrich, E. H. "An Early Seventeenth-Century Canon of Artistic Excellence: Pierleone Casella's Elogia Illustrium Artificium of 1606." *Journal of the Warburg and Courtauld Institutes* 50 (1987): 224-32.
- Goñi Gaztambide, José, ed. *Pedro Martínez de Osma (†1480): homenaje en el V centenario de su muerte*. Spec. issue of *Celtiberia* 30 (1980): 1-152.
- Hannah, Robert. *Greek and Roman Calendars: Constructions of Time in the Classical World*. London: Duckworth, 2005.
- Heilbron, J. L. *The Sun in the Church: Cathedrals as Solar Observatories*. Cambridge, MA: Harvard University Press, 1999.
- Herold, Werner, ed. *Reinher von Paderborn: Computus Emendatus; Die verbesserte Osterfestberechnung von 1171*. Paderborn: Bonifatius, 2011.
- Honecker, Martin. "Die Entstehung der Kalenderreformschrift des Nikolaus von Cues." *Historisches Jahrbuch* 60 (1940): 581-92.
- Iannuzzi, Isabella. "La condena a Pedro Martínez de Osma: 'ensayo general' del control ideológico inquisitorial." *Investigaciones históricas: Época moderna y contemporánea* 27 (2007): 11-46.
- Isserles, Justine. "Some Hygiene and Dietary Calendars in Hebrew Manuscripts from Medieval Ashkenaz." Eds. Charles Burnett and Sacha Stern. *Time, Astronomy, and Calendars in Jewish Tradition*. Leiden: Brill, 2013. Forthcoming.

- Jones, Charles W., ed. *Bedae Venerabilis Opera, Pars VI: Opera Didascalica*. Vol. 2. Corpus Christianorum Series Latina 123 B. Turnhout: Brepols, 1977.
- Juan de Segovia. "Historia gestorum generalis synodi Basiliensis." Ed. Ernst Birk. *Monumenta conciliorum generalium seculi decimi quinti*. Vol. 2. Vienna: Typ. Aulæ et Status, 1873.
- Kaltenbrunner, Ferdinand. "Die Vorgeschichte der gregorianischen Kalenderreform." *Sitzungsberichte der kaiserlichen Akademie der Wissenschaften (Vienna)*, phil.-hist. Kl., 82 (1876): 289-414.
- Keightley, Ronald G. "Alfonso de Madrigal and the *Chronici Canones* of Eusebius." *Journal of Medieval and Renaissance Studies* 7 (1977): 225-48.
- . "Hercules in Alfonso de Madrigal's 'In Eusebius'." Ed. Bruno M. Damiani. *Renaissance and Golden Age: Essays in Honor of D. W. McPheeters*. Potomac, MD: Scripta Humanistica, 1986. 134-47.
- Kristeller, Paul Oskar. *Iter Italicum: A Finding List of Uncatalogued or Incompletely Catalogued Humanistic Manuscripts of the Renaissance in Italian and Other Libraries*. Vol. 6. London: Warburg Institute, 1992.
- Labajos Alonso, José, ed. *Pedro de Osma y su comentario a la Metafísica de Aristóteles*. Salamanca: Publicaciones Universidad Pontificia, 1992.
- . "Pensamiento metafísico de Pedro de Osma." *La ciudad de Dios* 207 (1994): 49-75.
- . "Pedro de Osma: impulsor del humanismo y del conocimiento de Aristóteles en Salamanca." *Cuadernos salmantinos de filosofía* 22 (1995): 135-58.
- , ed. *Pedro de Osma: Comentario a la Ética de Aristóteles*. Salamanca: Publicaciones Universidad Pontificia, 1996.
- , ed. *Pedro de Osma y Fernando de Roa: Comentario a la Política de Aristóteles*. 2 vols. Salamanca: Publicaciones Universidad Pontificia, 2006.
- , ed. *Escritos académicos de Pedro de Osma*. Salamanca: Publicaciones Universidad Pontificia, 2010a.
- . *Proceso contra Pedro de Osma*. Salamanca: Publicaciones Universidad Pontificia, 2010b.
- . "Pedro de Osma y Fernando de Roa: significación histórica." Eds. Cirilo Flórez Miguel, Maximiliano Hernández Marcos, and Roberto Albares Albares. *La primera escuela de Salamanca (1406-1516)*. Salamanca: Ediciones Universidad de Salamanca, 2012. 143-62.
- Lasker, Arnold A., and Daniel J. Lasker. "Behold, A Moon is Born! How the Jewish Calendar Works." *Conservative Judaism* 41.4 (Summer 1989): 5-19.
- Lawrance, Jeremy N. H. "The Universities of Spain at the End of the Middle Ages." *Atalaya* 6 (1995): 21-40.
- Lecea, Carlos Romero de. *Introducción a los viejos libros de música*. Madrid: Joyas Bibliográficas, 1976.

- López de Salamanca, Juan, and Pedro Martínez de Osma. Ed. Ramón Hernández. *La confesión y las indulgencias: prerreforma y tradición*. Salamanca: Editorial San Esteban, 1978.
- Mahler, Eduard. *Handbuch der jüdischen Chronologie*. Leipzig: Fock, 1916.
- Marcos Rodríguez, Florencio. “Algunos datos biográficos y testamento del maestro Pedro Martínez de Osma.” *Salmanticensis* 2 (1955): 691-706.
- . “¿Pedro de Osma murió sinceramente arrepentido?” *Revista española de teología* 36 (1976): 113-23
- . “Pedro de Osma y los primeros incunables españoles.” *Revista española de teología* 39/40 (1979-80): 331-41.
- Marzi, Demetrio. *La questione della riforma del calendario nel Quinto Concilio Lateranense (1512-1517)*. Florence: Carnesecchi, 1896.
- Migne, Jacques-Paul, ed. *Patrologiae cursus completus ... series latina*. Vol. 192. Paris: Migne, 1855.
- Miola, Alfonso. *Notizie di manoscritti neolatini*. Vol. 1. Naples: Furchheim, 1895.
- Müller, Tom. “*ut reiecto paschali errore veritati insistamus*”: Nikolaus von Kues und seine Konzilsschrift De reparatione kalendarii. Münster: Aschendorff, 2010.
- Mütz, Karl, ed. “*Computus Chirometralis*”: *Spätmittelalterliches Lehrbuch für Kalenderrechnung*. Leinfelden-Echterdingen: DRW-Verlag, 2003.
- Nallino, Carlo Alfonso, ed. *Al-Battānī sive Albateni Opus astronomicum*. Vol. 1. Milan: Hoepli, 1903.
- North, John. “The Western Calendar—‘Intolerabilis, Horribilis, et Derisibilis’: Four Centuries of Discontent.” Eds. George V. Coyne, Michael A. Hoskin, and Olaf Pedersen. *Gregorian Reform of the Calendar*. Vatican City: Specola Vaticana, 1983. 75-113.
- Nothaft, C. P. E. “Between Crucifixion and Calendar Reform: Medieval Christian Perceptions of the Jewish Lunisolar Calendar.” Eds. Jonathan Ben-Dov, Wayne Horowitz, and John M. Steele. *Living the Lunar Calendar*. Oxford: Oxbow Books, 2012a. 259-67.
- . *Dating the Passion: The Life of Jesus and the Emergence of Scientific Chronology (200-1600)*. Leiden: Brill, 2012b.
- . “Nicholas Trevet and the Chronology of the Crucifixion.” *The Mediaeval Journal* 2.2 (2012c): 37-51.
- . “A Tool for Many Purposes: Hermann Zoest (d. 1445) and the Medieval Christian Appropriation of the Jewish Calendar.” *Journal of Jewish Studies* 2013. Forthcoming.
- . “Duking it out in the Arena of Time: Chronology and the Christian-Jewish Encounter (1100-1600).” Ed. Harvey Hames. *Religious Criticism and the Growth of Knowledge*. Spec. issue of *Medieval Encounters* 2014a. Forthcoming.
- . *Medieval Latin Texts on the Jewish Calendar: A Study with Five Editions*. Leiden: Brill, 2014b. Forthcoming.

- Paul of Middelburg. *Paulina de recta Paschae celebratione*. Fossombrone: Petrucci, 1513.
- Paulus, Nikolaus. "Petrus Martinez von Osma und der Ablass." *Zeitschrift für katholische Theologie* 33 (1909): 599-608.
- Porres de Mateo, Beatriz, and José Chabás. "Los cánones de las *Tabulae Resolutae* para Salamanca: origen y transmisión." *Cronos* 1 (1998): 51-83.
- Recio, Roxana, and Antonio Cortijo Ocaña. "Alfonso de Madrigal, 'El Tostado': un portavoz único de la intelectualidad castellana del siglo XV." *La corónica* 33.1 (2004): 7-15.
- Regiomontanus, Johannes. *Kalendarium*. Nuremberg, 1474.
- Reinhardt, Klaus. "Das erste in Spanien gedruckte theologische Buch." *Revista española de teología* 36 (1976): 377-78.
- , ed. *Pedro de Osma y su comentario al símbolo "Quicumque"*. Madrid: Joyas Bibliográficas, 1977.
- Reinhardt, Klaus, Andrés Barcala Muñoz, and Horacio Santiago Otero. "Tres sermones de Pedro Martínez de Osma." *Celtiberia* 30 (1980): 67-87.
- Reinhardt, Klaus, and Horacio Santiago Otero, eds. *Pedro Martínez de Osma y el método teológico: edición de algunos escritos inéditos*. Madrid: CSIC, Centro de Estudios Históricos; Centro de Estudios Sorianos, 1987.
- Santiago-Otero, Horacio. *Manuscritos de autores medievales hispanos*. Vol. 1. Madrid: CSIC, Centro de Estudios Históricos, 1987.
- . "Savoir et méthode dans l'oeuvre théologique de Pedro Martínez de Osma (m. 1480)." *Fe y cultura en la Edad Media*. Madrid: CSIC, Centro de Estudios Históricos, 1988. 269-80.
- Schabel, Chris. "The Quarrel over Unleavened Bread in Western Theology, 1234-1439." Eds. Martin Hinterberger and Chris Schabel. *Greeks, Latins, and Intellectual History, 1204-1500*. Louvain: Peeters, 2011. 85-127.
- Smith, David Eugene, ed. *Le comput manuel de Magister Anianus*. Geneva, 1928; repr. Geneva: Slatkine, 1977.
- Solan, Olivier de. "Les propositions de réforme du calendrier au XVe siècle." *École Nationale des Chartes: Positions des thèses* (1998): 275-81.
- . "La réforme du calendrier dans une question quodlibétique d'Henri de Runen (1444)." *Bibliothèque de l'École des Chartes* 157 (1999): 171-220.
- Sphera mundi noviter recognita cum commentariis et authoribus in hoc volumine contentis*. Venice: Giunti, 1518.
- Spier, Arthur. *The Comprehensive Hebrew Calendar: Twentieth to Twenty-Second Century (5660-5860, 1900-2100)*. 3rd ed. Jerusalem: Feldheim, 1986.
- Steele, Robert, ed. *Opera hactenus inedita Rogeri Baconi*. Vol. 6, *Computus Fratris Rogeri*. Oxford: Clarendon Press, 1926.
- Stegmüller, Friedrich. "Pedro de Osma: Ein Beitrag zur spanischen Universitäts-, Konzils- und Ketzergeschichte." *Römische Quartalschrift für Christliche Altertumskunde und für Kirchengeschichte* 43 (1935): 205-66.

- Stern, Sacha. *Calendar and Community: A History of the Jewish Calendar, Second Century BCE–Tenth Century CE*. Oxford: Oxford University Press, 2001.
- Sudmann, Stefan. *Das Basler Konzil: Synodale Praxis zwischen Routine und Revolution*. Frankfurt: Lang, 2005.
- Turriano, Juanelo. Eds. José A. García-Diego and José María Gonzáles Aboin. *Breve discurso a su majestad el rey católico en torno en la reducción del año y reforma del calendario*. Madrid: Fundación Juanelo Turriano, 1990.
- Valle Rodríguez, Carlos del. *Corpus Hebraicum Nebrissense: la obra hebraica de Antonio de Nebrija*. Madrid: Aben Ezra Ediciones, 2000.
- Villota Elejalde, José Luis. “Dos manuscritos inéditos de Pedro de Osma.” *Salmanticensis* 8 (1961): 159-74.
- Werbeck, Wilfrid. *Jacobus Perez von Valencia: Untersuchungen zu seinem Psalmenkommentar*. Tübingen: Mohr, 1959.
- Werner, Thomas. *Den Irrtum liquidieren: Bücherverbrennungen im Mittelalter*. Göttingen: Vandenhoeck & Ruprecht, 2007.
- Wijk, Walter Émile van, ed. *Le Comput emendé de Reinherus de Paderborn (1171)*. Amsterdam: North-Holland, 1951.
- Zinner, Ernst. *Regiomontanus: His Life and Works*. Trans. Ezra Brown. Amsterdam: North-Holland, 1990.