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A Bibliophile Performing Eclipse Computations: Lewis Caerleon and His Notebook

Abstract: This article examines Lewis Caerleon's notebook, Cambridge, University Library, MS Ee.3.61, composed between 1481 and 1484 and mainly copied by him. This volume of 192 folios contains mathematical, astronomical and astrological works. Amongst them are the drafts and notes of the physician-astronomer himself. This material includes computations, tables and treatises revealing an astronomical programme in which eclipses played a central role. This article attempts to provide a detailed account of the production and purpose of the notebook, and endeavours to situate this volume within Lewis Caerleon's scientific production and extant manuscripts. New evidence about the life of Lewis Caerleon and his manuscripts are also provided. An analysis of newly discovered evidence retained in the notebook suggests that Lewis Caerleon's eclipse writings are mainly based on the works of two little-known fifteenth-century astronomers from Merton College, Oxford.

1 Introduction

Performance or the act of performing is commonly perceived more as a witnessed action, either commissioned or spontaneous, than an introspective operation. Reception by an audience thus seems a key aspect of the performance. For that reason, theatre, music or liturgy are particularly well studied under that lens. However, the 'textualisation' or *mise à l'écrit* of the performance or performative ritual is essential to explore, whether as a medium of the performance or as part of it. This is particularly true of medieval liturgy, medical and magical charms which need to be sang or pronounced to reveal their force or power. In the case of thaumaturgical or magical charms, the performance needs to be included in a broader set of written instructions preceding the oral ritual.[1] Those narratives are short enough to be performed and adapted, and may be either written in a more informal way, in the margins or blank spaces of books, or

1 See Laura Albiero and Karen Desmond's contributions in this volume and Jones and Olsan 2015.

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included in florilegia, compendia or collections. Once written those narratives become part of a textual tradition, losing somewhat their performative value, but they may be used again by other practitioners. As suggested by Peter Jones and Lea Olsan, performance 'moved back and forth from oral-aural culture to manuscript, and from manuscript to manuscript or new performance'.[2] Recently, some studies have broadened the link between performance and manuscripts or documents, making scribes, authors or readers 'performers' of a book, a page or a margin.[3] This broad conception leads to scrutinise again the relationship between performance and manuscript, or rather the intrinsic link between the performance of writing and the codex.

Indeed, another aspect implied by the 'textualisation of the performance' deserves to be considered here. If one takes performance in its broad meaning of execution, completion or achievement, this certainly encompasses more implications, beyond the strong oral aspect given to the notion. In that case, it is rather the performance of writing which should be considered. Different writings may therefore be lined up on a large spectrum from first notes to finished treatise. This also raises the question of whether an autograph manuscript or a notebook constitutes a performance. *Memoranda* or other notes written in a volume are rarely intended to be read by someone else than the author. However, they reveal a wealth of information regarding reading and writing practices. Manuscripts containing informal notes and writings may present different degrees of achievements. They may include informal notes, preparatory works, drafts or authorial copies.[4] Drafts or *memoranda* were often not intended to survive, their survival is thus haphazard resulting from the fact that they were written on a perennial support. If we consider preparatory works and drafts of a treatise, leaving aside informal notes such as pen-trials, they all represent a certain degree of achievement aiming to the completion of a treatise or another work.

Those early steps thus constitute invaluable testimonies of medieval scholars at work, but they also are very rare. This is particularly true of medieval astronomers' autograph manuscripts. Observation and computations records were a necessary preparatory work to be displayed in a treatise or used to compute an astronomical table. Quite often, only part of a computation or an observation was to be included in the final text. For instance, Jean des Murs (fl. 1319–1347) refers in his *Expositio intentionis regis Alfonsii* (1321) to his observation of

2 Jones and Olsan 2015, 431.

3 Maxwell, Simpson and Davis 2013.

4 Hamesse 1994; Bourgain 2013.

the meridian altitude of the Sun made on 13 March 1319 to demonstrate the validity of the Alfonsine tables.[5] The same scholar used a late thirteenth-century manuscript (O.II.10) to write different notes, *memoranda*, computations, observations and prepare treatises and tables. This is a unique witness allowing us to retrace a part of Jean des Murs's biography, his connections to other scholars, but also his astronomical practices and his preparatory work.[6] Computations and observations were means by which the practitioner could predict and analyse an astronomical phenomenon, but they were also made to validate some theories and postulates. Similarly, astronomical canons may also be understood as sets of instructions written to be memorised and to perform a computation.

MS Ee.3.61 is one of those rare witnesses revealing the tireless preparatory work of an astronomer.[7] This manuscript was assembled by the physician Lewis Caerleon (d. *c*. 1495) and partly copied by him. This volume of 192 folios of paper and parchment contains mathematical, astronomical and astrological works. Amongst them are the work of the physician himself, mainly devoted to eclipses. This material includes computations, tables and treatises and, compared with other extant manuscripts of his, we may clearly detect an astronomical agenda in which eclipses played a central role. MS Ee.3.61 seems to display his preliminary work on eclipses. Considering these different aspects, one may carefully differentiate various pathways of performance: the production per se of the manuscript (by copying or commissioning); eclipse computations and the elaboration of texts and tables. This article attempts to provide a detailed account of the production and purpose of MS Ee.3.61, and endeavours to situate this volume within Lewis Caerleon's scientific production and extant manuscripts.[8] The first two sections provide a brief historiographical and biographical survey on Lewis Caerleon, including a list of his manuscripts to which must be added a newly found volume. Autography and the production of the manuscript is explored in a third section, where the authorship of some works ascribed to Lewis Caerleon are revised. Finally, the last section considers Caerleon's work on eclipses and his astronomical agenda.

5 Cf. Poulle 1980, 265–266; Nothaft 2015, 87; more generally on the text see also Husson 2011.

6 See Beaujouan 1964; Beaujouan 1975; Gushee 1969; Gushee 1998; Husson 2016; Nothaft 2019; Miolo 2019; Miolo 2021.

7 A description of the manuscript is provided in Appendix 1. See also Juste 2023a; Miolo 2022, 371–374.

8 A later article will provide a complete analysis of Caerleon's manuscripts and will include a list of his works.

2 From Cambridge to the court

Some decades after his death, Lewis Caerleon is depicted by the historian Polydore Vergil as the Welsh personal physician and counsellor of Margaret Beaufort, and *medicus* ('physician') of the queen, Elizabeth Woodville. In this capacity, the 'man of substance' acted as a 'go-between and member of that new conspiracy against Richard III' playing a central role in the marriage between Elizabeth of York and the future king, Henry VII.[9] One also learns from the Tudor historian that he recommended Christopher Urswick, Margaret Beaufort's chaplain and confessor.[10] Caerleon and Urswick were educated at the University of Cambridge and both were probably present in Cambridge in the first years of the 1480s.[11]

The picture of Lewis Caerleon in Polydore's narrative certainly covers some important aspects of his biography regarding his career of physician and courtier, going back and forth between the university and the court. Even in his scientific writing, his involvement in royal politics was never far away. His impris-

9 'Margareta invaletudinis causa utebatur medico nomine Ludovico natione Wallo, et quia vir gravis erat ac non minimi usus, saepe cum eo solebat libere loqui et familiariter suspirare. [...] Nam regina eius quoque opera utebatur, quod esset medicus artis peritissimus. [...] Ludovicus actutum officio functus inter mulieres facile negotium confecit, qui ex eo quod medicus erat sine suspitione aliqua internuntius ac socius est illis novae conspirationis in Ricardum adiunctus' ('Because of her ill health Margaret employed a Welsh physician named Lewis. Since he was a man of substance [and not the least], she was often accustomed to speak freely with him and sigh in his presence. [...] For the queen also employed him, because he was a physician most skilled at the art. [...] Lewis immediately performed this service and easily settled the business between these women, since, being a physician, he could act as a go-between and member of that new conspiracy against Richard without arousing any suspicion'). Vergil, *Anglica Historia*, ed. and tr. Sutton 2010, Book 25, 11.

10 'Margarita vero interim Christopherum Ursuychum sacerdotem probatum, spectatum, ac officii plenum in familiam recepit, datoque ab eo iureiurando, consilia omnia illi aperit, idque tuto se facere confidit quod Christopherus Henrici Sexti regis semper studiosus a Ludovico medico apud ipsam in gratia positus esset' ('And meanwhile Margaret took into her household Christopher Urswick, a well-tried, upright, and most dutiful priest, and, having obtained his oath, she revealed all her counsels to him. She was sure she could do so safely because Christopher had always been a follower of Henry VI, and had come to her recommended by Lewis the physician'). Vergil, *Anglica Historia*, ed. and tr. Sutton 2010, Book 25, 11.

11 On Lewis Caerleon in Cambridge see *infra*. He was studying there in 1465–1466. The astronomical tables he elaborated in 1482 and 1483 being based on the Cambridge latitude, there is some chance that he was there at some point in the early 1480s, before his imprisonment in the Tower of London. Christopher Urswick, fellow of King's Hall, was in Cambridge between 1470 and 1488, cf. Trapp 2010.

onment in the Tower of London in 1484 and his despoliation by Richard III are both used as a *topos* in Lewis Caerleon's writings. At the end of the first table of his set of lunar eclipse tables dated to 1482, he wrote:

> Note that after the composition of these tables that I lost through the despoliation of King Richard I, being incarcerated in the Tower of London, composed other eclipse tables that differed from these to a few seconds. The cause of this discrepancy is that the true and apparent lunar latitude differ from sometimes one second and sometimes as much as thirty thirds.[12]

Similarly, at the end of his eclipse canons composed in 1482–1483, he refers to his incarceration decided by Richard III: 'Seek at the end of the next quire the other canons that I composed before being incarcerated by King Richard'.[13]

Although Polydore's account focuses on Lewis's life as a courtier and his involvement in the Lancastrian cause, his scientific output was recorded by antiquarians, such as John Leland (d. 1552) who devoted to him an entry in his *Commentarii de scriptoribus Britannicis*.[14] In this description, though mentioning him as 'Joannes Cairleon', Leland lauds Lewis Caerleon's talent as physician and his keen interest in medicine, philosophy and the *mathesis*, which should be understood, in the light of Lewis's writings, as the science of the stars (astronomy and astrology). The only work of his mentioned by Leland are some

12 MS B. 19, fol. 1^{r}; Royal MS 12 G I, fol 1^{r}; Add MS 89442, p. 69: 'Nota quod post compositionem istarum tabularum quas amiseram per exspolationem Regis Ricardi, ego existens incarceratus in turre Londonarum, composui alias tabulas eclipsium que discordant ab istis in paucis secundis, cuius causa est quia latitudo lune vera et visa differt ab ista aliquando per unum secundum et aliquando per 30 tertia tantum'. Unless otherwise indicated all translations are mine.

13 MS B. 19, fol. 6^{r}; Royal MS 12 G I, fol. 6^{r}: 'Require alios canones in fine proximi quaterni quos primo composui priusquam fueram incarceratus per Regem Ricardum'.

14 'Joannes, cui ab urbe Legionum, in ripis Iscae fluminis condita, nomen Cairleon vulgo inditum, Grantae Girviorum academiae celeberrimae, ut ego colligo, operam impense magnam studiis politioribus dedit, at philosophia, medicina et mathesis primas tenebant partes. Tandem ab excellentia, qua in re praenituit herbaria, archiatri titulo, publicis suffragiis donatus est. Extant Grantae in Clarana biblioteca *Tabulae de rebus astronomicis,* ab eo scriptae quidem Londini, et editae anno Christo nato 1482' ('John, from the city of the Legions, founded on the banks of the river Isca, commonly named Cairleon, of the very famous academy Granta Girviorum [Cambridge], from what I gather, he paid great attention to the most refined studies, but philosophy, medicine and astrology held the upper hand. Finally, with the excellence with which he excelled in herbal medicine, he was awarded the title of chief physician by public favour. The *Tabulae de rebus astronomicis* [Astronomical tables] copied by him in London and edited in the year of the birth of Christ 1482 are extant in Cambridge in the library of Clare College'). Leland, *Commentarii*, ed. Goodlad and Hall 1709, 471.

astronomical tables based on the London meridian and dated to 1482, preserved in Clare College at that time. These tables were indeed witnessed by Leland himself during his visitation of 1535.[15] A more important list of Lewis's work was offered by John Bale in his *Index Britanniae* (1548–1552), for whom Lewis Caerleon and Lewis Charlton were one and the same person. Despite the confusion with Lewis Charlton, Bale describes a part of the contents of the manuscript seen by Leland in 1535 at Clare College, it contained the following items:[16]

1. 'De eclipsi solari ac lunari' ('On solar and lunar eclipse'); incipit: 'Modus operandi pro eclipsi lune'.
2. 'Tabulas eclipsium' ('Eclipse tables'); incipit: 'Altitudo lune in arcu longitudo'.
3. 'Canones eclipsium' ('Eclipse canons'); incipit: 'Eclipsim solis quantitatem et dur [*sic*] [durationem]'.
4. 'De tabulis umbrarum' ('Shadow tables'); incipit: 'Circa compositionem tabularum umbrarum'.
5. 'Atque alia plura composuit' ('and he composed many others').

The manuscript partially described by both scholars may indeed correspond to a volume that survives today, and which will be discussed below. In addition to the book once at Clare College, Bale describes an eclipse computation dated to the year 1480, held in the private collection of another Welsh mathematician, Robert Recorde (d. 1558).[17] This computation was certainly in the form of a fragment: *quedam fragmenta astronomica*. Those different descriptions demonstrate that the name of Lewis Caerleon was not unknown in the sixteenth century, at least for historians and collectors, though Leland and Bale relied on the very slight evidence provided by Clare College and Robert Recorde's collection. Despite the little diffusion of Lewis's work, a sixteenth-century collector copied, around 1595, a part of the physician's scientific production. This late copy is

15 'In biblioteca collegii de Clare: 6. Tabulae Ludovici de Cairlion doctoris medicinae de eisdem rebus Londini scriptae 1482' ('In the library of Clare College: 6. Tables of Lewis of Caerleon, doctor in medicine, on the same matters written in London in 1482'). Clarke 2002, 152.

16 The quotations in following list are taken from Bale, *Index Britanniae*, ed. Poole and Bateson 1902, 284.

17 'Ludovicus Kaerlion, doctor in medicinis, reliquit quedam fragmenta astronomica, *De eclipsium calculatione*, claruit a. d. 1480. Ex museo magistri Recorde' ('Lewis Caerleon, doctor in medicine, left some astronomical fragments, *On eclipse computation*, released in the year 1480. From the collection of Master Recorde'). Bale, *Index Britanniae*, ed. Poole and Bateson 1902, 284. On Robert Recorde, see Roberts 2016.

now part of a manuscript belonging to an astrologer active in London between 1594 and 1608,[18] Sloane MS 1697 (fols 25^{r}–32^{r}).[19]

Although these different accounts provide hints regarding Lewis's life, the most reliable piece of evidence about his career and scientific production remain the extant manuscripts he owned or commissioned. In 1952, Pearl Kibre was the first modern historian to produce a whole article devoted to the physician.[20] This seminal work differentiates once and for all the theologian, Lewis Charleton (d. 1369) from the physician and astronomer, Lewis Caerleon (d. after May 1495). In her article, Kibre carefully retraced Lewis's career, and provided an invaluable list of Lewis's manuscripts and works. Though this list may now be updated,[21] Kibre's study remains a central work. The activity of Lewis as a commentator and a collector or 'antiquarian' was explored by John North and Hilary Carey.[22] The keen interest of the physician in Richard of Wallingford's work was discussed by North in an appendix of his monumental edition of the abbot of St Albans's writings.[23] Similarly, North, and then Carey provided a lengthy analysis of the treatise related to the nativity of Henry VI, *Cum rerum motu*, a copy of which is preserved in Lewis's notebook, MS Ee.3.61.[24] Additionally, the activity of the physician as a courtier astrologer was recently investigated by Carey through a manuscript compiled for Henry VII, Arundel MS 66.[25]

Much of the evidence related to Lewis's career is scattered, but his life may be traced back to his years at the University of Cambridge and at the court. The earliest testimony about Lewis is held in the Cambridge University Archives. He was admitted bachelor of medicine during the year 1465–1466 and received a

18 About the provenance: David Juste's private communication.

19 Sloane MS 1697, fols 25–32 is a copy of one of the two 'twin' manuscripts: MS B. 19 and Royal MS 12 G I. This late sixteenth-century copy was done by someone versed in astronomy, as it displays a solar eclipse computation on fol. 32^{v}: 'Exemplum/ Sit eclipsis solis cuius medium fuit 1595 [superscript] anno, septembris [superscript] mense, 23 [superscript] die, 1 signum, 13 [gradus], 30 minuta'.

20 Kibre 1952. The short entry dedicated to Lewis Caerleon in Emden 1963 is based on Kibre's article. A brief bio-bibliographical entry about Lewis may be found in Sharpe 1997. More recently Keith Snedegar provided an entire biographical account on the physician (Snedegar 2004).

21 I am preparing an updated list of his works and manuscripts which will be the focus of another article.

22 Carey is describing an 'antiquarian movement among physician-astrologers' when discussing the activities of John Argentine and Lewis Caerleon (Carey 1992, 23).

23 North 1976, vol. 3, 218–220.

24 North 1986, 142–149; Carey 1992, 138–153.

25 Carey 2012.

fine of 20 shillings in 1466 for he did not lecture in medicine.[26] These brief details are all we know of his student years in Cambridge, at a time when the Faculty of Medicine admitted few scholars.[27] Despite the lack of evidence concerning his early career, by 1481 he had become a doctor of medicine as he mentions it himself in some places in his notebook.[28] Similarly, extant sources do not help to identify the university where he obtained his doctorate in medicine.[29] It is highly probable that he moved to the University of Oxford as, before 1481,[30] he corrected some astronomical tables based on the Oxford meridian and donated tables to that university in parallel with a similar donation he made to the University of Cambridge.[31] Whether they are the same or additional donations, two benefactions are also recorded at Cambridge and Oxford. One, as aforementioned, was made to Clare Hall (today Clare College), probably corresponding to Add MS 89442, and the other in 1490 to Merton College.[32] A manuscript described by John Leland in Clare College exactly corresponds to MS. Digby 178, fols 15^{r}–87^{v}, which belonged to Lewis Caerleon and might also have been given by him to the College in addition to Add MS 89442.[33] Clare Hall may well have been Lewis's own college in Cambridge, since the statutes clearly mentions the

26 Reg. I.2.32: 'Item Lodowicus Carlyon quia non legit in medicinis xx [sol']' ('Also, Lewis Caerleon, because he did not lecture in medicine, 20 shillings').

27 On the situation of the Faculty of Medicine in Cambridge in the fifteenth century, see Leader 1988, 202–210. Lewis is also mentioned in Leader 1988, 153–154.

28 For example, MS Ee.3.61, fol. 14^{v}: 'Lewys Caerlyon in medicinis doctoris'; MS Ee.3.61, fol. 107^{r}: 'per calculationem Lodowyci Caerlyon in medicinis doctoris'.

29 Carey suggested Padua as was the case for John Argentine (d. 1507/1508), however there is no clear evidence pointing to this direction, except a late seventeenth-century statement published in *The Cambrian Register* of 1795 (Carey 2012, 695).

30 See Section 4 below.

31 MS Ee.3.61, fol. 147^{v}: 'quia non calculavi istas tabulas ita precise sicut tabulas eclipsium quas dedi universitatibus Cantebrigie et Oxonie'.

32 '26° die mensis Octobris incathenatus erat liber in libraria continens tabulas astrologicas, secundo folio *vere puncta*, quem collegio donavit magister Lodowycus Caerlyon, doctor in medicinis et doctus astronomus, ad usum et profectum studentium in eadem. Habemus igitur magnas gracias sibi' ('On the 26 October, a book containing astronomical tables was chained in the library – first words of the second folio *vere puncta* – that Master Lewis Caerleon, doctor of medicine and learned astronomer, offered to the college, for the use and benefit of the students in the library. Therefore, we are really grateful to him'). Salter 1923, 139.

33 Clarke 2002, 153, items 14–15, which correspond to the contents of MS. Digby 178, fols 15^{r}–87^{v}, belonging to Lewis Caerleon. The items listed in the inventory describe Richard of Wallingford's *Quadripartitum* and Simon Bredon's commentary on the *Almagest* and quote verbatim the running title and incipit of the manuscript.

study of medicine.[34] Unlike some of his contemporaries who left Cambridge to pursue their medical education on the continent, as was the case of Thomas Denman (d. 1501), and of John Argentine (d. 1508) who went to Italy, everything suggests that Lewis Caerleon remained in England.[35] Interchange of students between Cambridge and Oxford was not rare, given that Oxford had a better endowed Faculty of Medicine at that time.[36] The donation to Merton College also reinforces this assumption.[37]

At that time, a whole generation of physicians from Cambridge enjoyed royal patronage and served as royal doctors. For instance, Thomas Denman was protected by Margaret Beaufort and John Argentine served Richard III and then Henry VII until 1501.[38] Both physicians were probably not unknown to Lewis Caerleon who was part of the same university and court milieux. At an unknown date, Lewis began to serve as physician to Lady Margaret Beaufort and her entourage. In the troubled context of the end of the Wars of the Roses, the Welsh physician clearly supported the Lancastrian faction and in return received patronage from them. His role of personal adviser and secret intermediary between Margaret Beaufort and Elizabeth Woodville in the conspiracy against Richard III is likely to have led to his imprisonment in the Tower of London in 1484.[39] Interestingly, according to the various mentions found in his writings, Lewis's time in the Tower of London was quite a productive one for his astronomical career. While deprived of his astronomical tables and probably of all his books, he elaborated new astronomical tables, such as eclipse tables and also observed the famous total solar eclipse of 16 March 1485 that he had previously calculated.[40] Lewis was released the same year after Richard III's defeat and death. He

34 Leader 1988, 205. The founder of the College of Physicians in 1518, Robert Yaxley, was a fellow of Clare Hall between 1489 and 1498.

35 John Argentine went to Ferrara or Padua between 1473 and 1476 to be trained in medicine (Rhodes 1967; Jones 1994; Jones 2004). As mentioned by Peter Jones, patients and friars from Ferrara are listed in Argentine's commonplace book (MS. Ashmole 1437). Thomas Denman graduated in medicine before 1473 on the continent before returning to Cambridge and obtaining his doctorate in medicine in 1486, see Rawcliffe 2004. Both physicians had an interest in astronomy.

36 For example, John Somerset was closely connected to both universities (Rawcliffe 2004).

37 On many grounds, the association of Lewis with Merton College may indicate that he spent sometimes there after he may have left Cambridge in 1466. See below for other evidence of such association.

38 Leader 1988, 205–210; Jones and Underwood 1992, 168, 172.

39 Kibre 1952, 102–103.

40 His computation of the total solar eclipse of 16 March 1485 and the record of his observation may be found in MS B. 19, fol. 6^{v}; and Royal MS 12 G I, fol. 6^{v}; the computation only is also in

was rewarded by Henry VII with several grants.[41] Finally, he continued to serve as royal physician to the queen, Elizabeth of York, likely until his death. The last piece of evidence about Lewis is an autograph note written to *Maister Stoks* on the 6 May 1495.[42]

> Master Stokes, I pray you my friend and attorney to receive from me the payment of the receipt, which is now after Easter, of 20 marks for a whole year, and I shall thank you for your work. Made on the 6th day of May, the tenth year of the reign of King Henry VII. / Lewys Caerlyon, one of the king's physicians.[43]

3 Lewis Caerleon's manuscripts

3.1 Collecting and commissioning

Today, eight manuscripts can be associated with Lewis Caerleon. Three of them only contain his own writings. They were commissioned and supervised by him. They doubtless were presentation copies of his work to institutions or individuals.

1. *London, British Library, Add MS 89442*. A large volume of one hundred and twenty-eight pages including most of Lewis Caerleon's scientific production.
2. *London, British Library, Royal MS 12 G I*. A sixteen-folio manuscript devoted to eclipse-related material composed by Lewis.
3. *Cambridge, St John's College, MS B. 19*. A sixteen-folio volume similar to Royal MS 12 G I.

MS B. 19 and Royal MS 12 G I are 'twin manuscripts' displaying canons and tables related to eclipses including a detailed computation of the solar eclipse of

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Add MS 89442, p. 71. A transcription and study of this eclipse computation with others he made will be included in a later paper.

41 On the different grants Lewis received from Henry VII between 1486 and 1494, see Kibre 1952, 102–103.

42 This short note written on a slip of paper is now held at the Sutro Library (M000054, no. 4). Alfred B. Emden mentioned the letter from an information provided by Neil Ker (Emden 1963, 117). Also mentioned in Snedegar 2004.

43 M000054, no. 4, fol. 5^{r}: 'Maister Stoks [*sic*], I prey you to be my frende and attorney to receyve my ffee of the receytte, the whiche is now behinde at Estir day.xx. marke for a hool yer and I shall plese ~~your labor~~ [*sic*] yow for your labour. Written the VI^{te} day of May the yer of the reyne of kyng Henry the VII^{te} the Xth yer [10th year of Henry's reign]. Lewys Caerlyon one of the kyng ffisiciens'. I am grateful to Diana Kohnke, librarian at the Sutro Library, for her kind help with finding this note and for providing photographs of the manuscript.

16 March 1485.[44] The copying of Add MS 89442, Royal MS 12 G I and MS B. 19 manuscripts was likely finished after 1485, since they all contain material composed that same year.

Four other codices were part of his personal library and include passages from his main sources: Richard of Wallingford, Simon Bredon and John Killingworth. They are contemporary copies, certainly commissioned by the royal physician, who regularly commissioned work from these two scribes. All those volumes contain additions or comments written by Lewis Caerleon.[45]

1. *Oxford, Bodleian Library, MS. Digby 178, fols 15^{r}–87^{v}:* includes Richard of Wallingford's *Quadripartitum* (fols 15^{r}–38^{r}), with *marginalia* throughout and a lengthy comment by Lewis (fol. 38$^{r–v}$); Simon Bredon, *Commentum super Almagesti*, fols 39^{r}–86^{v}. Lewis's note and diagram on the distance between the Earth and the Moon (fol. 87$^{r–v}$).[46] This manuscript was certainly donated by Lewis Caerleon to Clare College at some point.
2. *Oxford, Bodleian Library, MS. Savile 38:* contains astronomical tables and their canons by John Killingworth (d. 1445). Their main purpose was the production of ephemerides, largely used by astrologers and physicians. Lewis corrected the *radices* of Saturn and Jupiter and appended to the canons of John Killingworth a chapter to explain this correction.[47] This added section begins: 'For I, Lewis, found that the table of corrections of the radices made by John Kyllingworth was corrupted by the scribes. Therefore, I worked to find a correct value of these corrections and I composed a new table for my new *radices*'.[48]
3. *Oxford, Corpus Christi College, MS 234:* a unique version of Euclid's *Elements* (fols 10–170) with the enunciations found in Campanus of Novara's version but with proofs originating from diverse translations and adaptations. It al-

44 Sloane MS 1697 is a sixteenth-century copy of one of the twin manuscripts.

45 A detailed palaeographic study and the analysis of the different manuscripts will be provided in a later article.

46 Watson 1976; Juste 2022. This manuscript was owned by John Dee (d. 1609) and then Thomas Allen (d. 1632).

47 MS. Savile 38, fol. 4^{r}: 'Expliciunt canones tabularum J[ohannis] Kylyngworth ab ipsomet editi preter unum capitulum de correctione radicum Saturni et Jovis quod ego Lodowicus Caerlion superaddidi cum istis tribus tabulis de divisione motus augis' ('End of the canons on the tables of John Killingworth edited by himself, except one chapter on the correction of the radix of Saturn and Jupiter, that, I, Lewis Caerleon added with three tables on the division of the motion of the apogee'). The chapter added by Lewis may be found on fols 3^{v}–4^{r}.

48 MS. Savile 38, fol. 3^{v}: 'Quia ego Lodowycus, inveni tabulam correctionis radicum positam a magistro Johanne Kylyngworth vicio scriptorum corruptam. Ideo laboravi ad inveniendum rationum compositionis eiusdem et tabulam novam composui pro radicibus meis novis'.

so contains Archimedes, *De quadratura circuli* (fols 170^{r}–172^{v}). The volume opens with a long commentary by Lewis (fols 1^{r}–9^{v}). Euclid and Archimedes' texts are also glossed by Lewis.[49]

4. *London, British Library, Royal MS 12 G X:* must now be added to the list of Lewis Caerleon's manuscripts. This manuscript of thirty-two folios of parchment was produced by one of the scribes regularly employed by the royal physician. It contains the canons and tables of John Killingworth.[50] As in MS. Savile 38, there are canons beginning, 'Restat de compositione tabularum revolutionum planetarum', that are said to have been composed by John, and the canons beginning 'Multum conferre dinoscitur non solum astronomis', which are John's canons edited by Master Pray.[51] In Royal MS 12 G X, this material is preceded by three short anonymous canons (fol. 1^{r}), beginning: 'Incipit tractatus docens continuare radices tabularum Kylyngworth tam in tempore quam in motu pro tempore quocumque preterito seu futuro'.[52] Lewis Caerleon intervenes in the upper margin on fol. 1^{r}, where he wrote: 'Those canons are not sufficient, like those following in the other folio'.[53] He is also responsible for a short note written at the bottom of the table of correction of the planets in apogee, addressing the use of the table of correction for Jupiter and Saturn.[54] This note may be linked to his particular

49 This manuscript is described in Thomson 2011, 119. On the different versions of the proofs in this manuscript, see Folkerts 1989. This manuscript also belonged later to John Dee.

50 On John Killingworth's tables, see North 1977, 343–346.

51 MS. Savile 38 and Royal MS 12 G X are the only two witnesses containing the canons 'Restat de compositione tabularum'. The incipits of both manuscripts suggest that John Killingworth's original canons 'Restat de compositione tabularum' were edited by Pray whose canons are the most diffused: 'Multum conferre dinoscitur non solum astronomis'. For John Killingworth's canons 'Restat de compositione tabularum revolutionum planetarum', see MS. Savile 38, fols 2^{v}–3^{v} (they are directly followed by Lewis's addition 'Quia ego Lewis') and Royal MS 12 G X, fols 2^{r}–2^{v}. The canons revised by *Magister Pray,* 'Multum conferre dinoscitur non solum astronomis' may be found in MS. Savile 38, fols 4^{v}–5^{v}, and Royal MS 12 G X, fols 1^{r}–1^{v}. According to North, *Magister Pray* might have been Thomas Pray, fellow of University College, Oxford, who 'might have collaborated' with John Killingworth: North 2004.

52 This same canon entitled 'Incipit tractatus continuandi radices videlicet tam tempora vere radicis omnium planetarum quam motus pro tempore vere radicis ad proximam meridiem et tempus motus et argumenta lune divisus in certa capitula' is copied in a late fifteenth-century manuscript probably produced in Oxford (MS. Bodl. 432, fols 60^{v}–61^{v}).

53 Royal MS 12 G X, fol. 1^{r}: 'Isti canones non sunt sufficientes, etiam sed secuntur in alio folio'.

54 Royal MS 12 G X, fol. 3^{r}: 'Nota habemus opus hiis 2bus tabulis Saturni et Jovis pro reductione motuum ad meridiem'.

interest in those tables that he corrected.[55] That Lewis supervised the copy, particularly of the tables, is also legible in the autograph additions of 'religitur' written in the margins of fols 5^{v}–32^{r}. The formats of Royal MS 12 G X and the 'twin manuscripts' are very similar and may suggest that they were produced contemporarily, so after 1485.[56] Furthermore, Royal MS 12 G X and Royal MS 12 G I, containing Lewis's eclipse writings, have both a similar provenance: a certain Doctor Laidon or Laidun, priest of St Faith in the church of St Paul in London, who might be Richard Laiton or Layton (d. 1544), who had several benefices, including the rectorship of St Faith in London (from 1535), and who acted as a clerk of the Chancery and one of Henry VIII's commissioners and visitors to the universities of Oxford and Cambridge. Both manuscripts were purchased from Laidon by Nicolas Frazer on the same day, 15 June 1535.[57] The sixteenth-century shelfmarks 44 and 45 are also visible in the two manuscripts.[58]

3.2 The notebook's history

MS Ee.3.61 is one of the earliest manuscripts owned by Lewis Caerleon. He was responsible for its assembly and copied a great part of the volume. The volume was certainly assembled between 1481 and 1484, before his incarceration in the

55 Lewis's tables 'Hic incipiunt nove radices per me Lodowycum calculate' ('Here begin the new *radices* computed by me, Lewis') provides the radices for the *anni communi* between 1501 and 1612, which is a continuation of John Killingworth's work who gives the *anni communi* between 1442 and 1500, see respectively MS. Savile 38, fols 6^{r} and 8^{r}.

56 It is noteworthy to note that Henry VII's astronomical and astrological volume, Arundel MS 66 containing *inter alia* John Killingworth's canons revised by Master Pray and his tables was copied in 1490. A part of the manuscript was composed by John Willis or Wellys, who may perhaps be identified with the doctor of medicine from Cambridge, mentioned in the Cambridge Grace Book between 1456 and 1480, and a contemporary of Lewis. On Arundel MS 66, see Carey 2012; Fronska 2014.

57 Royal MS 12 G I, fol. 15^{v}: 'Ego Nicolaus Frazerus emi hunc librum ab doctore Laidun pastori Sancte Fide in divino [*sic*] Pauli ecclesia Londinensis anno 1535 die 25 Iunii'; Royal MS 12 G X, fol. 32^{v}: 'Ego Nicolaus Frazerus emi hunc librum a doctore Laidon pastori Sancte fide in divo [*sic*] Pauli ecclesia Londinensis anno 1535 die 25 Iunii' ('I, Nicholas Frazer, purchased this book from Doctor Laidon, priest of St Faith, in the vicinity of the church of St Paul of London, on 25 June 1535'). On Richard Layton, see Emden 1974, 346.

58 Both are written by the same hand: no. 44 corresponds to Royal MS 12 G X, fol. 2^{r}, and no. 45 to Royal MS 12 G I, fol. 1^{r}. Note that a similar shelfmark in the same handwriting, numbered 147, may also be found in MS. Digby 178, fol. 15^{r}, who might have belonged to Layton or Frazer before John Dee acquired it in 1559.

Tower of London. It displays indeed several dated works which allow us to determine when the codex was assembled in its final form: Lewis's computation of the solar eclipse of 28 May 1481 (fols 12^{v}–15^{r}); the horoscope of the solar eclipse of 17 May 1482 (fol. 1^{r}), the calculations related to the solar motion and the tropical year for the year 1482 (fol. 189^{v}),[59] and a short note on the 1484 conjunction of Saturn and Jupiter (fol. 188^{v}).[60]

Several additions demonstrate that the manuscript continued to be used by other practitioners. They are the work of later owners who were versed in the *scientia stellarum*. A slightly later scribe added a note on the *rectangulus*, *triangulus* and other astronomical instruments such as the gnomon and the quadrant (fols 45^{v}–46^{r}), while another sixteenth-century annotator also added sections excerpted from the *Almagesti minor* and the Menelaus Theorem.[61] Most of those additions complement the contents of the manuscript. Therefore, slightly later, a different sixteenth-century annotator copied a solar equation table (fol. 70^{r-v}) within John Holbroke's tables on a ruled folio left blank and drew diagrams of the instrument called *navicula* (fols 191^{v}–192^{r}). A signature on the verso of the second flyleaf of the manuscript, reading 'William Carye his book', shows that the volume was acquired by this clothworker in St Mary Magdalen parish in London, who was also a collector of medieval manuscripts, especially monastic manuscripts, and died in 1578.[62] Where or from whom William purchased Lewis Caerleon's notebook is unknown. That the manuscript was later used by a physician or a consultant astrologer is suggested by several mentions of 'Richard Jones' in the manuscript, including one inscription bearing the date 1659. Five horoscopes situated on blank leaves at the end of the volume, dated 1658–1659, demonstrate that Richard Jones was a physician practising astrological medicine.[63] Those horoscopes were designed for a certain 'Mrs Moores about her husband and his being'. It seems that those *figure celi* were drawn for interrogations, though the question is not explicitly formulated. The latitude of 52° for which the horoscopes were calculated may indicate that the astrological consul-

59 Those calculations also mentioned the year 1377 in relation to the motion of the apogee: 'Nota quod cum fuerit aux Solis in primo minuto Cancri sicut fuit anno Chirsti 1377 imperfecto', fol. 189^{v}.

60 MS Ee.3.61, fol. 188^{v}: 'Tempus vere coniunctionis ♄ [Saturn] and ♃ [Jupiter] quarto vicinius preter sciri per tabulas anno Domini currente 1484 post meridiem 25 diei novembri'. The different values were calculated by Lewis with the Alfonsine tables.

61 Zepeda 2018, 78–79.

62 Watson 1965. William Carye's mention is on fol. I^{r}.

63 The horoscopes are situated on fols 183^{r}–184^{r}. Richard Jones's inscription are on fols 47^{v}, 140^{r} and 182^{v}.

tation took place in East Anglia, not far from Cambridge, perhaps at Ipswich.[64] The later provenance of the manuscript is easily traceable since it was acquired by John Moore (d. 1714), while bishop of Norwich, sometime between 1691 and 1707. His significant library then passed to George I, who offered it to the library of the University of Cambridge in 1715.[65]

4 The notebook's composition

4.1 At the origin of the manuscript assembly

Although Lewis Caerleon is the scribe of most of the manuscript, he acquired or commissioned the quires containing the treatise beginning *Cum rerum motu*, devoted to the nativity of Henry VI and the different judgements made for the same king.[66] Some of his annotations may be read in the margins of this horoscopic tract, though there are not many and they are short.[67] *Cum rerum motu* was certainly provided with blank spaces or at least with unfilled horoscope charts, since Lewis completed the different values and titles of the four charts.[68] Interestingly, the chart on fol. 164^{r}, less regular than the three others, was probably quickly traced and filled by him. Facing this chart of profection (*ffigura profectionis 20ma*) are different values written by Lewis for establishing the *directiones* of the different planets, including the Sun and the Moon. The *directio* consists in the projection in time of the location of the planets as they were in the sky at birthtime – here the birth of Henry VI.[69] This *figura celi* is one of the intermediary steps before establishing the final horoscope and the judgement.[70] Contrary to the others, this chart was traced and completed by Lewis Caerleon.

64 According to John North, the astrologer used Regiomontanus's tables, cf. North 1986, 149.

65 McKitterick 1986, 47–152; Ringrose 1998.

66 MS Ee.3.61, fols 159^{r}–175^{v}. On *Cum rerum motu*, see North 1986, 142–149; Carey 1992, 138–153; and Juste 2021a, 574–575. According to Carey, this treatise might be attributed to the physician and Master of Peterhouse Roger Marchall (d. 1477). On Roger Marchall, see Voigts 1995.

67 Contrary to what is asserted in North 1986, 147, Lewis is not responsible of the seven-line note in margin about the latitude of London and Windsor (fol. 160^{r}). It was written by a late sixteenth-century handwriting.

68 MS Ee.3.61, fol. 164^{r} provides the *directiones* of the Sun, the Moon, the ascendant and the midheaven including their *partes*.

69 Al-Qabīṣī, *Introduction to Astrology*, ed. Burnett and Yamamoto 2004, 319–338.

70 Cf. North 1986, 148.

MS Ee.3.61 is one of the two witnesses containing this treatise,[71] and it seems that the royal physician was particularly interested in this episode, involving at least two Cambridge masters, John Holbroke (d. 1437) and John Somerset (d. 1454). However, we may wonder if in the troubled context of the Wars of the Roses, Lewis was not more interested in this treatise for an interpretation *post eventum*.[72]

Although Lewis probably did not himself copy all the astronomical tables displayed in MS Ee.3.61 he clearly supervised their copies. In the lower margin of the tables present in the volume one finds the inscriptions: *relegitur*, *corrigitur secundum copiam*; *correcta*; *relegitur totam*. On fol. 63^{r}, at the end of John Holbroke's *Opus primum*, Lewis wrote in the lower margin: 'totum opus predictus relegitur secundum copiam'. Like the *Opus primum*, the *Opus secundum* presents numerous *relegitur* or *corrigitur* mentions on each folio. Those notes clearly indicate that Lewis had the copies of the *Opus primum* and the *Opus secundum* in front of him to verify the tables and canons, the latter being copied by him along with the headings of the tables.[73] It is likely that he had access to John Holbroke's own copy, partly copied in his hand and presented to Peterhouse in 1426, which is now Egerton MS 889.[74] The manuscript remained in this college until the late sixteenth century, and we may thus assume that Lewis consulted it in Peterhouse. Another mention demonstrates that Lewis continued to adapt and edit some tables. In the lower margin of fol. 146^{r} displaying an example (*exemplum*) for the composition of eclipse tables applying the method described in the canons written on fol. 142$^{r–v}$, Lewis wrote: 'Istud exemplum corrumpitur per scriptores, ego multa correxi, sed tamen, cave bene'.[75] The tables indeed show a few numerical values written in the margin by Lewis. It is not explicitly stated here whether the tables on fol. 146^{r} were copied by Lewis's

71 The other witness is a mid-fifteenth-century manuscript who was probably produced in Oxford, now Garett MS 95, it is incomplete, retaining the Preface and Chapter 1 only. The treatise is situated between fols 127^{v} and 130^{v}. On this manuscript see Skemer 2013, 203–211; Juste 2021b. Some text such as Simon Bredon's commentary on Boethius's *De arithmetica* are also contained in this manuscript which could have been known by Lewis Caerleon.

72 On English court astrology and the analysis *post eventum*, see Boudet 2008.

73 On the *Opus primum* and *Opus secundum* composed at two different times, respectively 1430 and 1433, see Nothaft 2018.

74 This manuscript displays a table of contents written by the physician Roger Marchall, who was also a fellow of Peterhouse under the mastership of John Holbroke. On Egerton MS 889, see Voigts 1995, 278–279; Clarke 2002, 499, 557–558; Thomson 2016, 201–202; Nothaft 2018; Juste 2023b.

75 MS Ee.3.61, fol. 146^{r}: 'Exemplum de compositione tabularum eclipsium secundum canones anteposites folio 4° precedente istius quaterni'.

scribes or whether he was referring to the exemplar from which this *exemplum* was written. It would appear likely that those errors came indeed from the *exemplar* from which Lewis copied those tables. That is why he edited them.

Several physical aspects demonstrate the informal nature of this volume, which was, certainly, from the beginning, intended to be a notebook. The manuscript consists of fifty-one quires, alternating between parchment bifolia and paper binions, some parchment leaves are sometimes interleaved between a group of bifolia and binions. Parchment bifolia are of poor quality, some leaves contained holes due to the parchment preparation.[76] Paper leaves that included tables were ruled with a lead point in a small and regular grid pattern. Some quires or part of quires remained blanks or only displayed the grid pattern for the tables as if those spaces were intentionally left blanks to contain future notes, texts or tables.[77] Lewis used two types of script that are similar but with a different degree of formality. He employed either a typical English university cursive script characterised by round strokes but betraying a secretary influence, or a small and neat secretary script with some 'bastard secretary' features.[78] MS Ee.3.61 is mainly written with the first type of handwriting, a university cursive script, though Lewis tends to use a neater and more regular script for the treatises of which he is not the author (e.g. fols 8^{r}–12^{r}; 31^{v}–42). The roundness of the script is also more pronounced in parts composed with less care (e.g. fols 12^{v}–15^{r}). Throughout the manuscript, Lewis included a few decorative features, inserting red rubrics, initials highlighted in red, or paragraph signs. Tables are also composed in black and red. A few guide letters were also traced by him suggesting that he was perhaps planning to return to this part to apply the decoration or that the decoration was done by someone else (e.g. fols 48^{r} and 49^{r}). However, it is likely that Lewis was also in charge of this aspect, as it remains simple and sometimes quite rough.

76 MS Ee.3.61, fols 164^{r-v} and 165^{r-v}.

77 MS Ee.3.61, fols 18^{r}–26^{r}; 181^{v}–188^{r} are left blank, though fols 183^{r}–184^{r} retained the horoscope charts composed later by Richard Jones.

78 Parkes 1969.

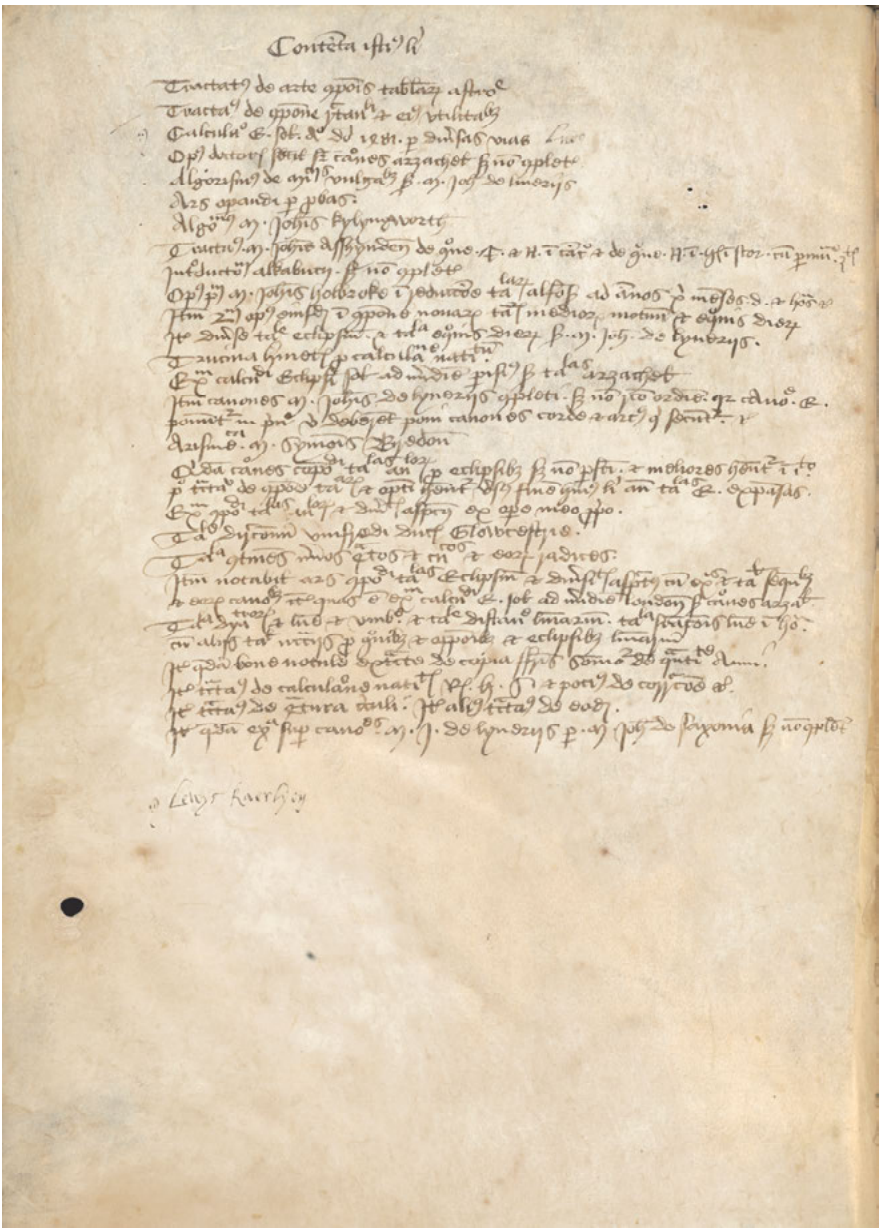

Fig. 1: Table of contents copied by Lewis Caerleon; MS Ee.3.61, fol. 2^{v}; courtesy of the Syndics of Cambridge University Library.

The table of contents (fol. 2^{v}) reveals interesting evidence about the history of the manuscript. Given the order of the works mentioned, the volume was bound as it is today. However, one learns from this table that one treatise is now missing. The entry reads:

> Treatise of Master John Ashenden on the conjunction between Mars and Saturn in the sign of Cancer, and on the conjunction of Saturn and Jupiter in the sign of Scorpion, with a change of triplicity.[79]

This item refers to the astrological judgement of John Ashenden (d. *c.* 1368) on the Saturn–Mars conjunction of 1357 and the Saturn–Jupiter conjunction of 1365. The change of triplicity – mentioned by Lewis – between the air and the water signs (Cancer, Pisces and Scorpio) is indeed discussed by John Ashenden in his judgement as a signifier of great religious and political events.[80] This judgement originally preceded the *Introductorius* of al-Qabīsī (Alcabitius), which was described as incomplete: 'Introductorium Alkabutii [*sic*], sed non completum'. However, the first part of the *Introductorius* was certainly copied on the same quire as John Ashenden's predictions, seeing that the beginning of this tract is now missing too.[81] At least one quire is now lacking.

The table of contents is also the place where Lewis Caerleon justified some of his choices in term of copy. The canons of John of Lignères are mentioned as complete but in a different order, first starting with his eclipse canons excerpted from his canons on planetary motions, *Priores astrologi*, followed by his canons on spherical astronomy, *Cuiuslibet arcus*.[82] This order was certainly justified by the fact that John of Genoa's computation of the solar eclipse of 3 March 1337 precedes the eclipse canons of John of Lignères, whose method partly inspired the former.[83]

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79 MS Ee.3.61, fol. 2^{r}: 'Tractatus Magistri Johannis Asshynden de coniunctione ♂ [Mars] et ♄ [Saturn] in Cancro et de coniunctione ♄ in ♃ [Jupiter] in Scorpione, cum permutatione triplicitatis'.

80 Cf. MS. Digby 176, fols 42^{r}–49^{v}; MS. Ashmole 393, fols 81^{v}–86^{r}. See also Carey 1992, 74–77; Boudet and Miolo 2022.

81 Only the *Differentiae* I.12–II.40 are copied. Cf. Al-Qabīṣī, *Introduction to Astrology*, ed. Burnett and Yamamoto 2004.

82 MS Ee.3.61, fol. 2^{r}: 'Item canones Mag[istri] Joh[ann]is de Lyneriis completi, sed non recto ordine, quia canones eclipsis ponuntur in principio veri deberent poni canones corde et arcus qui secuntur'.

83 On John of Genoa's *Investigatio eclipsis solis anno Christi 1337*, whose edition is forthcoming in the ALFA collection, see Miolo 2022, 371–374.

4.2 A sourcebook

Lewis gathered a wide range of astronomical material which probably laid the foundations for his own works. However, his own views on some of the tables or canons are shared throughout the manuscript. This is the case with the anonymous canons on the composition of the *tabule angulorum* (i.e. parallax tables) for computing eclipses that, according to Lewis, were less precise than the canons on the same topic copied towards the end of the manuscript.[84] At the bottom of parallax tables that are said to be part of the more precise group of canons and tables, he commented again:

> Although this prescribed work on the parallax is not precise and perfect due to the significant mistakes of the scribes, it nevertheless provides a good example and method of the table of parallax in longitude and latitude for someone with a good understanding [of the matter]. [About the eclipse tables on the next folio (fol. 146^{r})] Note also that this subsequent example on the composition of eclipse tables is corrupted by scribes with no understanding of this. Therefore, judge the proof before this. Note yet that when he composed those tables, this master assumed the solar and lunar diameters as they are noted in the previous folio at the bottom of the table.[85]

It is noteworthy that later, at some point, he crossed out all the parallax and eclipse tables, for they were deemed obsolete.

These notes also provide valuable evidence of his work as a collector and astronomer. Although this group of tables and canons was understandably assumed by Kibre to be part of the personal work of the physician, Lewis Caerleon clearly demonstrates in his annotations that he is not the author of this group of tables. Indeed, his own tables are only situated between fols 154^{v} and 156^{r}.

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84 We can read this passage in the table of contents: MS Ee.3.61, fol. 2^{r}: 'Quidam canones componendi tabulas angulorum pro eclipsibus sed non precisi et meliores habentur in isto primo tractatu de compositione tabularum et operationi habentur versus finem huius libri ante tabulas eclipsis expansas'. Those anonymous canons may be found on fol. 106$^{r–v}$, and we may assume that the best canons according to Lewis are on fol. 143$^{r–v}$.

85 MS Ee.3.61, fol. 146^{r}: 'Quamvis hoc opus prescriptum de diversitate aspectus non sit precise verum et perfectum, propter vitium forte scriptores, tamen dat bonum exemplum et viam describendi tabulam diversitatis aspectus in longitudine et latitudine, bene intellegenti. Nota etiam quod istud exemplum sequens de compositione tabularum eclipsis est corruptus scriptoribus non intelligentibus. Ideo probationem antequam ei considas. Nota etiam quod iste magister, quantitatem dyametri Solis et une et umbre, ut notatur in proximo folio precedente sub tabulas suis de eclipsis solis, supposuerit in componendo istas tabulas etc.'

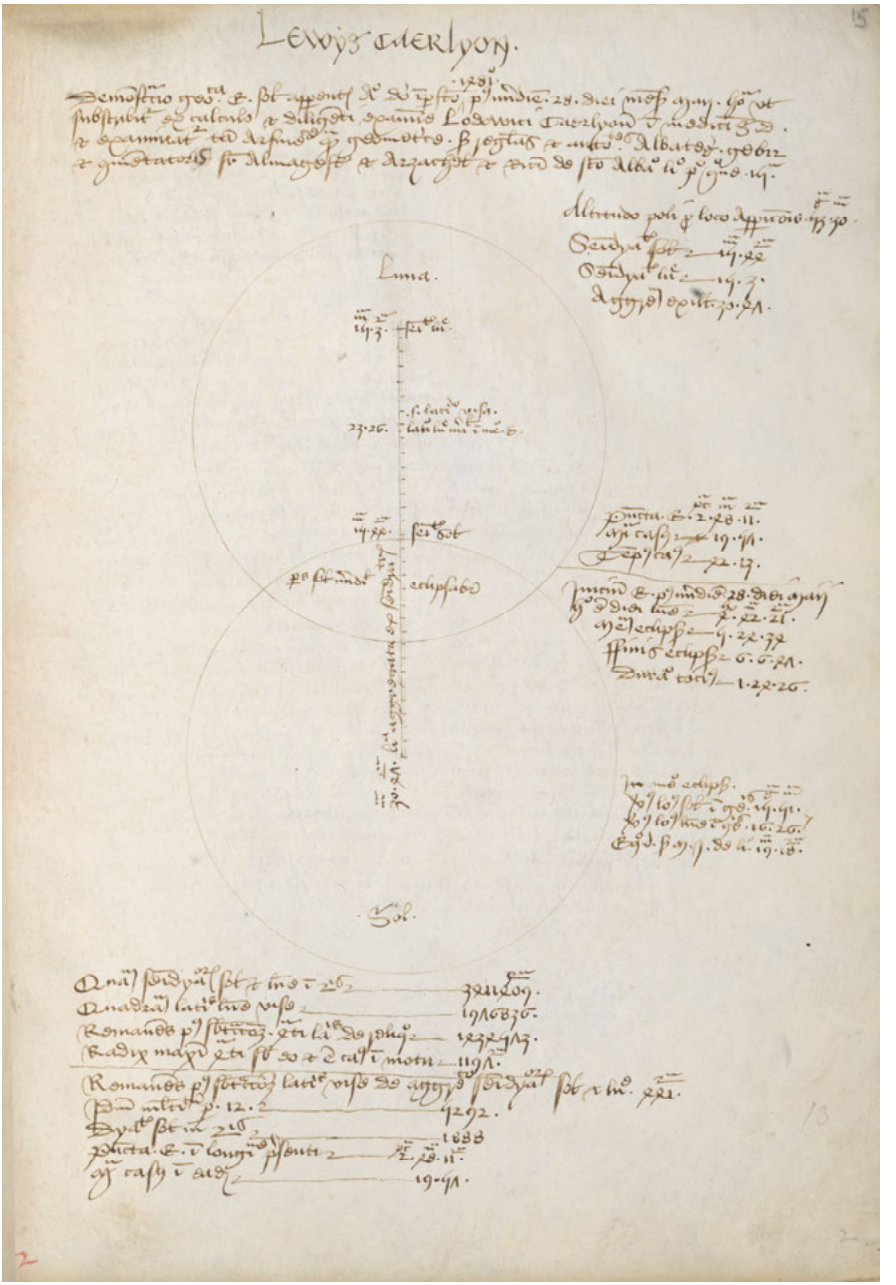

Fig. 2: 'Geometrical demonstration' of the solar eclipse of 28 May 1481 including Lewis Caerleon's signature; MS Ee.3.61, fol. 15r; courtesy of the Syndics of Cambridge University Library.

The signature 'Lewys' which is found in several places of the volume often indicates that Lewis Caerleon is the author of a work or a comment. For instance, at the end of his detailed eclipse computation of 28 May 1481, Lewis signs: 'Lewys Caerlyon, in medicinis doctoris' (fol. 14^{v}). Similarly at the top of his geometrical demonstration, 'Demonstratio geometrica eclipsis solis', his signature reads: 'Lewys Caerlyon'.[86] However, his signature is not only authenticating his authorship, but also his corrections or commentary. It is particularly noticeable in his treatment of John of Genoa's calculation of the solar eclipse of 3 March 1337. Lewis disagrees with his calculation of the parallax and thus corrects the computation all through the text. This is the subject of comment in a seven-line note at the end of the text, providing the reasons for those emendations. This short autograph note is authenticated on the first line by 'ego Lodowycus Caerlyon in medicinis doctor'.[87] Similarly, at the top of the anonymous universal table of the ascension of the signs, here ascribed to John Walter, he expressed his skepticism towards this method though he found it laudable: *conceptio tamen est laudabilis*. This note is also signed 'Lewys'.[88] It is also noteworthy that the English orthography 'Lewys' is used as a signature, though within a text, Lewis kept the Latin orthography of his first name 'Lodowycus'.

Although Lewis is clearly not their author, the anonymous short canons for composing eclipse and parallax tables, including the tables themselves, all bear this same signature. It appears that this material was entirely scrutinised, verified and corrected by the physician, as is stated in his annotations. Any amendment to a text or a table, whether it is correction or simple changes, is therefore established by his signature.[89]

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86 Though one finds the spelling 'Lewis of Caerleon', in reference to his supposed native town, this signature shows that the preferred spelling of the physician himself was simply 'Lewis Caerleon'.

87 MS Ee.3.61, fol. 81^{r}: 'Nota et indubitanter scias quod ego Lodowycus Caerlyon in medicinis doctor, singula prescripta calculo proprio probavi, et hoc feci quia inveni errores in divisione sua quando divisit excessum 3e diversitatis aspectus lune in latitudine super 2am, quia credidi ex illo modico errore plures maiores errores secutoros' ('Take that into account and you would indubitably understand that, I, Lewis Caerleon, doctor of medicine, I proved by my own computation all the things written above, and I did that because I found errors in his [John of Genoa's] division. When he divided the excess of the third lunar parallax in latitude to the second, because I believed that from this subtle mistake, many other and more important mistakes followed').

88 On this table see North 1986, 126–128. The table is in MS Ee.3.61, fol. 47^{r}. Fol. 46^{v} displays a short canon in the form of a *memorandum*, perhaps due to Lewis, beginning: 'Pro operatione subsequentum tabularum duo sunt consideranda'.

89 One finds 'Lewys' in several places facing the canons or the tables: MS Ee.3.61, fols 142$^{r–v}$ and 143$^{r–v}$ for the canons and fols 144^{r}–146^{r} for the tables.

The didactic nature of the eclipse material displayed on fols 142^{r}–146^{r} is demonstrated by the different *exempla* included. Lewis probably learned how to build tables from the different material he gathered as all canons or tables are followed by concrete application of the doctrine through examples.[90]

That he used the canons devoted to the composition of parallax tables and eclipse tables as a starting point to build his own tables is evidenced by the long example on the construction of parallax tables, following the anonymous canons *Componendi tabulas angulorum*. The anonymous text proposed the method to compose parallax tables based on the Oxford latitude,[91] and the steps described in those canons are followed by Lewis in his example, based on the Oxford latitude (51;50°). The *exemplum* is also said to be based on al-Battānī and Richard of Wallingford's writings. These two references correspond to al-Battānī's *De scientia astrorum* (translated from the Arabic by Plato of Tivoli between 1134 and 1138) and Richard of Wallingford's *Albion*.[92] It is probable that the reference to the first astronomer was excerpted by Lewis from Richard of Wallingford's *Albion* since Chapter 30 of the *De scientia astrorum* was one of the latter's sources.[93]

Lewis gathered in his notebook the required material to build what he calls his *opus eclipsium*. As a short introduction to the eclipse material included on fols 142^{r}–146^{r}, a brief note at the top of the folio states that to work on eclipses it is necessary to know the different radii and diameters expressed on the same page.[94]

90 Those examples are clearly mentioned by Lewis, e.g. fol. 145^{r}: 'Hic consequenter ponatur exemplar faciendi tabulas diversitatis aspectus in longitudine et latitudine secundum canones prepositor in isto quaterno'; this is a *renvoi* to the canons on fol. 143$^{r–v}$; fol. 146^{r}: 'Exemplum de compositione tabularum eclipsium'. Lewis is not the author of the *exempla* of fols 145^{r}–146^{r}.

91 The anonymous canons are preceded by the heading 'Nota canones sequentes pro compositione tabularum angulorum pro eclipsibus', MS Ee.3.61, fol. 106^{r}.

92 MS Ee.3.61, fol. 107^{r}: 'Exemplum componendi tabula angulorum et diversitatis aspectus ad eclipses per calculationem Lodowyci Caerlyon in medicinis doctoris et calculatur ad latitudinem 51 gradus 50 minuta secundum doctrinam Albategni et Ricardi de Sancto Albano, libro primo, conclusione 12, 13, 14, 15 et 16' ('Example of the composition of a table of angles and parallax for eclipses computed by Lewis Caerleon, doctor of medicine, and which is calculated for a latitude of 51;50° according to the doctrine of al-Battānī and Richard of St Alban [Richard of Wallingford], in the first book, conclusions 12, 13, 14, 15 and 16'). Al-Battānī's *De scientia astrorum* was edited by Nallino 1899–1907.

93 Cf. North 1976, vol. 1, 285–289.

94 MS Ee.3.61, fol. 142^{r}: 'Ad opus eclipsium requiritur notitia quantitatum dyametri corporis solaris, corporis lunaris in aspectu et dyametri umbre terris in contactu spere lunaris et quantitas maxime diversitatis aspectus in circulo altitudinis luna exeunte apud orizontem' ('For the eclipse computation, knowledge is required on the quantity of the diameter of the solar body, the lunar body in parallax and the diameter of the shadow of the Earth in contact with the

It is especially true for eclipse tables displaying the digits of eclipse and the parallax in latitude. Preceding the short canon *De arte componendi tabulas eclipsium* (fol. 142[r]) are values related to the radii of the Sun, the Moon and the shadow of the Earth excerpted from four authorities: Richard of Wallingford, al-Battānī, Jābir ibn Aflah (Gebir) and the anonymous author of the *Almagesti minor*. However, all those values are certainly taken from propositions 17–22 of the *Albion*. On the verso of the same folio Lewis supplemented those radii with radii and diameters found in the Toledan tables, which are displayed alongside those of al-Battānī and Jābir ibn Aflah (Gebir) whose values are repeated. It is noteworthy that the *Almagest* (Book 5, Chapter 14) and its abridged version by al-Farghani are mentioned regarding lunar parallax. The latter values have been also directly excerpted from the *Albion*, Book I, proposition 14, where Richard of Wallingford provides the 'maxima diversitas aspectus in circulo altitudinis apud orizontem' (the horizontal parallax in altitude).[95] It is nevertheless quite clear that he wrote down a large number of *auctoritates* to legitimate his tables and canons and perhaps to have an exhaustive overview of those different numerical values.

Lewis Caerleon's commitment to recording the *auctoritates* on which he based his writings is particularly noticeable in the introduction to his own *Opus eclipsium*, dated to 1482, only preserved in Add MS 89442, and opening the section devoted to his eclipse tables and canons:

> This being understood, I chose between all professors of astronomy, three authors between whom there are few differences in their respective works. I chose one from the ancients, Albategni [al-Battānī], who surpassed his predecessors by his fine observations and especially his work on eclipses, with whom agree Geber [Jabir ibn Aflah] and the commentator of the *Almagest* [i.e. the *Almagesti minor*]. I chose two [authors] amongst the moderns, Master Simon Bredon and Richard of Wallingford, abbot of St Albans, both English and former fellows of Merton College, who brilliantly surpassed all their contemporaries all around the world with their excellence and their fine demonstrations, as it is clear from their works. I am really delighted that these learned men in mathematics flourished in our nation.[96]

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lunar sphere and the greatest quantity of the lunar parallax in latitude moving towards the horizon').

95 Lewis uses exactly the same vocabulary and references as in the *Albion*. For *Albion*, I, proposition 14, see North 1976, vol. 1, 286–287.

96 Add MS 89442, p. 39: 'Hiis visis, inter omnes astronomie professores tres mihi autores elegi inter quorum sentencias modica et quasi insensibilis restat dissonantia, quorum unum ex antiquis elegi Albategni qui in subtilitate observationis et precipue in opere eclipsium omnis suos antecessores excessit, cui etiam concordat Geber ac insuper commentator super Almagesti; duos etiam ex modernis elegi, qui in novissimis nostris diebus in excellentia et subtilitate

Al-Battānī is indeed repeatedly invoked by Lewis in his notebook in relation to eclipse computations.[97] Some of the numerical values provided by Lewis may have been directly excerpted from Richard of Wallingford's *Albion*, which displays, in the first book, several values taken from al-Battānī, Jābir ibn Aflah's *Liber super Almagesti*, and the anonymous Latin treatise *Almagesti minor*.[98] Although his main source remains the *Albion*, it appears that Lewis had only access to al-Battānī's canons through Richard of Wallingford's work but also through another writing (perhaps the *Almagesti minor*), since he gave several values related to the radii of the shadow of the Earth and the Moon taken from the *De scientia astrorum* that are not explicitly displayed in Richard's work.[99] It therefore appears in the concordance tables that he drew upon the values of al-Battānī and Richard of Wallingford which may be found in the 'twin manuscripts' and Add MS 89442.[100] Conversely, it is noteworthy that the same concordance table retained in the notebook (fol. 142^{r-v}) is entirely based on the *Albion*, mentioning the usual other *auctoritates* straight out of this very same treatise. This demonstrates that Lewis, at some point after the final assembly of his notebook, had been able to consult a source reporting more numerical values from al-Battānī than in the *Albion*, particularly those expressed in Chapters 43 and 44 of the *De scientia astrorum*. It was certainly done by around or slightly after 1482, since he asserted in the introduction of his *Opus eclipsium* that he finally adhered to the values of the *Albion* more than others. This last statement

demonstrationum omnes suos contemporaneos in toto orbe terraris sparsum florentes eximie superarunt, ut ex eorum operibus manifeste liquet Magistrum Symonem Bredon et Ricardum Wallyngforth abbatem Sancti Albani, utrumque anglicum atque quondam socios collegii de Merton Oxonie verum valde sum gavisus quod nostre nationis viri studiosi in mathematicis floruerint'.

97 See e.g. MS Ee.3.61, fols 107^{r}–170^{v}, 142^{v}, 143^{v}, 153^{v}, etc.

98 See North 1976, vol. 1, 228–401. On Jābir ibn Aflah, see Lorch 1975.

99 A note rubricated 'Sequitur calculatio tabularum eclipsium Solis et Lune secundum semidiametros Solis, Lune et Umbre a Ricardo Wallingforthe abbate de Sancto Albono positos' in Add MS 89442 shows that he mainly based his eclipse tables on the *Albion*. Add MS 89442, p. 42: 'Iste Ricardus allegat commentatorem Almagesti et capitulum 44 Albategni perfecti, quos non habemus, summam vero libri Albategni in libris quos vidi in precedente opere allegavi. Istas precedentes conclusiones Ricardi hic induxi quia suis sentenciis magis considero et finaliter adherere propono' ('This Richard alleges the *Almagesti minor* and the Chapter 44 of the excellent al-Battānī which we do not have, but I saw a summary of al-Battānī's book in the books from the previous work I invoked. I have introduced these conclusions of Richard because I consider his opinions the more and finally I propose to adhere to them'). For al-Battānī's Chapters 43 and 44, see al-Battānī, *Scientia astrorum*, ed. Nallino 1899–1907, vol. 1, 96–113.

100 MS B. 19 and Royal MS 12 G I, fol. 7^{r}; and Add MS 89442, p. 40.

was certainly written after he elaborated a whole set of tables based on the radii values of al-Battānī dated to 1482. Those tables are only preserved in Add MS 89442.[101]

The two *moderni* praised by Lewis Caerleon are indeed the two main sources on which he directly relied: Simon Bredon and Richard of Wallingford. They are both stated as former fellows of Merton College, already the model in Lewis's days of an illustrious scientific centre. Although, Simon Bredon was certainly a fellow of this College, that is not the case for Richard of Wallingford.[102] With the statements written in his notebook and in MS. Digby 178,[103] Lewis helped to spread this mistaken information. Richard of Wallingford's *Albion* is the direct source of Lewis's eclipse tables. He explicitly cited it in the headings of his tables based on the first book of the *Albion*, proposition 18, 19 and 21 and also in his computation of the solar eclipse of 1481 (fols 14^{v}–15^{r}).[104] The heading of the parallax table that he copied on fol. 151^{v} leave little doubt about the source that inspired his work: 'Tabula diversitatis aspectus Lune in latitudine, pro Oxonia grosse calculata per albionum' ('Table of lunar parallax in latitude, made for Oxford and roughly computed with the albion'). It is obviously not from the

101 Add MS 89442, pp. 65–70.

102 On Simon Bredon, see Talbot 1962; Snedegar 1999. On Richard of Wallingford and the construction of the false affiliation to Merton College see North 1976, vol. 3, 129–131.

103 MS Ee.3.61, fol. 142^{r}: 'Istud elicitur ex primo libro Ricardi de Sancto Albano Socii domus Scolarium de Merton'. At the end of Lewis's copy of the *Quadripartitum*, Richard is said to have been the first fellow of the college. MS. Digby 178, fol. 38^{r}: 'Explicit quartus tractatus de corda recta et versa quem composuit fratrus Ricardus Wallyngforde quondam abbas Sancti Albani ac primus socius Collegiis Walteris de Merton Oxonie summus astronomus at geometer eximius, cuius anime deus propicietur excelsus' ('End of the fourth treatise on *corda recta* and *corda versa* that composed friar Richard Wallingford, former abbot of St Albans and first fellow of the College of Walter of Merton in Oxford, the greatest astronomer and an excellent geometer, whose soul may God favour').

104 The eclipse tables with the headings are found in Add MS 89442 (pp. 65–71); Royal MS 12 G I and MS B. 19, fols 1^{r}–3^{v}. See e.g. MS B. 19, fol. 1^{r}: 'Hic incipit tabula eclipsis Lunaris secundum dymaetros Ricardi abbatis de Sancto Albano, libro suo primo de compositione Albionis conclusione 18, 19 et 21, ad longitudinem longiorem cum differentia punctorum et minutorum casus et more, ad longitudinem propriorem noviter facta et expansa ad singula minuta argumenti latitudinis Lune per me Lodowycum, anno Christi 1482 et huic tabule finaliter adhereo ut in principio huius operis premisi' ('Here begins the table of lunar eclipse, based on the diameters of Richard, abbot of St Alban, in his book on the composition of the Albion, in the first book propositions 18, 19 and 21, at apogee with the difference of digits and the minutes of immersion and delay, and at perigee, newly made and expanded to a single minute of the argument of the lunar latitude, by me Lewis, in the year of the Christ 1482, and I finally adhere to this table, as I mentioned in the beginning of this work').

instrument but from the values found in the treatise that this table was composed. The *Albion* was not the only treatise by Richard of Wallingford that Lewis owned. Although, the royal physician's copy of the *Albion* does not seem to survive, the treatise on the instrument *Rectangulus*, composed contemporarily to the *Albion* (*c*. 1326) is copied in his notebook. The end of the copy contains a brief note by Lewis referring to Richard of Wallingford's *Quadripartitum* (composed before 1326), of which he had also a copy extensively annotated in MS. Digby 178.[105]

Simon Bredon's writings were extensively used by Lewis of Caerleon for trigonometrical astronomy and equation of time.[106] A copy of Simon's *Arithmetica* (*c*. 1330) may be found in the notebook following John of Lignères's canons on spherical astronomy. This is the same text that Lewis referred to in a note at the end of the table of square and cubic roots: 'as it appears from Master Simon Bredon in his arithmetic towards the end of the chapter on geometrical proportions'.[107] That Lewis had a particular interest in Bredon's works appears from two copies that he owned of Simon's commentary on Ptolemy's *Almagest*. This commentary is preserved in three witnesses which are all incomplete. Although it is not sure that a full version of this text had ever existed, Lewis had two copies of Simon's work: one in his notebook containing the commentary on Book I, propositions 12–20, and another in MS. Digby 178 with a fuller version that includes the text on the *Almagest* Book I.9–11, 12–14, Book II and III.[108] It would appear that he used some of this content for his equation of time table copied in Add MS 89442.[109] In his *Exemplum componendi tabulam angulorum et diversitatis aspectus*, Lewis dedicates a line to the straight sine (*sinus rectus*) of the altitude of midheaven according to Simon Bredon. This was certainly based on the method found in Simon Bredon's commentary on the *Almagest*, Book II in MS. Digby 178.[110] That Lewis used Bredon's commentary on the *Almagest* and Richard of Wallingford's *Quadripartitum* for spherical astronomy problems, and more specifically for computing the right and oblique ascensions and compos-

105 The note is facing the *Canon tabule corde verse* and reads, MS Ee.3.61, fol. 11^{v}: 'Conclusiones iste sunt prime partis Quadripartiti Abbatis'.

106 On the equation of time and the influence of Simon Bredon on Lewis Caerleon's tables, see Miolo and Zieme forthcoming.

107 MS Ee.3.61, fol. 125^{r}: 'ut patet per magistrum Symonem Bredon in arimestica sua versus finem capitulo de proportionalite geometrica'.

108 Zepeda 2013; Zepeda 2018.

109 Cf. Miolo and Zieme forthcoming.

110 MS Ee.3.61, fol. 107^{r}: 'Sinus rectus illius altitudinis secundum Magistrum Symonem Bredon, 31 gradus, 33 minuta, 5 secunda, 30 tertia, 4 quarta'.

ing ascension tables, is also evidenced by the numerous explicit references found in Add MS 89442, pp. 47–49, inserted in between the parallax-related material. It appears that Lewis Caerleon partly based the computation of angles for his own parallax table from both works, but he seems to have followed the procedure described in Ptolemy's *Almagest*, Book V and al-Battānī's Chapter 39, dedicated to the parallax.[111] A last piece of evidence of the use of Simon Bredon's work by Lewis Caerleon is preserved only at the beginning of Add MS 89442. It is a table of chords allegedly composed by Simon Bredon and revised by Lewis Caerleon. According to the latter, this table is more precise than al-Battānī's one.[112] This table was particularly used in the calculation of right and oblique ascensions preventing the astronomer from a cumbersome computation. Already in his notebook, Lewis copied a condensed version of the *Almagest* I, 11 containing the directions to build a table of chords.[113] Simon Bredon's original table cannot be found today; however, it may well have been linked to his commentary on the *Almagest*. His treatment of the chords of different arcs may be found in a short text copied in the part belonging to Lewis in MS. Digby 178.[114]

The particular interest in Simon Bredon's works which were not well known, except for his commentary on Boethius's *De institutione arithmetica*, demonstrates that Lewis Caerleon had a direct access to little circulated texts or even to authorial manuscripts. There is indeed some possibility that he copied Simon Bredon's commentary on the *Almagest* from the autograph copy of the Oxonian master, now MS. Digby 168. Similarly, the notebook reveals several mentions showing that he saw a manuscript copied and owned by the Francis-

111 Although he relied on the *Quadripartitum* and Simon Bredon for the computation of angles, Lewis's canons on his parallax table claim to be based on the Book V of the *Almagest*, indeed providing parallax values, and al-Battānī's Chapter 39, Add MS 89442, p. 128: 'Invenies enim longitudinem lune a terra in omni distancia ab auge deferentis et epycicli secundum doctrinam Ptholomei libro 5° capitulo 13 et secundum Albategni capitulo 39, ut productum est et hec ad presens sufficiant. Lewys' ('You will find indeed the lunar longitude to the Earth for every distance from the apogee of the deferent and epicycle according to the doctrine of Ptolemy, in Book 5, Chapter 13, and according to al-Battānī in Chapter 39, as it is produced and this suffices for now. Lewis'). For al-Battānī's Chapter 39, see al-Battānī, *Scientia astrorum*, ed. Nallino 1899–1907, vol. 1, 76–84.

112 Add MS 89442, p. 1: 'Tabula cordarum mediatarum Magistri Symonis Bredon expansa ad singula minuta per me Lodowycum, et est precisior quam tabula Albatgeni quia calculatur pro singulis 15 minutis usque ad 8a. Sed hic non posui nisi 4 verificata pro singulis 15 minutis'. The table is situated on pp. 1–30.

113 MS Ee.3.61, fol. 156^{v}.

114 On this text beginning *Arcus dicitur pars curcumferencie circuli* (MS. Digby 178, fols 39^{r}–41^{v}) ascribed to Bredon by Henry Zepeda (Zepeda 2018, 96–97).

can John Somer (d. *c.* 1409). The previous ownership of the volume he consulted is asserted within the table of contents of the notebook. The entry described an anonymous 'short note' on the true length of the year excerpted from the copy of John Somer. This note beginning 'De quantitate anni secundum computationem vulgarem' consists in two folios referring to diverse authorities such as John of Lignères and the Latin Alfonsine tables extensively, but also to the Toledan tables, al-Battānī, Thābit ibn Qurra or even Abū Maʿshar.[115] Lewis is more precise in the headings and canons related to two tables excerpted from Somer's volume. The autography is stated in the headings of both tables by the formula 'de copia manus proprie Frater Somer'.[116] A brief description of the volume is mentioned in the short canon facing the table of coefficients of interpolation (fol. 152^{r}): 'I found those tables in a certain old book copied by Brother Somer. Then, I, Lewis, made these canons, and I found some mistakes in this table that I corrected'.[117]

Lewis carefully recorded his source, emphasizing the authority of the renowned owner of the volume, who is the author of the widespread *Kalendarium*, and the age of the manuscript, 'an old book'.[118] Interestingly, the fact that this volume was autograph also seems to add a legitimacy to this source and a claim to an intellectual lineage. However, Lewis also mentioned the mistakes found in one of the two tables, asserting at the same time his own authority.

The different sources gathered by Lewis Caerleon in his notebook demonstrate that he was the heir to an important astronomical tradition. The works retained in the manuscript are representative of the fourteenth- and fifteenth-century sources used by the physician in his own work. He was well aware of the English astronomical tradition. His leading figures are Richard of Wallingford, Simon Bredon, John Somer, John Killingworth and John Holbroke. One finds those authors explicitly mentioned in his own writings. However, texts composed by fourteenth-century Parisian astronomers are also well represented in his notebook with John of Lignères's canons and his *Algorismus minutiarum*, along with John of Saxony's commentary on the canons on spherical astronomy

115 MS Ee.3.61, fols 156^{v}–158^{v}.

116 MS Ee.3.61, fols 152^{r} and 154^{r} (see *infra*).

117 MS Ee.3.61, fol. 152^{r}: 'Istas tabulas inveni scriptas in quodam veteri libro ex manu Frater Somer, istos tunc canones feci ego Lodowycus et in illa tabula quosdam errores inveni quos correxi'.

118 On the sense of the 'age' of manuscripts in late medieval descriptions of books, see Sawyer 2017, 114.

composed by the former.[119] The corpus of sources assembled by Lewis was an invaluable source for his astronomical writings.

5 A work devoted to eclipses

5.1 A Merton precedent?

The works copied by Lewis in his notebook represent authorial attempts, drafts and early version of his writings. It is noteworthy that all the tables situated between fols 142^{r}–151^{v} and 154^{r}–155^{v}) are crossed out by Lewis. The eclipse tables and canons retained in the notebook and authored by Lewis represent a first stage of his work and may be compared with later compositions retained in Add MS 89442, Royal MS 12 G I and MS B. 19. However, it seems that before composing his own tables the physician tried his hand at computing by reading canons and correcting existing tables.

Indeed, the different eclipse and parallax canons and tables copied on fols 142$^{r–v}$ and 146^{r} were not composed by Lewis himself as explicitly stated in some of his marginal notes. However, more information about where he found this material may be gleaned from partially erased citations. Those citations allow to establish another link between Lewis and the University of Oxford, and perhaps Merton College. The following notes may be read on the upper margin of fol. 142^{r}: 'Excerpted from the book of Walter Hertt',[120] and again on the heading of a lunar parallax table based on the Oxford latitude:

> Table of lunar parallax for the Oxford latitude, that is 51 degrees and 5 minutes, but it is not precisely computed, ~~and it differs from Hertt which is adequately corrected. But I doubt~~ [*sic*] the precise truth of one [table] for one minute, and of the other for the difference.[121]

119 John of Lignères's canons and John of Saxony's commentary on his spherical astronomy canons are edited in Saby 1988, vol. 1, 67–277 (John of Lignères's canons *Cuiuslibet arcus propositi sinum rectum invenire* and *Priores astrologi*) and vol. 2, 281–284 (John of Saxony's commentary on *Cuiuslibet arcus*).

120 The whole inscription was intentionally crossed out. MS Ee.3.61, fol. 142^{r}: 'Extracta de libro Magistri Walter Hertt'.

121 A part was voluntarily crossed out, MS Ee.3.61, fol. 144^{r}: 'Tabula diversitatis aspectus Lune ad latitudinem Oxonie, scilicet, 51 graduum et 50 minutarum, sed non est precise calculata, ~~sed differt a Hertt sufficienter correcta. Sed dubito~~ [*sic*] precisa veritate alium per unum minutum et alium per differentiam'.

A third of the folio has been carefully cut out, though on the verso, remains a part of the original note on the duration of the totality of an eclipse copied by Lewis. The inscriptions mentioning Walter Hertt are all intentionally crossed out. Although it cannot be proved, the similarity of ink might indicate that Lewis is at the origin of these erasures. He probably came back to the manuscript afterwards and crossed out those passages. It is difficult to know the exact reason, though it seems that the authority of Hertt was intentionally deleted. Walter Hertt (also written Hert or Hart) was a fellow of Merton College between 1437/1438 and 1455, and a resident of Lincoln College between 1455 and 1456, he died in 1484. He is mentioned in the Merton Rolls (between 1450 and 1452) for two pledges he respectively deposited in a university chest and in the Winton chest in exchange of the borrowing of two other books.[122] His brother, John Hertt (or Hart) is recorded in April 1490 giving to Merton College, a copy of Simon Bredon's medical tract, *Trifolium de re medica*, as mentioned in Walter's will dated to 1481.[123] The list of fellows of Merton College (*Catalogus vetus*, Merton College Records MS 4.16) first compiled in *c.* 1412 mentioned him as a *nobilis astronomus*.[124] However, he does not appear to have left manuscripts. Further in the notebook, another mention was entirely erased below a lunar parallax table based on the Oxford latitude. The heading written by Lewis specifies that this table of lunar parallax in longitude based on the Oxford latitude is not precise as it misses one minute in comparison with the other table.[125] It is doubtless one of the tables referred on the note found on fol. 144^{r}.

The next folio reveals the author of this set of parallax tables, and certainly of the entire set of tables retained between fols 147^{v} and 151^{v} whose explicit is written by Lewis Caerleon at the bottom of the table of lunar parallax in latitude 'roughly computed with the *Albion*' ('grosse calculata per Albionum') on fol.

122 See Tanner 1748, 382; Powicke 1931, 218; Emden 1957–1959, vol. 2, 881a–882a; Thomson 2009, 137, 277. Thomas Tanner seems to have read the inscription in MS Ee.3.61, fol. 142^{r}, as he states: 'in MS. Norwich More 820 sunt quaedam de eclipsibus extracta ex libro magistri Gualteri Hertt'. According to an inscription in MS 184 (lower pastedown), the pledge (*cautio*) deposited in the university chest in 1446 was renewed until November 1455. He pledged this volume six times.

123 Salter 1923, 47–48 and 131.

124 Merton College Records MS 4.16, p. 26. Walter Hertt is mentioned in the year 1437.

125 MS Ee.3.61, fol. 150^{v}: 'Tabula diversitatis aspectus lune in longitudine pro Oxonia, sed non est precisa, sed deficit alium per unum minutum vel circiter' ('Table of lunar parallax in longitude for Oxford, but it is not precise and it misses another by one minute or so'). The erased mention cannot be read entirely, it begins: 'Nota quod diversitates aspectus hic positi sunt' ('Note that here are put parallax tables').

151^{v}. The name of the author is entirely erased but still legible with an UV lamp. The explicit reads:

> The new tables of eclipses composed by Master John Curteys fellow of Merton College in Oxford end. The quantities of the diameters of the Sun, the Moon and the shadow of the Earth appear to be those written before folios 4 and 7, where the art of composing eclipse and parallax tables is displayed.[126]

John Curteys is therefore the author of the eclipse and parallax tables of fols 147^{r}–151^{v}. He doubtless corresponds to the fellow of Merton College elected in 1442 who died in 1448/1449, though only scarce evidence of his life remains.[127] However, it is noticeable that he and Walter Hertt were both contemporaries. John Curteys is also mentioned as a renowned astronomer in the *Catalogus vetus* of Merton.[128] The two fellows were also at Merton College in the same time as John Killingworth who was there between 1432 and 1445, the year of his death, occupying various college positions.[129] It is thus tempting to establish a link between those two scholars and the astronomical production of John Killingworth,[130] but no evidence proves a master–disciple relationship between the three men. However, the last part of the explicit indicates that John Curteys relied on the values displayed on what are now fols 142^{r}–144^{r},[131] corresponding to the part excerpted from Walter Hertt's book. Those quantities were taken from Richard of Wallingford's *Albion*, but they are also accompanied with short canons, probably due to Hertt. It is therefore possible that Curteys was Hertt's student. No other writings from these two Merton fellows seem to have survived except in this notebook.

Those mentions clearly demonstrate that Lewis Caerleon had access to all this material and that he relied extensively on this for his work on eclipses. The fact that he kept correcting the different pieces before finally deleting them also

126 Italics show the erased portion. MS Ee.3.61, fol. 151^{v}: 'Expliciunt nove tabule eclipse composite *per Magistrum Johannem Curteys socium Collegii Oxonie de Mertone*, et supponunt quantitates dyametrorum solis et lune et umbre, ut scribitur ante folio 4° et 7° ubi ponitur ars componendi tabulas eclipsis et tabulas diversitatis aspectus'.

127 See the brief entry in Emden 1957–1959, vol. 1, 530.

128 Merton College Records MS 4.16, p. 26.

129 North 2004.

130 This link is asserted by George Brodrick but with no evidence. See Brodrick 1885. Geoffrey Martin and Roger Highfield are more careful but did not mention John Curteys, see: Martin and Highfield 1997, 132–133.

131 The mention of folios four and seven shows that the volume was probably not originally bound, and that Lewis had different quires in his possession.

show that he was taught or taught himself from those tables and canons. Correcting and editing sources is also a constant for Lewis who is responsible for the enhancement of John Killingworth's Jupiter and Saturn tables or Simon Bredon's table of chords. Where Lewis found those sources is also another question. It is likely that after he left Cambridge in 1466, he found his way to the University of Oxford, and perhaps to Merton. The donation he made in 1490 to Merton College is evidence of his link to this institution. Direct access to sources such as Simon Bredon's manuscripts (particularly MS. Digby 168), Walter Hertt and John Curteys's writings, that he plausibly may have only found at Merton College, are other hints of this connection. To this might be added that he perhaps knew some contemporary fellows.

On the 25 October 1497, a certain master John Davys borrowed the book donated by Lewis Caerleon seven years before. This volume was thus unchained for the occasion.[132] The manuscript offered in 1490 does not seem to have survived since the words of the second folio do not correspond to an extant manuscript. However, MS. Savile 38 displays on the verso of the front endleaf (the former pastedown) the following ownership inscription: 'Pertinet magistro Johanne Davys'. The two John Davys were certainly one and the same person. John Davys (d. 1521) was a fellow of Merton College between 1484 and 1497, thus much younger than Lewis but contemporary to him.[133] However, since MS. Savile 38 does not correspond to the manuscript donated to the college in 1490,[134] it is thus possible that John Davys had it from the college or directly from Lewis Caerleon before 1495.

A more plausible association is between Lewis Caerleon and Richard Fitzjames (d. 1522). Elected fellow in 1465, he was warden of Merton College between 1483 and 1507, but also chaplain to Henry VII from 1489. His interest in astrology is attested by the zodiac archway he commissioned for the college in 1497, but also for the collection of books he requested during his wardenship.[135] He thus received the astrological manuscript assembled by William Reed, MS. Digby 176 and a volume containing astronomical tables.[136] However, if it was not at Merton, there is a strong chance that Lewis Caerleon and Richard Fitzjames met at the Royal court at some point.

132 John Davys pledged a manuscript of Seneca in exchange (Salter 1923, 215).

133 Emden 1957–1959, vol. 1, 551–552.

134 MS. Savile 38 does not seem to have been damaged, no folios or quires were removed, replaced or moved. It does not display the keywords, *vere puncta*, of the volume donated by Lewis Caerleon at Merton College.

135 See Carey 2012.

136 Thomson 2015, vol. 2, 953. On MS. Digby 176, see Boudet and Miolo 2022.

Those different sources demonstrate that Lewis Caerleon was directly or indirectly linked to Merton College. In any event, he had probably access to manuscripts and works preserved in the institution at that time. There is no longer any doubt that he was in Oxford at some point after 1466 and before his imprisonment in 1484. The last piece of evidence in favour of his stay in Oxford after 1466 is contained in Lewis's own writings.

5.2 The early stages of the *opus eclipsium*

Although Walter Hertt's and John Curteys's tables and canons were certainly used by Lewis as educational tools to learn eclipse tables composition and eclipse computations, he also produced his own work. The first stage of his scientific production is displayed in the notebook. Those early steps are symbolised by the detailed computation of the solar eclipse of 28 May 1481. The table of contents of the notebook refers to this as a computation made in various ways (*Calculatio eclipsis solis anno 1481 per diversas vias*). Indeed, this calculation was made according to four different sets of tables. It was first performed with the Toledan tables and John of Lignères's tables dated to 1322 (fols 12^{v}–13^{v}).[137] Both sets are explicitly invoked within the computation, though the heading on fol. 12^{v} only mentions the Toledan tables put under the authority of Azarchel (al-Zarqālluh, d. 1100) to whom they were usually attributed during the medieval period: 'Calculatio eclipsis contingentis anno domini currente 1481, post meridiem, 28 diei Maii, ut sequitur secundum tabulas Azarchelis'. The first line of the calculation specifies that the true time of the conjunction is given in mean days (*diebus non equatis*). Immediately after, Lewis Caerleon gives the equation of time (*equatio diei*) – allowing to find the time in true days (*diebus equatis*) – in the Toledan tables and in John of Lignères's tables.[138] Only the main results, such as the true time of the conjunction given in true days, are given according to both sets of tables, the rest was computed with Latin Alfonsine tables.

137 For the edition of the Toledan tables, see Pedersen 2002, for John of Lignères's tables, see *The Tables of 1322*, ed. Chabás and Saby 2022.

138 MS Ee.3.61, fol. 12^{v}: 'Tempus vere coniunctionis diebus non equatis post meridiem prescriptis 3 hore, 51 minuta, 45 secunda, 31 tertia/ Equatio dierum secundum magistrum Johannem de Lineriis, 19 minuta, 18 secunda, 16 tertia, 30 quarta/ Equatio dierum secundum Azarchelem 20 minuta, 21 secunda, 32 tertia' ('Time of the true conjunction predicted in mean days after midday 3 hours, 51 minutes, 45 seconds, 31 thirds/ Equation of time according to John of Lignères, 19 minutes, 18 seconds, 16 thirds, 30 fourths/ Equation of time according to Azarchel, 20 minutes, 21 seconds, 32 thirds').

The computation is partially made again with another set of tables, called the 'new tables', based on the Oxford meridian. For that purpose, Lewis starts from the true time of the conjunction found with John of Lignères's tables to perform the whole calculation again with this new set of eclipse tables. Those new tables are in fact those made by John Curteys as they are based on the *Albion*'s diameters as specified by Lewis himself in his aforementioned note. The introductory paragraph of this part of the computation reads as follows:

> Computation of the same eclipse according to the new eclipse tables based on the values of the diameters of the Sun, the Moon and the shadow of the Earth that are found in Albategni, Gebir, and the commentator of the *Almagest* [*Almagesti minor*] and Richard of St Alban. Those are the diameter of the Sun at mean longitude 32 minutes, 32 seconds; the diameter of the Moon at apogee, 29 minutes, 20 seconds, and at perigee, 35 minutes and 20 seconds; the diameter of the shadow of the Earth at apogee 38 minutes, 10 seconds, and at perigee 45 minutes, 56 seconds etc. And computed as well according to the new tables of lunar parallax based on the Oxford meridian.[139]

After the whole computation was redone, Lewis added another way to derive other parts of the same calculation with the help of the 'new tables expanded', meaning that the 'new tables' composed by John Curteys were enhanced. The title of this part is explicit: 'Computation of the same eclipse with the new tables expanded to the individual minutes rejecting all fractions up to the minute, both in time and in motion'.[140] This shorter calculation end with a long paragraph signed by Lewis Caerleon where he explains the origin of the difference between the results obtained with the 'new tables' and with the 'expanded tables', which according to him, are due to the lunar parallax in latitude.[141]

If the new tables themselves are the work of John Curteys, the question of responsibility for their enhancement arises. The answer may be found in manu-

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139 MS Ee.3.61, fol. 13^{v}: 'Calculatio eiusdem eclipsis secundum novas tabulas eclipsis fundatas super quantitate dyametrorum solis et lune et umbre ut ponuntur Albategni, Gebir et commentator super *Almagesti* et Ricardus de Sancto Albano, que est hec dyameter Solis in longitudine media 32 minuta, 32 secunda, dyameter Lune in auge epicicli 29 minuta, 20 secunda in opposito augis 35, 20; dyameter umbre in auge epicycli 38, 10, in opposito augis 45, 56 etc. ac etiam secundum novas tabulas de diversitate aspectus Lune ad meridiem Oxonie'.

140 MS Ee.3.61, fol. 14^{vb}: 'Calculatio eiusdem per tabulas novas expansas ad singula minuta abiciendo omnes fractiones usque ad minuta, tam in tempore quam in motu'.

141 MS Ee.3.61, fol. 14^{vb}: 'Nota quod tota causa differentie seu discrepantie per hanc viam, sicilicet, per tabulas expansas, a priori, oportet immediate precedente, est propter diversitas aspectus in latitudine' ('Note that the whole cause of the difference or discrepancy with this method, that means, with those expanded tables, must be immediately preceding, for it is due to the parallax in latitude').

scripts commissioned by Lewis Caerleon and containing his own tables. The heading of the lunar eclipse tables found in MS B. 19, Royal MS 12 G I and Add MS 89442 makes it clear and more precise: they are tables expanded to a single minute of the argument of the lunar latitude.[142] The set of eclipse and parallax tables displayed in those three manuscripts are dated to 1482 and 1483, and are based on the Cambridge latitude, though it is specified that the solar eclipse tables were composed in London in 1482.[143] All the tables are clearly signed in their headings, leaving little doubt about their author, Lewis Caerleon. Thanks to the eclipse table we also learn that he was in London at least from 1482, likely serving Margaret Beaufort and the Lancastrian faction.

The rest of the 1481 solar eclipse computation shows that he used two other methods to derive the same eclipse. He applied for one an arithmetical procedure and for the other a geometrical (trigonometrical) procedure. As for the previous ways of computing the eclipse, he introduced his calculation by a short explanatory paragraph. The arithmetical method is explicitly derived from the doctrine excerpted from Walter Hertt's book. The following calculation based on the extraction of the *radix* of the diameters of the Sun and the Moon is an application or an *exemplum* following the different steps described in the *Ars componendi tabulas eclipsium*. However, the values of the diameters are taken from the Toledan tables.[144] Lewis Caerleon says he prefers this method to the

142 For the quotation of the heading see note 95. One finds another table in MS B. 19 and Royal MS 12 G I, fol. 4^{r}, with a heading echoing the previous table: 'Tabula latitudinis lune infra terminos eclipsium expansa ad singula minuta argumentis latitudinis lune per me Lodowycum' ('Table of lunar latitude below the limits of eclipses expanded to the individual minutes of the argument of the lunar latitude, by me, Lewis').

143 Cf. MS B. 19 and Royal MS 12 G I, fol. 3^{r}: 'Hic incipit tabula eclipsis solis secundum diametros Ricardi Abbatis de Sancto Albano ad longitudinem longiorem cum differentia punctorum et minutorum casus ad longitudinem propriorem Lune. Sed sol supponitur esse semper in sua longitudine medie in compositione istius tabule per me Lodowycum anno Christi imperfecto 1482 apud Londonum' ('Here begins the table of solar eclipse based on the diameters of Richard the abbot of St Albans, at apogee with the difference of digits and the minutes of immersion at lunar perigee. But the Sun is supposed to always be in its mean longitude in this table composed by me Lewis in the imperfect year of the Christ 1482 at London'). Cf. on Lewis's whole works, see my subsequent article in preparation.

144 MS Ee.3.61, fol. 14^{v}: 'Calculatio eiusdem eclipsis per extractionem radicis semidyametrorum solis et lune secundum quam artem fuerint tabule eclipse eclipsium solis et lune [...] et inveni quantitatem dyametrorum solis et lune secundum doctrinam canonem Gerardi Cremonensis super tabulam Azarchelis [...] tamen elegi hanc viam propter secunditatem ab erroribus etc.' ('Computation of the same eclipse based on the extraction of the roots of the radii of the Sun and the Moon according to what art the solar and lunar eclipse tables displayed [...] and I found the quantity of the diameters of the Sun and the Moon according to the

subsequent one based on 'geometry and arithmetic' and entitled *Demonstratio geometrica*, which, according to him, is mistaken as it is based on mean values. This geometrical model is based on the *Albion* and is accompanied with a diagram of the mean time of the eclipse.[145]

This eclipse computation was certainly used to apply and evaluate several sets of tables and methods of computation. It was probably also one of the first applications of the 'expanded tables' that he drew from John Curteys's set of eclipse and parallax tables crossed out at the end of the notebook. Interestingly, Lewis Caerleon wrote two notes in two different places facing Curteys's tables justifying the cancellation of the tables:

> Note that I did not compute those eclipse and parallax tables as precisely as the eclipse tables that I donated to the universities of Cambridge and Oxford. However, the difference is subtle and by means of these tables the first part of eclipses may very well be computed.[146]

That Lewis claimed the authorship of those tables would seem clear here and might explain why the different references to Hertt and Curteys were erased afterwards. Unless, the verb *calculavi* refers here to the different corrections he made to the different tables and would also explain the signature 'Lewys' applied to every folio. In any event, those mentions show that Lewis's *nove tabule expanse* found their ways to the universities of Oxford and Cambridge, to which he donated copies of his tables. The 'twin manuscripts', MS B. 19 and Royal MS 12 G I, copied after 1485, may have represented one or both donations, though they do not correspond to the donation made to Merton College in 1490. If the 'twin volumes' correspond to the donations mentioned in the note, that would mean that Lewis would have come back to his notebook after 1485 to add both notes. It seems highly probable that Lewis made the different donations during his lifetime.

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canonical doctrine of Gerard of Cremone on the tables of Azarchel [...]. However, I chose this method because of the errors of the second method'). Lewis probably refers to the following Toledan canons, i.e. Pedersen 2002, Cb 193–198 or Ca 186–187 or Cc 289–293, to find the diameters of the luminaries.

145 MS Ee.3.61, fol. 15^{r}. For the detail see Appendix 2, *infra*.

146 MS Ee.3.61, fol. 147^{v}: 'Nota quod istas tabulas eclipsium et diversitatis aspectus cancellavi quia non calculavi istas tabulas ita precise sicut tabulas eclipsium quas dedi universitatibus Cantebrigie et Oxonie, insensibilis tamen est differentia et per istas tabulas satis bene et prime parte eclipsium calculari'. On fol. 151^{v}, one finds a similar note: 'Nota quod tabulas precedentes quia eas non ita precise calculavi sicut tabulas quas dedi universitatibus Cantabrigie et Oxonie tamen quasi insensibilis est differentia in calculo, experiatur quicumque velit'.

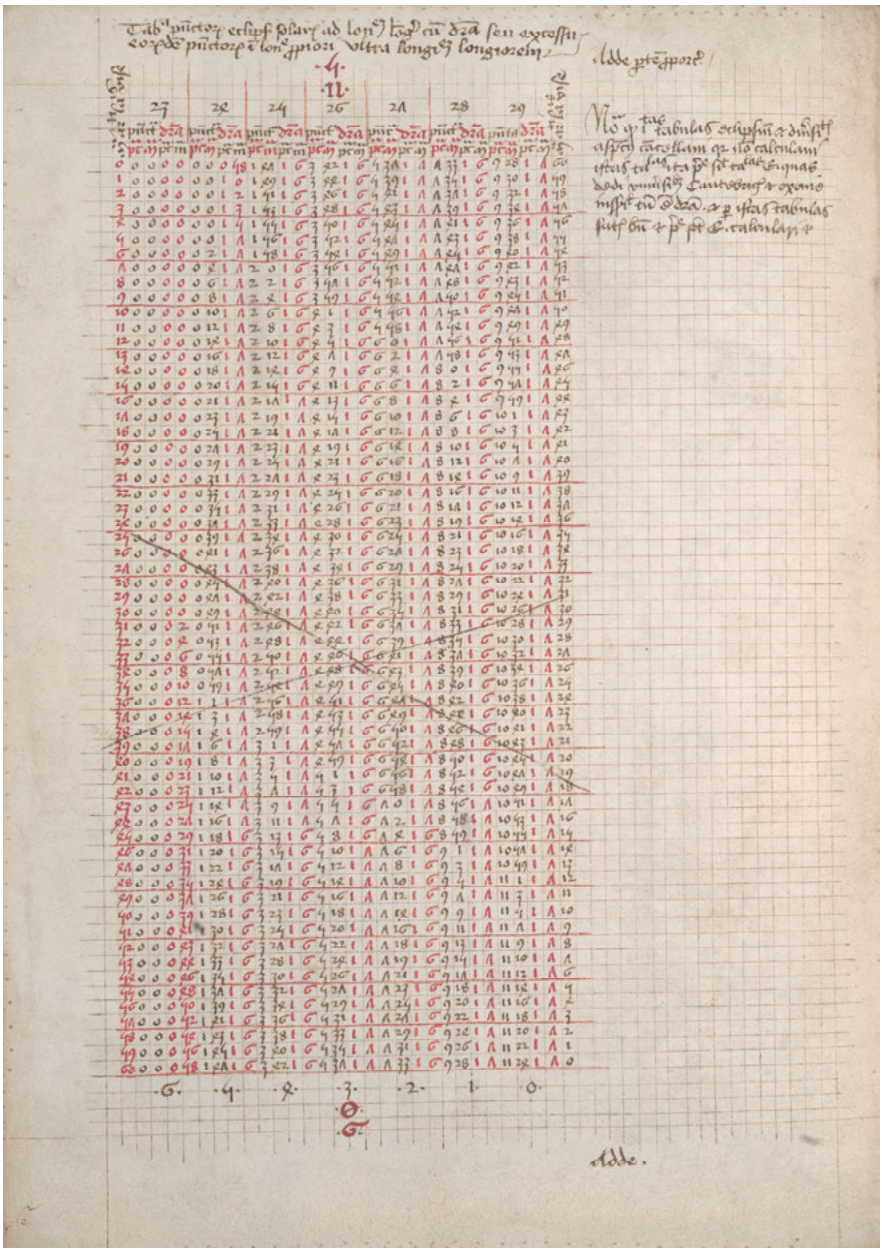

Fig. 3: Lewis Caerleon's note facing a solar eclipse table; MS Ee.3.61, fol. 147^{v}; courtesy of the Syndics of Cambridge University Library.

The genesis of his work is well-represented by this brief passage. It is remarkable that in the two notes, Lewis only mentions the eclipse tables that he composed, and not the parallax tables based on the Cambridge meridian, which are present in MS B. 19 and Royal MS 12 G I. A short inscription written by Lewis in front of the parallax tables excerpted from John Somer's book demonstrates that at the time, Lewis had not yet composed his parallax tables based on the Cambridge meridian and eclipse tables but was planning to. Indeed, he already stressed the need for a new set of parallax tables, and here again, he points out that the parallax table facing his commentary was mistaken and that despite his editions, some errors remain. The process is very similar to the one observed earlier with Walter Hertt and John Curteys's compositions. In this note, Lewis explicitly states that he proposed to elaborate a new set of parallax tables based on the meridian of Cambridge and new eclipse tables.

> In these tables I found some errors that I corrected, and some of them remain incorrect. With God's favour, I propose to build other new parallax tables based on the meridian of the University of Cambridge and new eclipse tables with all tables for the same purpose.[147]

This note probably predates the computation of his new set of tables that may be dated to 1482. The 1481 eclipse computation might be a retrospective computation since a part of this employed those *nove tabule expanse*.

The short eclipse canons (fols 152^{v}–153^{r}) associated with the eclipse and parallax tables are divided up into two different parts as is often the case with such instructions to find lunar and solar eclipse. The first part is entitled 'Modus operandi pro eclipsi lune per tabulas novas' and the second part 'Canones eclipsium solis per easdem tabulas'. There is little doubt that the tables used in those canons are those situated on fols 147^{v}–151^{v}. The mention of parallax tables made for the Oxford latitude demonstrate that they are indeed the tables in question.[148] The question arises of who authored this short piece. No signature or mention of Lewis Caerleon may be found in those canons. The table of contents does not mention him as the author of this short text, but the canons are clearly associated with the table: 'with examples and subsequent tables with

147 MS Ee.3.61, fol. 152^{r}: 'in illa tabula quosdam errores inveni quos correxi et hec restant quidam incorrecti. Alias, tunc favente Deo, novas tabulas diversitatis aspectus ad meridiem Universitatis Cantebrigie propono construere et novas tabulas eclipsium cum omnibus tabulis easdem continentibus etc.'

148 MS Ee.3.61, fol. 152^{v}: 'intra in tabulas diversitatis aspectus factam pro latitudine Oxonie' ('Enter in the table of parallax made for the latitude of Oxford').

their canons'.[149] However, it should be noted that Lewis copied these canons verbatim in MS B. 19 and Royal MS 12 G I for his 'expanded tables' of 1482 and 1483, based on John Curteys's tables but adapted to the Cambridge latitude, only modifying the short passage mentioning the meridian by 'factam pro latitudine Cantebrigie' ('made for the latitude of Cambridge').[150]

In the notebook, one set of tables in particular can surely be attributed to Lewis Caerleon. It is situated right after a single lunar eclipse table, based on 'old eclipse tables', which is crossed out. Unlike the previous eclipse and parallax tables, the set of tables copied on fols 155^{r}–156^{r} was not cancelled by Lewis Caerleon. Fol. 155^{r} displays a table of the difference between the mean velocities of the two luminaries (*superatio lunae*) in one hour at mean conjunction or opposition, and fol. 156^{r} shows the same difference in true conjunction or opposition. This excess between both velocities is central for calculating the time between mean and true conjunctions of the luminaries. These two tables are provided with two canons, one on fol. 154^{vb} and the other on fol. 156^{r}.[151] Those tables may be found in a more expanded version in Add MS 89442. A set of tables entitled 'Tabula revolutionis coniunctionum et oppositionum solis et lune cum motibus' displays these same tables in degrees (Add MS 89442, pp. 71–76), minutes and seconds (Add MS 89442, pp. 77–117). They are supplemented by a table of the mean motion of the Sun and the Moon, the mean argument of the Moon at mean conjunction and the mean motion of the head of the dragon (the lunar node) (Add MS 89442, p. 71). The notebook represents a first stage of this set which was greatly expanded by Lewis and included in Add MS 89442; this may explain why those tables were not crossed out. The canons situated at the end of the set of tables displayed in Add MS 89442 (pp. 117–118) were also expanded by comparison with the two short canons copied in the notebook. The text gives some hints regarding the date of composition of the tables. Lewis Caerleon provides an *exemplum operationis* to illustrate his instructions. The

149 MS Ee.3.61, fol. 153^{r}: 'cum exemplis et tabulis sequentibus et eorum canonibus'.

150 These 'new' canons are displayed in the 'twin manuscripts', MS B. 19, fols 14^{v}–15^{r} and Royal MS 12 G I, fol. 15^{r-v}.

151 The heading of the first table specifies that the canons are situated on the left (fol. 154^{v}): 'Prima tabula et est tabula distantie solis et lune in gradu solum tempore medie coniuntionis et oppositionis cuius canones precedentes hic a sinistris in folio precedente'. Fol. 155^{v}, which remains blank has been ruled for a table and displays the following title: 'Differentia motuum solis et lune in hora tempore coniunctionis vere et oppositionis vere luminarium', this table was finally copied on fol. 156^{r}.

example is the first conjunction of the year 1482.[152] Lewis probably expanded those tables of difference between the solar and lunar velocities on that year.

The same year 1482 Lewis developed new eclipse and parallax tables. A work that he continued in 1483 with new interpolation tables.[153] The set of eclipse tables elaborated in 1482–1483 is displayed in the three manuscripts commissioned and supervised by Lewis. These tables are derived from Richard of Wallingford's *Albion*, more particularly from Book I, Chapters 18, 19 and 21 containing specifically the diameters values needed for computing a part of these tables. Although these tables are displayed in Add MS 89442, pp. 65–71, they are preceded by a similar set of tables, but, this time, based on al-Battānī's diameters and radii for the Sun, the Moon and the shadow of the Earth, excerpted from Chapters 30, 43 and 44 of his *De scientia astrorum*.[154] Therefore, it seems that in 1482 Lewis of Caerleon elaborated two different sets of tables, one deriving from Richard of Wallingford's *Albion* and the other from al-Battānī's *De scientia astrorum*.

However, if the 'twin manuscripts' do not display the tables derived from al-Battānī, it is certainly because Lewis eventually chose the one based on the *Albion*, as suggested in several notes. At the end of the heading of the first lunar eclipse table based on the *Albion*, he underlined: 'and finally I adhered to those

152 Add MS 89442, p. 117: 'quorum exempla subiungam in sequentibus, volo ergo invenire primam mediam coniunctionem iam anno domini imperfecto 1482' ('to which I will add exemples in what follows, therefore, I want to find the first mean conjunction already in the imperct year of the Lord 1482').

153 They are both displayed in the 'twin manuscripts', MS B. 19 and Royal MS 12 G I, fol. 4^{r}: 'Tabula minutorum proportionalium seu tabula proportionis vel affinitatis seu portiones longitudinum ad eclipses per me Lodowycum noviter facta anno Christi 1483' ('Table of interpolation or proportion [called in different ways: *tabula minutorum proportionalium*, *tabula proportionis*, *tabula affinitatis* or *portionum longitudinum ad eclipses*] for eclipses newly made by me Lewis in the year of the Christ 1483').

154 Add MS 89442, p. 61: 'Tabula eclipsis lunaris secundum diametros Albategni, capitulo 30 et 43 ad longitudinem longiorem cum differentia punctorum et minutorum casus et more ad longitudinem propriorem noviter facta et expansa ad singula minuta argumenti latitudinis lune per me Lodowycum anno Christi 1482' ('Table of lunar eclipses based on the diameters of Albategni, Chapters 30 and 43, at apogee with the difference of digits and minutes of immersion and delay at perigee, newly made and expanded to the individual minute of the argument of the lunar latitude by me, Lewis, in the year of the Christ 1482'). The solar eclipse table is based on the Chapters 30 and 44. On Chapters 30, 43 and 44 of al-Battānī's *De scientia astrorum*, see al-Battānī, *Scientia astrorum*, ed. Nallino 1899–1907, vol. 1, 50–63 and 96–113.

tables, so that I place them at the beginning of my work'.[155] The reason for this choice is explained in the introduction to his *Opus eclipsium*.

> Then, I observed a solar eclipse, in the imperfect year 1482, after midday, the 17 May, of which the beginning of the eclipse was at 5 hours and 54 minutes and its end was after 7 hours and 42 minutes. According to sense and sight, it corresponds to the sentences of Richard the Abbot [Richard of Wallingford]. And therefore I propose to adhere more to them, unless in the future, I prove the contrary by observations with sight, and so may those who follow me.[156]

A partial account of this eclipse is recorded in the notebook on the upper parchment flyleaf. Although the detailed computation is not displayed, several values were reported by Lewis such as the positions of the Sun and the Moon their diameters, the times of the beginning of the eclipse, its middle and end; the size of the eclipse (expressed in digits); and times of immersion. Interestingly, Lewis drew the astrological chart of the eclipse at the time of mid-eclipse, the maximum of the eclipse (*figura tempore medii eclipsis*). This is the only evidence of his actual astrological practice, though the notebook includes some astrological tracts and tables. However, as a royal physician, one may assume that he likely practised medical astrology. Indeed, astrological 'universal' predictions based on eclipses were mostly employed in astrometeorology and medicine. Lewis Caerleon's particular focus on eclipses may perhaps be explained by his profession of physician.

In any event, the values recorded by Lewis for the solar eclipse of 17 May 1482 in the notebook and in the introductory text of Add MS 89442 agree. The beginning of the eclipse took place at 5:54 pm and the end at 7:42 pm. Those values also coincide with the Cambridge latitude, demonstrating that he employed his 1482 tables based on the Cambridge meridian. The short statement mentioned above where he endorsed Richard of Wallingford's values was conceived as an empirical confirmation. Lewis Caerleon used eclipse calculations, as well as observations – when doable – to test the accuracy of his tables. In the notebook, he copied two other detailed computations, one made by John of

155 Add MS 89442, p. 61: 'et huic tabule finaliter adhereo ut in principio huius operis premisi' ('and I finally adhere to this table, as I mentioned at the beginning of this work').

156 Add MS 89442, p. 39: 'Ego tunc unam eclipsim solis observavi, anno imperfecto 1482, post meridiem 17 diei Maii quo ad initium eclipsis 5 horis 54 minuta et finis eiusdem post horam 7am 42 minutis, quod mihi ad sensum et aspectum visum est concordare cum sententiis Ricardi Abbatis. Et ideo illius magis adherere propono, nisi in posteris per observationes contrarium probavero ad sensum in aspectu, et sic faciant qui me secuntur. Brevis canon componendi tabulas eclipsium Lewys'.

Genoa (fl. 1329–1348) for the annular solar eclipse of 3 March 1337 computed with the Alfonsine Latin tables based on the Paris meridian,[157] and one for the annular solar eclipse of 7 July 1339 computed for the London latitude with Toledan tables.[158] Interestingly for the last calculation, the zodiac signs of the ascendants are given for the beginning, middle and end of the eclipse implying an astrological use of this eclipse prediction. These two calculations served as *exempla* to Lewis Caerleon who probably exerted himself with the help of such models.

In addition to the computations of the eclipses that occurred in 1481 and 1482, Lewis Caerleon finally made a detailed computation of the total solar eclipse of 16 March 1485. This calculation is only displayed in the 'twin manuscripts' and Add MS 89442. The adverse effect of this full eclipse had been discussed from a medical perspective by Diego de Torres (*c*. 1480–after 1487), who had the chair of astrology at the University of Salamanca.[159] In the English context, the solar eclipse was interpreted after the event as linked to Anne Neville's death by the Crowland chronicles.[160] This eclipse was visible from London, and Lewis claimed to have observed it from the Tower of London where he was imprisoned by Richard III. The comparison between the computation and the observation is clearly stated in a short paragraph written at the bottom of the calculation in the 'twin volumes', though it is absent from Add MS 89442.[161] The tables used were those elaborated by Lewis during his incarceration in 1485 rather than the tables of 1482–1483. The three eclipse computations of 1481,

157 It seems not clear to Lewis Caerleon that this computation was done with Alfonsine tables since in the table of contents he refers to this as 'Exemplum calculandi eclipsis solis ad meridiem Parisius secundum Tabulas Azarchelis' (MS Ee.3.61, fol. 2^{v}).

158 MS Ee.3.61, fols 146^{v}–147^{r}. The year is specified as 'complete' (1340), but it appears to be the 'incomplete' year, so 1339.

159 Amasuno 1972.

160 *The Crowland Chronicle Continuations*, ed. Pronay and Cox 1986, 175.

161 MS B. 19 and Royal MS 12 G I, fol. 6^{v}, the observation statement begins with: 'Istam eclipsis Solis anno Christi imperfecto 1485, post meridiem 16 diei Martii contingentem ego observavi in turre Londoni, et inveni principium eclipsis in altitudine solis .31. gradus et finem in altitudine solis .15. gradus fere et in quantitate .10. punctorum fere per estimationem, et sic convenit cum calculo et si aliqua fuerat discrepancia, hoc fuit in quantitate, quia mihi apparuit estimatione quod fuit parvum ultra .9. puncta' ('I observed in the Tower of London the solar eclipse of the imperfect year of the Christ 1485, occurring after midday on the 16th March. And I found the beginning of the eclipse with a solar altitude of around 31 degrees, and the end with a solar altitude of around 15 degrees, and an estimate of around 10 digits. And thus this was in accordance with the calculation. And if there was a discrepancy, this would be in quantity, because it appears based on my estimate that it was a little beyond 9 digits').

1482 and 1485 corresponds to three key periods in the development of Lewis Caerleon's eclipse material. He clearly seemed to have tested the accuracy and efficiency of different sets of tables in predicting eclipses. His notebook preserves the early stage of a whole astronomical agenda devoted to eclipse predictions that he probably started to develop in Oxford. The supervision and commission of the three volumes containing his own works represent the achievement of this *opus eclipsium*.

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Appendix 1: Description of Cambridge, University Library, MS Ee.3.61

Cambridge, University Library, MS Ee.3.61

Old shelfmarks: 820 (John Moore)

Summary of the contents:
Lewis Caerleon, *Eclipsis Solis post meridiem 17 die maii ut sequitur anno Domini imperfecto* 1482; Lewis Caerleon (?), *De arte compositionis tabularum astronomie*; Richard de Wallingford, *Rectangulus*; Lewis Caerleon, *Calculatio eclipsis Solis* 1481; Lewis Caerleon (?), note on chords and sinus; commentary on the Toledan tables canons Cb; Johannes de Lineriis, *Algorismus minutiarum*; Anonymous, *Algorismus*; John Killingworth, *Algorismus*; Simon Bredon, *Expositio super almagesti*, Book I (incomplete); Anonymous, notes about astronomical instruments; Lewis Caerleon, short canons regarding John Walter's tables; John Walter, universal table of the ascension of the signs; al-Qabīsī (Alcabitius), *Introductorius* (incomplete); Menelaus Theorem; *Almagesti minor* (excerpts); Johannes Holbroke, *Opus primum et Opus secundum*, and tables; *Residuum Trutina Hermetis*; John of Genoa, *Investigatio eclipsis Solis anno Christi 1337*; John of Lignères, *Canons Priores astrologi motus corporum*, only the canons devoted to eclipses (canons 33–38); Johannes de Lineriis, *Canones Cuiuslibet arcus propositi sinum rectum*; Simon Bredon, *Arismetica* (commentary on the *De institutione arithmetica*); Anonymous, *Canones componendi tabulas angulorum*, mentioning the Oxford meridian; Lewis Caerleon, example based on the table of angles and parallax; Anonymous, astrological tables (tables of aspects) attributed to Humphrey, duke of Gloucester with canons; table of square and cubic roots; John Curteys (?), *De compositione tabularum diversitatis aspectus*; John Curteys (?), eclipse and parallax tables; Lewis Caerleon, *Modus calculandi eclipsis solis secundum canones Azarchelis, anno Christi 1339 completo [...] pro Londoniense*; John Curteys, eclipse and parallax tables; interpolation tables excerpted from the book of John Somer with Lewis Caerleon's canons; John Curteys (?), eclipse canons; John of Genoa, table of solar and lunar velocities with columns for their radii 'Tabula semidiametrorum Solis, Lune et umbre'; table excerpted from John Somer's book; Lewis Caerleon, lunar eclipse table; tables of difference between the solar and lunar velocities at the time of mean and true conjunction, and their canons; Lewis Caerleon (?), *Canon tabularum Ptholomei de corda et archu*; Lewis Caerleon (?), *De exordio annorum secundum diversas sectas*; Anonymous, *Notula de quantitate anni*; Anonymous, judgement on the nativities of Henry VI,

Cum rerum motu; Anonymous, treatise on quadrature of the circle; Campanus de Novare, *De quadratura circuli*; John of Saxony, *Exempla super tabulas primi mobilis et canones Johannes de Lineriis* (incomplete); Lewis Caerleon, note and computation on the conjunction Mars/Jupiter of 1484; Lewis Caerleon, computations of the length of the seasons and the year on the year 1482; Lewis Caerleon, circular diagram with notes.

s. XV^{ex} (between 1481 and 1484)

Origin: England (Cambridge and Oxford)

Written in Latin. Mostly copied by Lewis Caerleon. A composite manuscript assembled by Lewis Caerleon between 1481 and 1484, made of different quires bound together at that time. The table of contents is autograph.

Provenance:
Lewis Caerleon; Richard Jones (fols 47^{v}, 140^{r}, 182^{v}); William Carye (fol. 1^{v}); John Moore (1646–1714) – manuscript cited by Thomas Tanner as Norwich Moore 820); George I who donated the manuscript to the University Library of Cambridge in 1715.

Physical description:
192 fols of parchment and paper. Parchment endleaves, bifolia are mostly of parchment. Fols 1^{v}; 2^{r}; 18$^{r–v}$–26^{r}; 29^{v} blanks. Parchment and paper flyleaves are mounted on paper stubs.

51 Quires: ii + 1^{2} (fols 1–2, parchment mounted on paper stub) + 1 leave of parchment mounted on a stub (fol. 3) + 2^{4} (fols 4–7) + 3^{2} (fols 8–9) + 4^{4} (fols 10–13) + 5^{2} (fols 14–15) + 6^{6} (fols 16–21) + 7^{4} (fols 22–25) + 8^{3} (fols 26–28) + 9^{2} (fols 29–30) + 10^{4} (fols 31–34) + 11^{2} (fols 35–36) + 12^{4} (fols 37–40) + 13^{2} (fols 41–42) + 14^{4} (fols 43–46) + 1 parchment flyleaf (fol. 47) + 15^{3} (fols 48–50) + 16^{2} (fols 51–52) + 17^{3} (fols 53–55) + 1 parchment flyleaf (fol. 56) + 18^{3} (fols 57–60) + 19^{2} (fols 61–62) + 20^{4} (fols 63–66) + 21^{2} (fols 67–68) + 22^{4} (fols 69–72) + 23^{2} (fols 73–74) + 24^{4} (fols 75–78) + 25^{2} (fols 79–80) + 26^{6} (fols 81–86) + 27^{2} (fols 87–88) + 28^{6} (fols 89–94) + 29^{2} (fols 95–96) + 30^{4} (fols 97–100) + 31^{2} (fols 101–102) + 32^{4} (fols 103–106) + 1 parchment flyleaf (fol. 107) + 33^{10} (fols 108–117) + 34^{7} (fols 118–124) + 1 parchment flyleaf (fol. 125) + 35^{6} (fols 126–131) + 36^{2} (fols 132–133) + 37^{6} (fols 134–139) + 38^{6} (fols 134–139) + 39^{2} (fols 140–141) + 40^{5} (fols 142–146) + 41^{6} (fols 147–152) + 1 parchment flyleaf (fol. 153) + 42^{4} (fol. 154–158) + 1 parchment flyleaf

(fol. 159) + 1 paper flyleaf (fol. 160) + 43^4 (fols 161–163) + 44^2 (fols 164–165) + 45^4 (fols 166–169) + 46^2 (fols 170–171) + 47^4 (fols 172–175) + 48^2 (fols 176–177) + 49^4 (fols 178–181) + 1 parchment flyleaf (fol. 182) + 50^4 (fols 183–186) + 51^2 (fols 187–188) + 1 parchment flyleaf (fol. 189) + iii parchment flyleaves (fols 190–192) + i unfoliated paper enleaf.

Modern binding (1966).

Appendix 2: Contents of Cambridge, University Library, MS Ee.3.61

Fol. 1^r **Lewis Caerleon, *Eclipsis Solis post meridiem 17 die maii ut sequitur anno Domini imperfecto 1482***
Computation of the eclipse of 17 May 1482 including the astrological chart of the mid-eclipse.

Fols 1^v–2^r Remain blanks.

Fol. 2^v **Table of contents**
Table of contents copied by Lewis Caerleon.

Fols 3^r–7^v **Lewis Caerleon (?), *De arte compositionis tabularum astronomie***
'Circa compostionem tabularum elevationum signorum [...]–[...] signorum prescriptorum prout volueris. Explicit'.
A florilegium largely inspired by John of Sicily's commentary on the Toledan tables canons.
This is followed by a note written in a sixteenth-century hand referring to the conjunction between Saturn and Jupiter which will take place in 1702. The author of the note also predicted a new conjunction of both planets in 1763. The note ends with a prediction of the end of the world in 1765.

Fols 8^r–12^{rb} **Richard de Wallingford, *Rectangulus***
Different tables entitled 'De compositione rectanguli' (fols 8^r–9^v); 'De utilitatibus rectanguli' (fols 9^v–11^v); 'Canon tabule corde verse' (fols 11^v–12^{ra}); 'Tabula pro rectangulo' (fol. 12^{rb}).
Fols 8^r–12^{ra}: '[Rubric] Prologus in artem componendi rectangulum. [Text] Rectangulum in remedium tediosi et difficilis operis armillarum [...]–[...] arcum tuum in tabula tunc non oportet bis intrare. [Rubric] Explicit compositio rectanguli et operatio cum eodem'.
At the bottom of fol. 12^r, an early modern hand wrote the date '1326'.

Fols 12^{v}–15^{r} **Lewis Caerleon, *Calculatio eclipsis Solis* 1481**

Fol. 12^{v}–15^{r}: '[Rubrique] Calculatio eclipsis [Solis] contingentis anno domini 1481, 28 Maii post meridiem, ut sequitur secundum tabulas Azarchelis [...] fol. 13^{v}: Calculatio eiusdem eclipsis secundum novas tabulas [...]–[...] novas tabulas de diversitate aspectus Lune ad meridiem Oxonie ... [fol. 14^{r}] Calculatio eiusdem per tabulas novas expansas [...] [fol. 14^{v}] Calculatio eiusdem eclipsis per extractionem radicis semidiametrorum solis et lune [...] [fol. 15^{r}] Lewis Caerlyon, Demonstratio geometrica eclipsis solis apparentis anno domini imperfecto 1481 post meridiem'.

Signature at the bottom of fol. 14^{v}: Lewis Caerlyon in medicinis doctor. Fol. 15^{r} displays a figure of the eclipse.

Fol. 15^{v} **Lewis Caerleon (?), note on chords and sinus**

'Corda recta vel sinus rectus est medietas chorde [...]–[...] canones vero magistri Iohannis de Lineriis continentur in isto libro etc.'

Mentions John of Lignères, the Toledan tables and Gerard of Cremona.

Fols 16^{r}–17^{v} **Commentary on the Toledan tables canons Cb**

'Incipit opusculum doctorum subtilis super aliquos canones Azarchelis. Quoniam cuiusque actionis quantitatem temporis metitur spatium [...]–[...] Propositio ista apparet vera in numeris'.

Fols 18^{r}–26^{r} Remain blanks.

Fols 26^{v}–29^{r} **Johannes de Lineriis, *Algorismus minutiarum***

'Modum representationis minutiarum vulgarium et phisicarum proponere [...]–[...] ad propositum minutiarum vulgarium et phisicarum sufficiunt. Explicit de minutiis vulgaribus secundum magistrum Johannem de Lineriis'.

Fols 30^{r}–31^{r} **Anonymous, *Algorismus***

'Ars operandi per probas in speciebus algorismi [...]–[...] 8 ergo bene sit. Explicit de probis'.

Fols 31^{v}–42^{v} **John Killingworth, *Algorismus***

'Incipit prohenium in algorismum magistri Johannis Kyllyngworth. [Prologue] Oblivione raro traduntur que certo. [Text] Brevis sermo de 4or primis speciebus [...]–[...] ad denominatorem numeri quadrandi etc. Explicit tractatus brevis calculationis M. John Kyllyngworth quondem socii collegium Walteri de Merton, Oxonie'.

Tables displayed on fols 40^{r}–42^{v} are linked to John Killingworth's *Algorismus*. Fol. 40^{r}: Tabula multiplicationis integrorum; fol. 40^{v}:

Tabula uniformis additionis; fol. 41^{r}: Tabula difformis additionis, fol. 41va: Residuum tabule difformis additionis; fol. 41^{vb} (unfinished): Tabula multiplicationis fractionum divisionis, fol. 42^{v}: Tabula reductionis integrorum ad minutias phisicas.

Note written by Lewis Caerleon at the bottom of fol. 40^{r}: 'Nota quod in ista tabula nullus numerus scribitur bis in una linea descendente a capite tabule [...]–[...] notabile signum ut patet in suprascripta tabula et canones vero istius tabule ponuntur intitulatur precedente de Algorismo Magistri J Kyllyngworth'.

Fols 43^{r}–45^{r} **Simon Bredon, *Expositio super almagesti*, Book I (incomplete)**

'[Rubric] Expositio M. Symonis super quedam capitula Almagesti Ptholomei. Nunc superest ostendere quanta sit maxima declinatio ecliptice ab equinocciali'.

Fols 45^{v}–46^{r} **Anonymous, notes about astronomical instruments**

'Fiat triangulus rectangulus qui est triangulus [...]–[...] quem numeri divide pro denumerationem fractionis vel per 4 et exibit idem scilicet 45 etc.'

Not copied by Lewis Caerleon.

The same treatise may be found in a fourteenth-century English manuscript containing several writings by Richard of Wallingford (MS. Ashmole 1796).

Fol. 46^{v} **Lewis Caerleon, short canons regarding John Walter's tables**

'Pro operatione subsequentie tabule duo sunt consideranda primum quod signum et quis gradus signi est cuius ascensio est querenda'.

Fol. 47^{r} **John Walter, Universal table of the ascension of the signs**

'Tabula diversitatis ascensionis signorum pro omni terra habitabili secundum declinationem Almeonis et dicitur esse tabula Magistri Johannis Walteri, sed tamen certus sum quod non potest esse vera, propter difformitatem augmenti et decrementi ascensionis singulorum in circulo obliquo, sed errat hec regula in latitudine 52 graduum per 26 minuta. Conceptio tamen est laudabilis quia per hanc viam possumus devenire ad gradum in omnu regione ascendentem per altitudineme poli notam ut inferius declarabo etc. Lewys'.

Fols 48^{r}–54^{v} **al-Qabīsī (Alcabitius), *Introductorius* (incomplete)**

'Deinde Mercurius, deinde Luna que est terre proprior et cursu omnibus velocior [...]–[...] gradus significat initii contrarietis'.

Differentia. I.12–Differentia II.40 (Al-Qabīṣī, *Introduction to Astrology*, ed. Burnett and Yamamoto 2004, *Alcabitius*).

Fols 54^{v}–55^{r} **Menelaus Theorem**

'Kata coniuncta potest haberi per numerum' (Zepeda 2018, 78–79).

Fol. 55$^{r–v}$ ***Almagesti minor*** **(excerpts)**

'Libro 5 parvi Almagesti propositione 18. Elongationem Lune a centro terre cognosces iuxta terminos [...]–[...] et illud quoque rarissime eveniet'.

Excerpt added by a sixteenth-century hand. Passage preceded by a paraphrase of the Almagest V.17.

Fols 56^{r}–57^{r}, 63^{v}–65^{r}, and 56^{r}–73^{v} **Johannes Holbroke,** ***Opus primum*** **(fols 56^{r}–57^{r})** ***et Opus secundum*** **(fols 63^{v}–65^{r}), and tables (fols 56^{r}–73^{v})**

Canons copied below the tables.

Opus primum, fols 56^{r}–57^{r}: 'Quoniam celestium motum calculus annorum supputatione [...]–[...] informare mihi propositum sit. Explicit canonis'.

Opus secundum, fols 63^{v}–65^{r}: 'Incipiunt canones magistri Johannis Holbroke ad opus secundum. Gloriosus atque sublimis Deus a rerum exordio [...]–[...] in fine primi gradus Cancri ut sic tabula diuturnior existeret. Hanc siquis desiderat eam in 3° folio precedente istius libri inveniet in pergameno scriptis etc.' Added note 'Vide solum et videm finem canonis'.

Short canon added in the right margin of fol. 69^{r}, facing the 'Tabula diversitatis differentie ascensionum universe terre': 'Per istam tabulam poteris cognoscere ascensiones'.

Added table on a folio left blank but ruled by a sixteenth-century handwriting (fol. 70$^{r–v}$): 'Tabula aequationis Solis inventa in anno Christi 1220'.

Fols 57^{v}–62^{r} **Lewis Caerleon, notes on John Holbroke's tables**

'[*in marg.*] Secundum Holbroke. [Text] Nota quod media coniunctio Saturni et Jovis fuit ante annum diluvii .280. 33 diebus [...] (fol. 58^{r}) nota quod a tempore magistri Johannis de Lineriis usque ad annum domini 1428 completum stelle fixe processerunt [...]–[...] et proveniet verus locus eiusdem planete in 9a spera, et sic operandum est in omnibus 5 planetis etc. Lewys'. Followed by a short note on fol. 62^{v}: 'Pro vero loco capitis draconis, primo debes calculare eius medium motum'.

Different calculations made by Lewis Caerleon on the inferior margin of fols 65^{v}–66^{r}. Those computations mention the longitude and latitude of Cambridge and other values (fol. 66^{r}): 'Longitudo Cantebrigie 15 gradus, 45 minuta/ Latitudo Cantabrigie 52 gradus 19

minuta; Altitudo capitis Arietis Cantebrigie 37 gradus 41 minuta; Umbra solis recta in principio Arietis Cantebrigie 15 puncta 32 minuta'. 'Radices augium planetarum ad meridiem Cantabrigie'.

Fol. 74$^{r–v}$ ***Residuum Trutina Hermetis***

Fol. 74^{r}: 'Trutina Hermetis ostendens moram nati in utero per distantiam graduum lune ab ascendente vel a gradu 7e domus'. Fol. 74va: a table entitled 'Residuum Trutine Hemertis'. Fol. 74^{vb}: three short paragraphs written by Lewis. (1) A short paragraph written by Lewis Caerleon on a case study of a nativity of 1403 based on the table: 'Quedam nativitas accidit 29^{o} diebus, 12 horis, 41 minutis a principio anni domini 1403, 26 gradus Leonis ascendente, erat quorum luna in 24 gradu Scorpionis [...]–[...] in quo fuit spermatis infusio secundum opinionem huius tabule compositoris etc.'; (2) 'Nota quod compositor huius tabule supponit moram minorem, scilicet luna exeunte supra terram in principio 7e domus [...]–[...] ut patet per tabulam suam etc.'; (3) 'Item, nota quod ipse dividit distantiam lune ab angulo per gradus equales et non per gradus ascensionum seu per tempora horis diurnaruis vel nocturnaris [...]–[...] ut patet patet evidenter per tabulam etc.'

Fols 75^{r}–81^{v} **John of Genoa, *Investigatio eclipsis Solis anno Christi* 1337**

'[Rubric] Distinctio calculatio eclipsis Solis pro anno Christi 1337 in mense Martii secundum tabulas Alfonsii ad meridiem Parisius. [Text] Ad investigandum eclipsim Solis proximam venturam oportet procedere secundum hunc modum. Primo oportet querere tempus prime medie coniunctionis anni secundum modum datum in canone de hoc facto [...]–[...] Duratio eclipsis: 2 hore, 3 minuta, 54 secunda, 16 tertia, et secundum me 2 hore, 3 minuta, 52 secunda, 52 tertia. Explicit'.

Detailed computation of the solar eclipse of 3 March 1337, corrected by Lewis 'secundum me'.

Note by Lewis (fol. 81^{v}): 'Nota et indubitanter scias quod ego Lodowycus Caerlyon in medicinis doctor, singula prescripta calculo proprio probavi, et hoc feci quia inveni errores in divisione sua quando divisit excessum 3e diversitatis aspectus lune in latitudine super 2am, quia credidi ex illo modico errore plures maiores errores secutoros. Sed tamen quasi minima est discrepantia, scilicet, in paucis secundis et tertiis et numquam devenerit ad unicum minutum. Quicumque idem velit probare sciat quod ego posui primum operationem suam et subsequentem meam'.

Fols 82^{r}–86^{v} **John of Lignères, *Canons Priores astrologi motus corporum*, only the canons devoted to eclipses (canons 33–38)**

'Canon magistri Johannis de Lineriis de calculatione eclipsium extractus de canonibus suis et est 60, 61, 62 et 63 canonum suorum sicut ego inveni [...] Eclipsis solis et lune in quocunque anno volueris possibilitatem invenire. Quere primam conjunctionem mediam januarii [...]–[...] horam medie eclipsis et maxime obscurationis solis. Expliciunt canones optimi et precissi utriusque eclipsis secundum magistrum Johannem de Lineriis'.

Fols 86^{v}–96^{r} **Johannes de Lineriis, *Canones Cuiuslibet arcus propositi sinum rectum***

'Cuiuslibet archus propositi sinum rectum invenire. Archus cuius sinum queris [...]–[...] ut prius quousque concordet cum vero loco solis qui fuit in radice et sic patet propositum. Expliciunt canones magistri Johannis de Lineriis. Nota tamen quod hic non ponuntur ordinate, quia canones eclipsium proponuntur cum suis quotationibus, ut patet in principio istius tractatus etc.'

Note preceding the canons fol. 86^{v} and referring to the canons copied in the inferior margin: 'Item hic subsequenter ponuntur alie conclusiones extracte de canonibus eiusdem magistri Johannis de Lineriis, quarum quotationes ego posui in margine sicut ipse ponit in suo libro etc.'

In the lower margin of fols 86^{v}–87^{r}, the canon (7) devoted to the construction and use of instruments excerpted from John of Lignères's *Cuiuslibet* arcus are copied: 'Instrumentum pro linea meridia considera [...]–[...] et erit vera linea meridiana pro loco illo etc.'

Fols 96^{v}–105^{v} **Simon Bredon, *Arismetica* (commentary on the *De institutione arithmetica*)**

'[Running title] Arismetrica Magistri Symonis Bredon continens sententiam arismetrice Boecii. [Text] Quantitatum alia continua que magnitudo dicitur [...]–[...] geometricalis proportio inter 2um et 3um terminum reperitur. Explicit Arismetrica Bredon'.

Fol. 106$^{r–v}$ **Anonymous, *Canones componendi tabulas angulorum*, mentioning the Oxford meridian**

'[Running title] Nota canones sequentes pro componendo tabularum angulorum pro eclipsibus. [Text] Nota quot requiruntur hic ad habendum archum primum, cuius sinus est primum proportionale. Primo punctus ecliptice [...]–[...] 4um proportionale, se-

cundo archuato et eius archu de 90 subtracto etc.'
Note added by Lewis Caerleon right after the canons: 'Fforte prescripta quotatio linearum non concordat in simul tabula angulorum, tamen series et ordo rerum seu proportionalium concordabunt etc.'

Fol. 107$^{r–v}$ **Lewis Caerleon, example based on the table of angles and parallax**
'Exemplum componendi tabula angulorum et diversitatis aspectus ad eclipses per calculationem Lodowyci Caerlyon in medicinis doctoris et calculatur ad latitudinem 51 gradus 50 minuta secundum doctrinam Albategni et Ricardi de Sancto Albano, libro primo, conclusione 12, 13, 14, 15 et 16, ut patet ibidem ex demonstrationibus eius pro 7 horis ante meridiem Sole in ultimo secundo contrariorum [...]–[...] Nota quod hoc est verum ad horam seu distantiam predictam, scilicet 7 horis, a meridie ante meridiem supposita Luna in principio signi Cancri 0 in gradu et 0 in minutis et secundis, et supposita luna in auge eccentrici et epicycli, ut supponunt Alfraganus in *Floribus Almagesti*, capitulo 27, Albategni, capitulo 30, et Ptholomeus 5° Almagesti, capitulo 17, qui sententialiter ponunt in locis preallegatis maximam diversitatem aspectus polem in circulo altitudinis apud orizontem Luna in auge ecentrici et epicicli 54 minuta. Sed Luna in auge ecentrici et opposito augis epicicli 64'.

Fol. 108^{r} **Table entitled 'Conversio horarum et fractionarum in gradibus / Conversio graduum in tempora'**

Fols 108^{r}–120^{v} **Anonymous, astrological tables (tables of aspects) attributed to Humphrey, duke of Gloucester with canons**
The canons are situated below the tables fols 108^{v}–116^{r}.
Fols 108^{v}–116^{r}: '[Rubric] Incipit prologus in tabulas illustrissimi principis et nobilissimi domini ducis Gloucestrie. Effectus planetarum presentes preteritos et futuros pronosticare voltentibus [...]–[...] equa domos sicut prius fecisti. Explicit'.
Fols 121–124 blanks. Fol. 124^{r} is ruled for a table.

Fols 125^{r}–141^{v} **Table of square and cubic roots**
Tables of square and curbic roots for number 1 to 4680. A later handwriting continued until 4730.
Fol. 125^{r}: Tabula continens quadratos et cubitos cum radicibus eorumdem. On fol. 125^{r}: notes written by Lewis Caerleon: 'Nota quod medium proportionale in quadratis est numerus proveniens

ex multiplicatione radicis parte in sequentem radicem [...]–[...] ut patet per magistrum Symonem Bredon in arismetica sua versus finem capitulo de proportionalitate geometrica'.

Fol. 142$^{r–v}$ **John Curteys (?), *De arte componendi tabulas eclipsium***

At the left top of the margin fol. 142^{r}: 'Extracta de libro Magistri Walteri Hertt'.

Right top margin, signature fol. 142^{r}: 'Lewys'. Same signature on the verso (fol. 142^{v}), top margin 'Lewys'.

Fol. 142$^{r–v}$: 'Ad opus eclipsium requiritur notitia quantitatum dyametri corporis solaris, corporis lunaris in aspectu et dyametri umbre terre in contactu spere lunaris et quantitas maxime diversitatis aspectus in circulo altitudinis Luna extracte apud orizontem'.

Followed by the runninng title 'De arte componendi tabulas eclipsium'. The text begins on fol. 142^{r}: 'Si volueris componere tabulas eclipsis pro longitudine propriori longiori epicicli Lune [...]–[...] (fol. 142^{v}) Sicut ergo habebis puncta eclipsis et minuta'.

Followed by different values said to be excerpted from Albategni, Gebir (Jabir ibn Aflah) and Azarchel (Toledan tables) preceded by the mention: 'Nota quod Azarchel posuerit semidiametrum Solis in longitudine media: 16 minuta, 20 secunda'.

Fol. 143$^{r–v}$ **John Curteys (?), *De compositione tabularum diversitatis aspectus***

Running title: 'De compositione tabularum diversitatis aspectus *sine astrolabio*'. Sine astrolabio was crossed out.

Fol. 143^{r}: 'Invenias primo gradus ascendente et altitudinem Lune et altitudinem gradus motus centri [...]–[...] et quotiens est diversitas aspectus latitudinis'.

In front of the text a note (written by Lewis as well) mentioning a calculation error has been erased.

Fol. 143^{r}: This canon is followed by three short paragraphs entitled in the margin 'Altitudo Lune', 'Altitudo medii celi' and 'Altitudo gradus 90'.

'Altitudo Lune: Pro altitudine Lune invenienda per altitudinem gradus 90 ab ascendente sicut operare [...] Altitudo medii celi. Invenias gradus ascendente [...] Altitudo gradus 90: Istum sinum multiplica per sinum archus inter ascendens et Lunam'.

A horizontal red line has been traced to highlight the division between the two parts on the page. A new text begins as followed: 'Signata aliqua hora ante meridiem vel post, diversitatem aspectus

Lune in longitudine et latitudine ad opus eclipsis calculare pro eadem hora [...]' and ends on fol. 143^{v}: 'ad 17am ut patet ibidem ex demonstrationibus eius etc.' In the right margin (fol. 143^{v}): 'Nota quod totius et precisis est accipere diversitatem aspectus in circulo altitudinis de tabula Albategni, intrando tabula cum distancia Solis vel Luna a cenith capitum'.

Fol. 143^{v}: a four-line note in a paler ink written afterwards by Lewis and erased. It mentions Richard of Wallingford's *Albion* and the *Almagesti minor*.

Fols 144^{r}–146^{r} John Curteys (?), eclipse and parallax tables

All the tables have been crossed out.

Lewis's signature may be found on of fols 144^{r}, 145^{r}, 146^{r}. Fols 144^{v}, 145^{r}: Two notes written in the upper margin 'corrigitur ultimate'.

Fol. 144^{r}: Parallax table. At the top of the folio the lunar sign is drawn. 'Tabula diversitatis aspectus Lune ad latitudinem Oxonie, scilicet, 51 graduum et 50 minutarum, sed non est precise calculata, sed differt a [the following part in italics is crossed out] *Hertt sufficienter correcta. Sed dubito* precisa veritate alium per unum minutum et alium per differentiam'. The bottom of fol. 144^{r} is missing, it has been cut off later.

Fol. 144^{v}: Two eclipse tables: (1) Tabula eclipsis ad longitudinem longiorem. Eclipsis Lune; (2) Tabula eclipsis Lune ad longitudinem propiorem. The two tables has been crossed out.

A computation has been written by Lewis below the tables, but part of it is illegible because the page has been cut off: 'Nota quod maxima mora totalis possibilis in eclipsis solis esset vix 6 minuta si esset coniunctio [...] Tabule eclipsium Solis et Lune supponendo dyametrum corporis Solaris'.

A note in a smaller size written in the right margin facing the second table: 'Nota quod numerus interceptus ostendit quantitatem argumenti et numerorum et cum quolibet incipit eclipsis habere moram'.

Fol. 145^{r}: At the top of the folio the solar sign is drawn. Two solar eclipse tables in the first half page: (1) Tabula eclipsis Solis ad longitudinem longiorem; (2) Tabula eclipsis Solis ad longitudinem propriorem.

Two other tables are drawn below. They are parallax tables such as the ones on fol. 144^{r} and give value for Cancer and Leo. A note has been written by Lewis above the respective headings of the tables:

'Hic consequenter ponatur exemplar faciendi tabulas diversitatis aspectus in longitudine et latitudine secundum canones prepositos in isto quaterno'.

Fol. 145^{v}: Two parallax tables providing the values in Virgo and Libra. At the bottom of the page, a note wrote by Lewis: 'Quamvis hoc opus prescriptum de diversitate aspectus non sit precise verum et perfectum, propter vitium forte scriptores, tamen dat bonum exemplum et viam describendi tabulam diversitatis aspectus in longitudine et latitudine, bene intellegenti. Nota etiam quod istud exemplum sequens de compositione tabularum eclipsis est corruptus scriptoribus non intelligentibus. Ideo probationem antequam ei considas. Nota etiam quod iste magister, quantitatem dyametri Solis et une et umbre, ut notatur in proximo folio precedente sub tabulas suis de eclipsis solis, supposuerit in componendo istas tabulas etc.'

Fol. 146^{r}: Example of eclipse table. In the right margin, Lewis's signature: 'Lewys'. 'Exemplum de compositione tabularum eclipsium secundum canones antepositos folio 4° precedente istius quantitatum. Compositio tabularum eclipsium Lune in longitudine longiori'.

In the lower margin, this note: 'Istud exemplum corrumptur per scriptores, ego multa correxi, sed tamen, cave bene'.

Fols 146^{v}–147^{r} **Lewis Caerleon, *Modus calculandi eclipsis solis secundum canones Azarchelis, anno Christi 1339 completo [...] pro Londoniense***

'[Running title] Modus calculandi eclipsis Solis secundum canones Azarchelis, anno Christi 1339 completo de Julio 6 diebus, 16 horis, 52 minuta, 42 secunda fuit tempus coniunctionis medie pro Londonie. Medius motus Solis et Lune 3 signa, 22 gradus, 41 minuta, 10 secunda, 49 tertia [...]–[...] Ascendens in principio eclipsis eclipsis: 25 Libre. In medio eclipsis: 6 Scorpionis. In fine eclipsis 17 Scorpionis. A principio istius eclipsis per 6 annos solares et 7 menses incipiet effectus istius eclipsis et durabit effectus per 2 annos 24 dies et 8 horas.

It appears that the solar eclipse occured in the 7 July 1339, so *in anno incompleto* and not *completo* as erroneously written in the running title.

Fols 147^{v}–151^{v} **John Curteys, eclipse and parallax tables**

In the lower and upper margins the mention 'adde' or 'adde partem proportionalem' have been added as directions to use the

tables. Those directions are also specified in the following canons.
Fol. 147^{v}: Solar eclipse table entitled: 'Tabula punctorum eclipsis solaris ad longitudinem longiorem cum differentia seu excessu eorumdem punctorum in longitudine propiori'.
Short text written in the right margin:
'Nota quod istas tabulas eclipsium et diversitatis aspectus cancellavi quia non calculavi istas tabulas ita precise sicut tabulas eclipsium quas dedi universitatibus Cantebrigie et Oxonie, insensibilis tamen est differentia et per istas tabulas satis bene et prime parte eclipsium calculari'.
Fol. 148^{r}: 'Tabula minutorum casus eclipsium solaris ad longitudinem longiorem cum differentia seu excessu eorumdem ad longitudinem propiorem ultra longitudinem longiorem'.
Fol. 148^{v}: 'Tabula eclipsis lunaris ad longiorem longitudinem cum differentia tabula punctorum quam minutorum casus et minutorum dimidii more ad longitudinem propiorem'.
Fol. 149$^{r–v}$: 'Residuum tabule eclipsium lunaris'. In the lower margin of fol. 149^{r}: 'Nota quod sub titulis minute est differentia minuenda a minutis casus in hac tabula ad habendum eadem minuta casus pro longitudine propiori'.
Fol. 150^{r}: Three tables. On the left: 'Tabula motus equati' followed by a short canon: 'Accipe motum equatum in prima linea a dexteris qui intitulatur motus equatus, et accipe differentiam 3e diversitatis aspectus et 4e in capite tabule in minutis et in concursu differentie et motus equati, invenies partem proportionalem in minutis quam adde vel minue de horis 2e diversitatis aspectus quemadmodum docent canones'. At the end of the table: 'corrigitur verum'. On the right: Two interpolation tables one above another: 'Tabula attacium: Tabula triangularis, verum correcta per me'. Followed by a 'Tabula quadrangularis': 'Ista tabula est bene correcta per me. Tabula quadrangularis'.
Fol. 150^{v}: Parallax table. 'Tabula diversitatis aspectus Lune in longitudine pro Oxonia, sed non est precisa sed deficit alii per unum minutum vel circiter'. A note at the bottom of the page has been entirely erased and is not legible with a UV lamp.
Fol. 151^{r}: Parallax table (excess) 'Residuum tabule diversitatis aspectus in longitudine'. At the top right of the page 'Lewys'.
Fol. 151^{v}: Parallax table 'Tabula diversitatis aspectus lune in latitudine pro Oxonia grosse calculata per albionum'.

Followed by two notes:
'Nota quod tabulas precedentes quia eas non ita precise calculavi sicut tabulas quas dedi universitatibus Cantabrigie et Oxonie tamen quasi insensibilis est differentia in calculo, experiatur quicumque velit'.
'Expliciunt nove tabule eclipse composite *per Magistrum Johannem Curteys socium Collegii Oxonie de Mertone*, et supponunt quantitates dyametrorum solis et lune et umbre, ut scribitur ante folio 4° et 7° ubi ponitur ars componendi tabulas eclipsis et tabulas diversitatis aspectus'.

Fol. 152^{r} **Interpolation tables excerpted from the book of John Somer with Lewis Caerleon's canons**

'Tabula proportionalis diversitatis aspectus secundum quamcumque differentiam ad 30 extracta de copia manus proprie Frater Sommer'.
Below, interpolation table: 'Portiones longitudinum et est tabula attacium expansa'.
Two short canons are facing the two tables:
First canon: 'Nota quod ista tabula facta est ad alleviandum laborem. Primo ergo, intrandus est in tabula communem diversitatis aspectus regionis [...]–[...] et minuta latitudinis, si pro eis operatis'.
Second canon: 'Nota quod tabula invente subscripta est tabula intitulata ab Azarchele tabula attacium de equatione diversitatis aspectus Lune, sive tabula equationis [...] Istas tabulas inveni scriptas in quodam veteri libro ex manu Frater Somer, istos tunc canones feci ego Lodowycus et in illa tabula quosdam errores inveni quos correxi et hec restant quidam incorrecti. Alias, tunc favente Deo, novas tabulas diversitatis aspectus ad meridiem Universitatis Cantebrigie propono construere et novas tabulas eclipsium cum omnibus tabulis easdem continentibus etc.'
In the margin of the second table, in red ink: 'hec est antiqua tabula'.

Fols 152^{v}–153^{v} **John Curteys (?), eclipse canons**

The eclipse canons are divided into two different parts as it is usual: lunar eclipse (fol. 152^{v}) and the solar eclipse (fols 152^{v}–153^{r}). Emphasis on the different parts made by Lewis who highlighted in red some words to rubricate them. He also wrote in the margins, the titles of the different steps of the eclipse computation developed in his canons.

Fol. 152v: '[Rubric] Modus operandi pro eclipsi Lune per tabulas novas. [Incipit] Intra in tabula eclipsium lunaris cum argumento latitudinis secundo equato cum signis et gradibus eius in capite tabule et cum minutiis [...]–[...] si nullum fuerit dimidium more subrathe solum tempus casus a tempore medio eclipsis pro initio eclipsis habendo et ipsum dupla pro duratione eclipsis habenda etc. Et sic completur opus eclipsis Lune'.

Fols 152v–153r: '[Rubric] Canones eclipsium solis secundum easdem tabulas. [Incipit] Pro quo primitus ista sunt requerenda et memorie commendanda, scilicet tempus vere coniunctionis lunarium diebus equatis. Verus locus lunarium, argumentum verum lune, superatio lune in una hora, centrum lune [...]–[...] principium eclipsis et durationem totalem eclipsis sicut ibidem invenitur [addition by Lewis Caerleon] accipiendo super partem proportionalem de differentia punctorum et minutorum casus inter 2 longiores et sic completur opus. Explicit'.

Fol. 153v **Lewis Caerleon's notes**

On the possibility of a lunar eclipse:

'Secundum Albategni, Arzachelem et Ricardum de Sancto Albano: si distantia a modo sit ultra 12 gradus et 14 minuta non erit eclipsis Lune. Secundum alios si distet per 14 gradus vel plus non erit eclipsis'.

Followed by 'Inventa latitudine lune tempore oppositionis vere cum illa ingredere tabulas Albategni scilicet eclipsim lune quam si solum in tabula longitudinis propioris et non longioris invenies [...]–[...] dico fere propter diversitatem motus lune diversi in hora, propter variationem argumenti in tempore eclipsis etc.'

Fol. 154r **John of Genoa, table of solar and lunar velocities with columns for their radii 'Tabula semidiametrorum Solis, Lune et umbre'**

In the upper margin 'Istam tabulam dubito'. Followed by 'Nota quod luna equatur in tabula considerando equationem centri lune et eius equatione pro una hora distantie ab auge hoc est pro centro, unius gradus et 51 secunda. Sed in quasi tabula quam habemus nulla consideratio ab equatione centri etc.' The table of John of Genoa is indeed computed by considering the 'anomaly' affecting the movement of the Moon: it is described by the equation of centre, which is a corrective function.

John of Genoa's table of radii of the Sun, the Moon and the shadow of the Earth (on the left margin), associated with the canon *Verum*

motus Solis et Lune in una hora. The two last parts of the canon are missing (as it is usual in the tradition) and begins differently.

Heading of the table: 'Tabula semidiametrorum Solis, Lune et umbre et pertinet ad eclipses'.

The canon begins: 'Cum argumento Solis invenies dyametrum eius sicut et motum in una hora sicut semidyametrum Lune et umbre et motum Lune in hora, cum argumento vero Lune. Si argumentum precise non inveneris, vide differentiam. Intrando cum minora propinquiori primo et precise cum maiori propinquiori [...]–[...] in centro epicycli exeunte in auge. Sed in Sole habetur vericumque fuerit'.

Fol. 154^{r} **Table excerpted from John Somer's book**

Red rubric above the table: 'Tabula semidyametrorum solis et lune et umbre et variationis extracta de libro Fratris Sommer de manu sua propria'.

Canon associated with the table: '[Rubric] Sequitur canon tabularum semidiametrorum solis et lune et umbre sequenter extractus de copia manus Frater Sommer. [Text] Cum volueris scire quantitatem dyametri Solis per ista tabula [...]–[...] Item nota quod diametri solis, et lune et semidiametri sunt initii in eclipsi solis, dyametri et semidiametri lune et umbre sunt initii in eclipsi lune etc.'

Fols 154^{v} and 155^{r}–156^{r} **Lewis Caerleon, lunar eclipse table (fol. 154^{v}); tables of difference between the solar and lunar velocities at the time of mean and true conjunction, and their canons, fols 155^{r}–156^{r}**

Notes 'relegitur' and 'religitur totum' or 'relegitur totum et corrigitur totum'.

Fol. 154^{v}: 'Tabula eclipsis Lune pro punctis et minutiis pro gradibus et minutiis argumenti latitudinis lune, fundata super veteres tabulas eclipsium'. This table was crossed out.

Two short canons in the right margin:

'Pro canone tabule sequentis bipartite, quarum prior pars ponatur in prima medietate proximi folii sequentis et est de gradibus distantie luminarium equate tempore medie coniunctionis et oppositionis pro vera coniunctione vel oppositione habenda. Secunda sequentia et est pro minutiis superfluentibus ultima gradus est notandum quod habitis vero loco solis et lune et differentia motuum solis et lune in una hora, id est superatione lune in hora pro tempore medie coniunctionis vel oppositionis [...]–[...] Si vero volueris corrigere vel componere tabula distantie [written above

pro gradus] tot accipe in latere sinistro differentiam motuum solis et lune quamcumque volueris et reduc eam ad idem genus fractionum et per eam sic reductam divide gradum distantie lunarium [...]–[...] ad quotcumque gradum volueris'. Added in a sloppier hand: 'De compositione vero tabule pro minutis superfluentibus invenies in folio proximi'.

Fol. 155^{r}: 'Prima tabula et est tabula distantie solis et lune in gradu solum tempore medie coniunctionis et oppositionis cuius canon precedit hic a sinistris in folio precedente etc.'

Fol. 155^{v}: No table, but the page was ruled for a table. A heading was written: 'Differentia motuum solis et lune in hora tempore coniunctionis vere et oppositionis vere luminarium'. The table was copied on the next folio.

Fol. 156^{r}: Same heading as for fol. 155^{v}: 'Differentia motuum solis et lune in hora tempore coniunctionis vere et oppositionis vere luminarium', it includes the addition: 'pro minutis ultra gradus perfectos in distantia solis et lune'.

A table associated with a short canon in the margin, explaining how to compute and correct it:

'Si velis componere vel corrigere tabulam istam de minutiis superfluentem ultra gradus distantiae luminarium tempore medie coniunctionis vel oppositionis accipe differentiam motuum Solis et Lune [...]–[...] compones tabulam usque ad huius minuta ut produxi'.

Fol. 156^{v} **Lewis Caerleon (?), *Canon tabularum Ptholomei de corda et archu***

'Canon tabularum Ptholomei de corda et archu quas Ptholomeus ponit directione prima Almagesti, capitulo II°, que tabule habent primo lineas numeri continentes numerum graduum et minutorum ab 0 in gradibus et 30 in minutiis usque in 180 gradus crescendo certissime per additionem 30 minutorum [...]–[...] 2da corda correspondente archui 18 gradus, 24 minuta. Et sic operandis est usque in casu consimili etc.'

Lewis Caerleon (?), *De exordio annorum secundum diversas sectas*

'De exordio annorum secundum diversas sectas. Sciendum quod Greci suorum annorum primum computant ab Alexandro Magno et ideo annum suum incipiendo ab Octobri [...]–[...] Anni insuper Diocletiani et anni Alfonsi incipiunt a Junio etc.'

Fols 156^{v}–158^{v} **Anonymous, *Notula de quantitate anni***

According to the table of contents, this text was found by Lewis in John Somer's book. He refers to this text as 'Item quidam bone notule extracte de copia Fratris Sommer de quantitate anni'.

Extensive annotation to the Latin Alfonsine tables and John of Lignères. Some sources of the text are mentioned in the margins. The text also quotes: al-Battani, Albumasar, Azarchel (Toledan tables), Thebit ibn Qurra, etc.

Fols 156^{v}–158^{v}: 'De quantitate anni secundum computationem vulgarem. Annus apud diversas sectas quantitate variatur, nam apud Latinos annus accipiuntur pro spatio temporis quo Sol recedit ab aliquo puncto certo zodiaci [...] (fol. 158^{v}) [in the margin: Conclusio] Nos, quia vestigia et doctrinam peritorum astronomorum regis Alfonsi sequentes et considera communibus nostro tempore acceptis diligenter [...]–[...] Quotiens vero fuerit caput Arietis in meridionali parte circuli brevis a 180 gradibus usque in 360 gradus dictum equatio motus accesus et recessus, predicta subtrahi a medio modo augium planetarum ut habeatur augium verus locus etc., ut patet per tabulas Alfonsi et similiter Thebit etc.'

Fols 159^{r}–175^{v} **Anonymous, judgement on the nativities of Henry VI, *Cum rerum motu***

'Cum rerum motu ac varietate sideree virtutis intelligentiam [...]–[...] vere scientie dilectoribus via veritatis clarius ministretur. Amen. Completum est hoc opusculum, anno Domini M^{mo}CCCC°XLI°, XVIII° die mensis Julii magistris meis specialibus magistro Johanni Somerset et magistro Johanni Langton in vigilia assumptionis beate Marie eodem anno mense Augusti in familia Regis apud Schene per manus meas liberatum'.

Fol. 176$^{r–v}$ **Anonymous, treatise on quadrature of the circle**

'Proposito circulo quadratum equale describere [...]–[...] circulum quod fuit proportionum. Explicit'.

Fols 176^{v}–177^{v} **Campanus de Novare, *De quadratura circuli***

'Franco scolasticus Loadecensis ad humanum archiepiscopum scripsit hunc librum de quadratur circuli [...]–[...] omnis ergo circulus est equalis quadrato. Explicit de quadratura circuli'.

Here the treatise is falsy attributed to Franco of Liège.

Fols 178^{r}–181^{r} **John of Saxony, *Exempla super tabulas primi mobilis et canones Johannes de Lineriis* (incomplete)**
'Quia plures astrologorum diversos libros fecerunt de operationibus tabularum [...] (fol. 178^{v}) illum numerum minorem propinquerem quem accepisti in tabula [...] (fol. 179^{r}) Umbram rectam seu extensam per quamcumque altitudinem seu alterius notam invenire [...]–[...] cum ergo ascendit de equali cum arcu zodiaci proposito'.
Fol. 178$^{r–v}$ only retain John of Saxony's commentary on the first two canons on spherical astronomy of John of Lignères and fols 179^{r}–181^{r} are related to canons 12–18.

Fols 181^{v}–182^{v} Remain blanks.

Fols 183^{r}–184^{r} Horoscopes for Mrs Moores and her husband dated to 1658 and 1659.

Fols 185–187 Remain blanks.

Fol. 188^{v} **Lewis Caerleon, note and computation on the conjunction Mars/Jupiter of 1484**
'Tempus vere coniunctionis ♄ [Saturn] and ♃ [Jupiter] quarto vicinius preter sciri per tabulas anno Domini currente 1484 post meridiem 25 diei novembri'.

Fol. 189^{v} **Lewis Caerleon, computations of the length of the seasons and the year on the year 1482**
'[Running title] Lewis anno Christi 1482 imperfecto. [Beginning of the computation] Dies a vero equinoctio vernali ad verum equinoctium autumnale secundum tabulas Alfonsi'.

Fol. 190^{r} **Lewis Caerleon, circular diagram with notes**
'Circulus exterior est 30 et circulus interior ecentricus Solis'

Fols 191^{v}–192^{r} Sixteenth-century drawings of the navicula.

Appendix 3: Table of contents (Cambridge, University Library, MS Ee.3.61, fol. 2^{v})

Contenta istius liber

Tractatus de arte compositionis tabularum astronomie
Tractatus de compositione rectanguli et eius utilitatibus
Calculatio eclipsis solis anno domini 1481 per diversas vias [added 'Ludo' by a sixteenth-century handwriting]
Opus doctoris subtilis super canones azarchelis sed non completus
Algorismus de minutiis vulgaribus secundum magistrum Johannem de Lineriis
Ars operandi per probas
Algorismus magistri Johannis Kylyngworth
Tractatus Magistri Johannis Asshynden de coniunctione ♂ [Mars] et ♄ [Saturn] in Cancro et de coniunctione ♄ in ♃ [Jupiter] in Scorpione, cum permutatione triplicitatis
Introductorium Alkabitii sed non completum
Opus primum magistri Johannis Holbroke in reductione tabularum Alfonsii ad annos Christi, menses, dies et horas etc.
Item secundum opus eiusdem in compositione novarum tabularum mediorum motuum et equationis dierum
Item diverse tabule eclipsium et tabula equationis dierum secundum magistrum Johannem de Lyneriis
Trutina Hermetis pro calculatione nativitatum
Exemplum calculandi eclipsis solis ad meridiem Parisius secundum tabulas Arzachelis
Item canones magistri Johannis de Lyneriis completi, sed non [in] recto ordine quia canones eclipsis ponuntur in principio ubi deberent poni canones corde et arcus qui secuntur
Arismetica magistri Symonis Bredon
Quidam canones componendi tabulas angulorum pro eclipsibus sed non precisi et meliores habentur in isto primo tractatu de compositione tabularum et operationi habentur versus finem huius libri ante tabulas eclipsis expansas
Exemplum componendi tabulas angulorum et diversitatis aspectus ex opere meo proprio
Tabule directionum Umfredi ducis Gloucestrie
Tabula continens numeros quartos et cubicos et eorum radices
Item notabilis ars componendi tabulas eclipsium et diversitatis aspectus cum exemplis et tabulis sequentibus et eorum canonibus, inter quas est exemplum calculandi eclipsis solis ad meridiem Londoniensis secundum canones Arzachelis
Tabula dyametrorum [solis] et lune et umbre et tabule distantie lunarium, tabula stationis lune in hora cum aliis tabulis necessariis pro coniunctionibus et oppositionibus et eclipsibus lunarium
Item quidam bone notule extracte de copia Fratris Sommer de quantitate anni
Item tractatus des calculatione nativitatis Regis Henrici 6 et potius de correctione etc.
Item tractatus de quadratura circuli. Item alius tractatus de eodem
Item quedam extracta super canones magistri Johannis de Lyneriis per magistrum Johannem de Saxonia sed non completus

[Added 'Lewys Kaerlyon' by a sixteenth-century hand]