An Easter cycle in Hebrew from c. 725 CE

Abstract:
A fragmentary manuscript from the Cairo Genizah (T-S NS 98.51) contains a description in Hebrew of the Julian calendar, how to calculate its dates, and a 19-year Easter cycle, all in the Byzantine tradition of calendar computation. The Easter cycle is presented in this document as a list of (Christian) Passover dates, and can be dated precisely as starting in 725 CE; this provides an approximate date for the text's composition. Palestinian provenance is most likely. Some the Easter cycle's features have been Judaized, seemingly to adapt it for Jewish use. This text opens a new perspective on transfer of knowledge from Christians to Jews in this period, and also provides a context for the origins of the fixed Jewish calendar. Edition of this manuscript has been assisted by multi-spectral imaging (MSI).

Keywords: Easter, Jewish calendar, 19-year cycle, Cairo Genizah, multi-spectral imaging

A fragmentary manuscript from the Cairo Genizah presents a description in Hebrew of the Julian calendar and how to calculate its dates, and the cycle that is used by Christians to calculate the date of Easter. Jewish knowledge of the Christian calendar is generally not well attested in the medieval Near East;[1] all the more remarkable is the earliness of this Genizah text, which can be dated to the early eighth century CE. The extent to which late antique and early medieval Jews were knowledgeable of Christianity, as reflected for example in polemical passages within early rabbinic literature, remains much debated. This document, completely factual and non-polemical, opens a new perspective on Jewish knowledge of Christianity and attitudes towards it in the early Islamic period.

The Christian invention of Easter cycles goes back to the early third century. Until then, Christians had depended largely on when the Jews celebrated Passover. This is because Passover and Easter were originally one and the same festival, sharing the same name of *Pesaḥ* (Hebrew) or *Pascha* (Greek), and presumably observed in similar ways, at least by those Christians who were still committed to Jewish observances. The main difference, probably from the outset, was that Christians invested the Biblical festival with an additional meaning: it was the anniversary of the death of Jesus and of his resurrection. For many Christians, the integrity of this celebration depended on observing Easter at the same time as the Jews, because it was on the Jewish Passover that Jesus was crucified. However, by the third century, Christians began to devise cyclical, fixed schemes to enable the calculation of the date of Easter regardless of when the Jews might have been celebrating it. It was about dissociating themselves from the Jews, and endowing the main celebration of Christianity with an increasingly distinctive identity.[2]

The Easter cycle of 19 years emerged in Alexandria during the fourth century, and by the mid-fifth century became dominant through most of the Christian world. It took at least another century to

---

[1] See N. Vidro, 'Muslim and Christian calendars in Jewish calendar booklets: T-S K2.33', Genizah Research Unit: Fragment of the Month (March 2021), https://doi.org/10.17863/CAM.82611; N. Vidro and S. Stern, 'A tenth-century Jewish correction of the Easter calendar', *Le Muséon*, 134 (2021), 353-371. It is only later, in western Europe and under Christian rule, that Jews produced detailed descriptions and discussions of the computation of the date of Easter (the earliest known is Abraham bar Ḥayya, *Sefer ha-Ibbur* 3:10, c. 1123 CE, followed by Isaac Israeli, *Yesod Olam* 4:17, c. 1310 CE, and shorter anonymous texts such as in Parma Ms. 2113, fol. 113r, c. 1381 CE) and of the Christian liturgical calendar (on which see S. Stern, 'Christian Calendars in Medieval Hebrew Manuscripts', *Medieval Encounters* 22 (2016), pp. 236-65).

[2] See A. A. Mosshammer, *The Easter Computus and the Origins of the Christian Era*, Oxford: Oxford University Press, 2008; S. Stern, *Calendars in Antiquity*, Oxford: Oxford University Press, 2012, pp. 380-422.

become accepted in Syria and the Near East, where the tradition of 'following the Jews' for the date of Easter remained tenacious for much longer.[3] At a later stage the Jews themselves adopted a 19-year cycle to regulate their calendar; when this happened in unclear, but mention of a 19-year cycle in not attested in Jewish sources before the seventh century.[4]

Jewish Passover and Christian Easter were thus closely entangled through late Antiquity and the early Middle Ages, and this mutual entanglement strongly impacted the history of both Christian and Jewish calendars. This entanglement is much at work in our Genizah fragment, as we shall presently see. Early eighth-century Jewish interest in Easter cycles was related to attempts, in this period, to establish a Jewish calendar that would become, like Easter cycles, eventually fixed.

Description and synopsis

Cambridge University Library T-S NS 98.51 consists of a single bi-folio on parchment. It is frustratingly very mutilated, with little or no realistic hope of ever recovering its missing fragments. It is unclear whether the folios are continuous, and which folio comes first. The maximum dimensions of each folio are 15 x 9 cm, with approximately 20 lines of text. I estimate the width of the text is about 7 cm, based on lines that can be reconstructed with near certainty (e.g. recto left ll. 15-16). There is sporadic Tiberian pointing. The manuscript can be dated palaeographically to the late tenth century, but as I shall argue, its text was composed much earlier.

Although very damaged and lacunary, enough has been preserved of the bifolio to enable a partial reconstruction of the text. Textual reconstruction or conjecture are eased by the formulaic nature of calendars. But calendar texts also present specific challenges, as the legibility and accurate reading of numerical characters can often be critical to meaning and interpretation. I was able to improve my readings by examining the original in 2020, but the real breakthrough came about through multi-spectral imaging (MSI), provided by Cambridge University Library in the summer of 2024. MSI consists in capturing multiple images of a single object in light wave-lengths ranging from infra-red and visible colours to ultra-violet; the set of monochrome images (called 'multi-spectral cube') is then processed to create composite images that can reveal features not visible to the human naked eye. The successful use of MSI for the edition of this text is an encouragement to use this technique more widely in Cairo Genizah studies.[5]

In broad terms, the extant text can be divided into four sections. The first section, which takes up the whole of the first folio, consists of a description of the Julian calendar and how to calculate its dates, as well as the Julian dates of new moons. The second section, at the beginning of the next folio (which is not certainly continuous with the first), is very mutilated but appears to be about the

---

[3] S. Stern, 'Rabbinic, Christian, and local calendars in late antique Babylonia: influence and shared culture', in M. Geller (ed.), *The archaeology and material culture of the Babylonian Talmud*, Leiden: Brill, 2015, pp. 260-288, on pp. 275-81. This tradition was still live in Syria, in a certain form, in the eleventh century: see S. Stern, *The Jewish Calendar Controversy of 921/2 CE*, Leiden: Brill, 2019, p. 458.

[4] Its earliest attestation in Jewish sources is in the Qilliric *Silluq* for *Shabbat Rosh Ḥodesh*: CUL T-S 10H7.1 fol.1 recto and Paris Ms AIU IV.C.489.

[5] I am grateful to Maciej Pawlikowski (Cambridge University Library) for providing this service and for his general advice. The monochrome images were taken on a MegaVision Monochrome camera system; they ranged from the ultra-violet band (365nm) to the infra-red (1050nm), and variously captured reflective, transmissive, and fluorescence light. The multi-spectral cubes were processed with ENVI Geospatial software, mostly using the processes of Maximum Noise Fraction (MNF) and Independent Component Analysis (ICA). All images, monochrome and composite, are identified in this article by the filenames assigned to them by Cambridge University Library, but for economy I have generally omitted the prefix 'TS-NS-00098-00051'. For an explanation of a sample of filenames and the technical information they signify, see the captions on the figures.

calculation of *tequfot* (equinoxes and solstices) as found in the Babylonian Talmud (*bEruvin* 56a). The third section is the 19-year cycle, which I identify as an Easter cycle. The fourth section begins a prognostication treatise in Aramaic, known as *Masoret Ezra*.[6]

The following is a more detailed synopsis, by line number (square brackets indicate textual conjectures):

Recto left

1-4: length of solar months and solar year (in the Julian calendar).
5-7: [the Julian leap year].
8-13: length of lunar months and lunar year (in the Jewish calendar); difference from solar year.
13-19: calculating the weekday on which any Julian month starts (starting from *Marḥeshwan* = October).

Verso right

1-7: calculating the weekday on which any Julian year starts, based on a 28-year cycle.
7-11: the year when the 28-year cycle starts [this is year 4105 (344/5 CE)].
11-20: calculating the Julian date of any new moon (*molad*), i.e. beginning of any lunar month.

[lacuna?]

Verso left

1-6: [calculating *tequfot*]
7-21: the 19-year cycle: years 1-14

Recto right

1-5: continued: years 15-19
5-18: *Masoret Ezra*

The bifolio presents itself as a compendium of diverse texts of calendar and divination, in Hebrew and Aramaic, from a variety of sources. Although I shall date the Easter cycle to the early eighth century, the other texts could well have been composed much later. There is nevertheless a certain unity binding these texts together. The prognostications of *Masoret Ezra* are based on the day of the week when 1 January has fallen. The use of this work demands knowledge of Julian dates, which would not be obvious to Jewish calendar users. This explains why the compendium includes an explanation of the Julian calendar, and specifically of how to calculate the weekday of the beginning of Julian months and year. In contrast, the calculation of *tequfot* and the Easter cycle are irrelevant to *Masoret Ezra* and appear to interrupt the link between the Julian calendar and the latter. This may be an argument for reversing the folios, and positioning verso left / recto right (*tequfot*, cycle, *Masoret Ezra*) before recto left / verso right (Julian calendar). In this edition, however, I have chosen to retain the recto-verso order that is assumed in the Cambridge University Library catalogue.

[6] On *Masoret Ezra* see R. Leicht, *Astrologumena Judaica. Untersuchungen zur Geschichte der astrologischen Literatur der Juden*, Tübingen: Mohr Siebeck, 2006, pp. 56-9. The version in T-S NS 98.51, not known to Leicht, was identified more recently by Gideon Bohak, who is now preparing a critical edition of it (further text witnesses omitted by Leicht include Vatican Ms ebr. 525, fols. 62r-63r; Cambridge Ms Add. 530, fol. 128r; and New York Ms JTSA 6926 (Rab. 1093) fol. 76v). I am grateful to Gideon Bohak for directing my attention to the calendrical part of T-S NS 98.51 in the summer of 2018, and encouraging me to edit it separately.

I have also taken the decision not to edit the *Masoret Ezra*, as it lies outside my expertise, and its edition would necessitate a different methodological approach (including systematic comparison with other known versions of the work). I leave this task to more expert scholars.

T-S NS 98.51: text and translation[7]

Recto left

1	… should know the solar months:	[......]ה יהא יודע חדשי ש[מש כל]
2	every month has 30 days and 10 hours	א[חד וא]חד חֹדֶשׁ יש בו לׄ יום ו[יׄ שעות]
3	and a half, and this amounts to three hundred and sixty-	וחצי ו[הן] עולים שלוש מאות וש[שים]
4	five days and six hours in the year.	וחמש[ה ימים ושש] שׁעות [לשנה]
5	Every year there remains 6 hours and in four years	נותר [לכל שנה וׄ ש]עות ו[לארבע שנים?][8]
6	this amounts to one day, and they make of it	זה [עולה אחד יו]ם וע[ושים ממנו]?
7	a leap year ….	[שנת עיבור? ....]מק[.........]
8	The lunar months are of 29 days and a half	[חדשי לבנה] הן מן כׄ[טׄ ימים וחצי]
9	and two thirds of an hour and 73 parts,[13] which make three	ו[9][שתי ידות] שעה ועׄגׄ [חׄל]ק[10] [והן שלוש]
10	hundred and fifty-four days, eight	מא[ות] וחמשים וארבע ימ[ים ושמונה]
11	hours and 876 parts.[14] Solar years	שעות וחׄלק תׄתׄעׄוׄ < [שנים שלחמה]
12	exceed lunar ones by 10 days, 21	יתירות משללבנה יׄ[11] [ימים וכׄאׄ]
13	hours and 204 parts. To find on which	שעות ורׄדׄ חׄל < הרוצ[ה למצוא באיזה]
14	(week)day their Kalends fall, let him take from Marḥeshwan[15]	יום יבוא קלנדס שלהן יט[ול ממרחשון]
15	3 days, from Kislev 2 days, from Tevet 3 days,	[גׄ] ימים מכסליו גׄ[12] ימים מטבת [גׄ ימים]
16	from Shevat 3 days, from Adar in a leap year	[מ]שבט גׄ ימׄים ומאדר כש[יש עיבור]
17		אׄ יום ומניס[ן גׄ י]מים ומ[כל חודש]
18		[י]טול ממנו [הימים היתירים]
19		מכׄ[חׄ] ימים עד החוד[ש שירצה?]

[7] A preliminary and simplified edition of T-S NS 98.51, with a brief discussion, appeared in S. Stern, 'An Eighth-Century Easter Cycle in Hebrew (T-S NS 98.51)', Genizah Research Unit: Fragment of the Month (April 2022), doi:10.17863/CAM.99631. The present edition is more detailed and reflects the improved readings achieved in 2024 with MSI, leading in some cases to substantial revisions. In the text, I have greyed the characters that are poorly legible; characters in square brackets (and greyed) are conjectures. In the translation, only the most significant conjectures are greyed.

[8] I have marked these conjectures with question marks as they are completely tentative and many other options are possible.

[9] The character is faint and could be read differently, but in context can only be *waw*. Traces of ink are visible in F+RFCUBECM3-MNFb-B3B7B11.

[10] Abbreviation of חלקים, and so in ll. 11 and 13.

[11] This character appears faint but it is clearly visible in multi-spectral imaging.

[12] Error for בׄ (corrected in the translation).

[13] As appears in *bRosh ha-Shanah* 25a.

[14] The total of twelve lunar months.

[15] 'Kalends' designate the first day of any month in the Roman, Julian calendar. 'Marḥeshwan' and the other month names in ll. 14-17 do not refer to Jewish but to Julian months: Marḥeshwan is October, Kislev is November, etc., as found in later Hebrew sources.

17 1 day,[16] from Nisan 3 days, and from all (other) months
18 take the days in excess
19 of 28 days, until the desired month.

Verso right

1 For every desired month, let him calculate
2 also how many years have gone into the 28-year cycle[17]
3 … and from each one take 1 day and another day from every four
4 years, add them all up, cast out the 7s, and see
5 how many are left. If 3 are left, it will fall
6 on Wednesday, if 2, on Tuesday, if 1, on Monday,
7 and so the whole week. To find
8 when the first year falls,
9 let him calculate from the year 4105
10 which is the beginning of the count of the years of the cycles
11 of 28 and 19 years.[18] To find

1 [ולכל]חודש שרוצה למצוא י[חשוב?]
2 [גם כ]מה שנים ניכנסו למחזו[ר כׄחׄ שנים]
3 [....] וטול מכל[22] יום אׄ ועוד י[ום מ]ן ארבעה
4 [שנים וי]כללם[23] כו[לם ויוציאם] זׄזׄ ויראה
5 [כמה נות]רו[24] א[ם נותרו] ג יבוא
6 [ביום דׄ אם] בׄ ביום [גׄ אם אׄ] ביום
7 בׄ ולכל השבו]ע > [הרוצה]
8 [למצוא מתי נו]פלת שנ[ה ראשונ]ה
9 [יחשוב משנת] ארבעת א[לפים ו]קה[25]
10 [שהיא שנה אׄ ?] מחשבון שנת[מחז]ורי
11 [כׄחׄ[26] ו]יׄטׄ שנה > הרוצה [למ]צוא
12 [המולד בח]שבון שלהן יחשוב ימי [כל][27]
13 [חודש מ]ן יונאריס לׄאׄ פבראריס
14 [כׄחׄ וב]עיבור כׄטׄ עד שתבוא בחודש
15 [בו יה]א מולד לבנה וראה[28] בכמה[29]
16 [בח]ודש שלחמה יבוא ראש חו[דש][30]
17 [...] וימי[31] החודש [ש]וי[ם] הכל[32]

---

[16] February has 29 days, hence an excess of one day.

[17] i.e. how many years of the cycle have passed.

[18] 4105 from the Creation corresponds to 344/5 CE, which is year 1 of the grand 532-year cycle (= 28 x 19) in the Byzantine tradition.

[22] Perhaps אחת is missing here.

[23] The *kaf* is best visible in MSI images, e.g. B+RFCUBECM3-MNFy-B5B9B13 and B+RFCUBECM3-MNFb-B3B5B9. The verb כלל is attested in this sense in *Baraita de-Shemuel* ch. 5 (late 8th century): G. B. Sarfatti, *Mathematical Terminology in Hebrew Scientific Literature of the Middle Ages* (Jerusalem: Magnes Press, 1968), pp. 51-2 (no. 64) and 100-1 (no. 141) [Hebrew].

[24] Cf נותר in recto left l.5. Alternatively: רו[נשתיי] (cf verso right l. 20). The apparent space before the extant letters רו is most likely due to ink fading.

[25] The *heh*, and fragments of *waw-qof*, are faintly visible at naked eye and more clearly in B+RFCUBECM3-MNFb-B3B5B9 and B+IRCUBE-MNFb-B1B2B4. However, in the MSI images these characters look very discoloured in comparison to the rest of the manuscript, which may be viewed as problematic (see the contrast between end of lines 9 and 10 in Figure 1). Ink penetration from the recto cannot be excluded, although the expected text on the other side is ושתי (recto left, line 9), which cannot be read on this side in mirror writing.

[26] This reconstruction seems reasonable as otherwise the lone mention of the 19-year cycle is out of context.

[27] The end of the line is covered over with a small piece of parchment (?) with the letters תבׄ upside down, but the handwriting seems different and this piece may well have stuck itself on from elsewhere.

[28] The *resh* is clearest in B+RFCUBECM3-MNFy-B5B9B13 (which generally assists the reading of ll. 15-18: see the following notes and Figure 2).

[29] The *kaf* is very faint, but plausible in context.

[30] The last three words are only legible in MIS images, particularly B+RFCUBECM3-MNFy-B5B9B13.

[31] B+RFCUBECM3-MNFy-B5B9B13 suggests that the initial letter is *waw* rather than for example *bet.*

[32] The *heh* is only visible in B+RFCUBECM3-MNFy-B5B9B13 (which generally assists the reading of this line). The *lamed* is fragmentary and uncertain.

12 the new moon according to their reckoning,[19] let him calculate the days of every
13 month, from[20] January 31, February
14 28 or in a leap year 29, until the month
15 in which the new moon occurs,[21] and see on which day of
16 the solar month the beginning of the (lunar) month falls
17 … and the dates of the (lunar) month(s) are all the same
18 (in any cycle of 19 years). Take
19 …. the first
20 … that remains from completing

18 [בכל מחזור] יט̇[33] שנה ויט[ול]
19 [...................] הראשונים
20 [.............]ה שנשתייר מלהשלים

Verso left

1	… you are seeking …	[...........] תבקש[35][...	1
2	… sev]en hours [and a half]…	[...]ק תש[. שב]ע[36] שעות [וחצי	2
3	… 91 days …	[..]ויא ימ̇ צ̇א [........]	3
4	day 6 …	יום ו [..........]צא:	4
5	fourth … parts	רביעי[37] [..........] ח̇ל̇[ק]	5
6	New [months …]	ראשי [חודשים.....]ה [....]	6
7	The 19(-year) cycle	[מחזור] יט̇	7
8	First year: Passover falls on 2 (April),[34]	שנ[ה ראשונה יבוא פ]סח בש[נים][38]	8
9	…day. Year 2: Pass. falls on 2(2 March),	יום [. שנה ב̇ יב̇ פס̇] בעשרים וש[נים][39]	9
10	…day. Y3: intercalation, Pass. falls on 10 (April), …	יום [. ש̇ ג̇ עיבור]י̇ פ̇ בעשרה [יום .]	10
11	Y4: Pass. falls on 30 (March), Tuesday	ש̇ ד̇ יב̇ [פ̇ בשל]ושים יום ג̇	11
		ש̇[40] ה̇ יב̇ פס̇ בתשע עשרה יום[41] [.]	12
		ש̇ ו̇ עיבור יב̇ פס̇ בשבעה יום ו̇	13
		ש̇ ז̇ יב̇ פס̇ בעשרים ושבעה י̇ [.]	14

[19] i.e. the Julian date of the new moon.

[20] i.e. starting from January with 31 days, etc. Unlike recto left ll.14-17 (above), the text here uses Latin (or Hellenized Latin) Julian month names (January and February). Since the context is the calculation of lunar dates, the text finds it perhaps more important to disambiguate and clarify, through the use of Latin or Greek names, that these are Julian months.

[21] i.e. the new moon whose Julian date is sought.

[33] The *yod* is more clearly visible in B+RFCUBECM3-MNFy-B5B9B13.

[34] As in most Easter cycles, the month names of March and April are not explicit, but this is because they are easy to identify. Any number below 21 is April. In any year when there is an intercalation, the Passover date is in April; in subsequent years, the date recedes each year by 11 days, until it falls in March.

[35] If the final letter is indeed a *shin*, only its right stroke is preserved. But the descender of the *qof* is strikingly visible in ink that has penetrated to the recto, e.g. F+IRCUBE-ICAb-B1B3B4, where the readings of verso left ll. 1-3 are generally clarified: see Figure 3. This reading is also confirmed in B+RFCUBECM3-MNFb-B3B5B9.

[36] MSI images confirm that the first two characters are not extant.

[37] The final *yod* is somewhat elongated, but this seems like the only plausible reading.

[38] The reading of *shin* is doubtful; only its right stroke would be very faintly visible. The next two letters are covered over by a small fold in the parchment (I have not requested Cambridge University Library to unfold this). [בש[לשה is also possible, but I favour [בש[נים (‘two’) as this is the date of the Byzantine Easter cycle.

[39] Here the *shin* is clearly visible but only in MSI images, e.g. B+RFCUBECM3-MNFb-B3B5B9 and B+RFCUBECM3-MNFy-B5B9B13. As to my textual conjecture, the same applies as in the previous note.

[40] From this point onwards the *shin* for שנה is broken.

[41] The left edge of the *mem* is rubbed off.

12	Y5: Pass. falls on 19 (March), …day.	שׂ חׄ עיבור [יבׄ] פוׄס בחמשה עש[ר יׄ .]	15
13	Y6: intercalation, Pass. falls on 7 (April), Friday	[שׂ טׄ] יבׄ פוׄס [ב]ארבע יׄ זׄ	16
14	Y7: Pass. falls on 27 (March), …day.	[שׂ יׄ יבׄ פוׄס ב..] יׄ גׄ	17
15	Y8: intercalation, Pass. falls on 15 (April) …	[שׂ יׄאׄ ע[י]בו[ר יבׄ פוׄס ב..] יׄ גׄ	18
16	Y9: Pass. falls on 4 (April), Saturday	[שׂ יׄבׄ] יבׄ פוׄס [ב... יׄ] אׄ[42]	19
17	Y10: Pass. falls on …, Tuesday	[שׂ יׄגׄ] יבׄ פוׄס ב[.. יׄ .] ה[43]	20
18	Y11: intercalation, Pass. falls on …, Tuesday	[שׂ יׄדׄ] עיבור יבׄ פוׄס [בש]בע[44] יׄ גׄ	21
19	Y12: Pass. falls on …, Sunday		
20	Y13: Pass. falls on …		
21	Y14: intercalation, Pass. falls on 7 (April), Tuesday		

Recto right

1	Y15: … day	[שׂ יׄהׄ יבׄ פוׄס ב..] יׄ [.]	1
2	Y16: Pass. …	[שׂ יׄוׄ יבׄ] פוׄס [ב.. יׄ .] [45]	2
3	Y17: intercalation, Pass. falls …	[שׂ יׄזׄ עיב]ור יבׄ [פוׄס ב. יׄ .]	3
4	Y18: … tw[enty ….] Sunday	[שׂ יׄחׄ יבׄ פוׄס ב]ע[46][שרים וחמישה יׄ] א[47]	4
5	Y19: intercalation, Pass. … If the	[שׂ יׄטׄ עיבור יבׄ] פוס[48] [ב.. יׄ . < אין][49] אתא	5
6	Kalends of January fall on a Sunday, winter will be good …	[קלנדס יינרו בחב]שובה [יהא סיתוא] טב	6

Julian calendar calculations

In this section, I shall explain the calculations that appear in the first folio (recto left– verso right). Understanding these calculations is not essential for the reader. What matters most is to appreciate

[42] The traces of ink are firm, but do not add up to the size of a whole character; they are most likely remnants of *aleph*, as more visible in B+RFCUBECM3-MNFb-B3B5B9 and B+RFCUBECM3-MNFy-B5B9B13: see Figure 4. If, as I shall argue, our text is a Byzantine Easter cycle and the date for this year is thus 1 April, then the Julian calendar necessitates that its day of the week is Sunday, in consistence with the extant date of Tuesday 30 March in Year 4.

[43] Traces of *heh* are visible in B+RFCUBECM3-MNFb-B3B5B9 and B+RFCUBECM3-MNFy-B5B9B13: see Figure 4. Again, if our text is a Byzantine Easter cycle and the date for this year is 21 March, Thursday is necessitated by the Julian calendar, after the extant date of Saturday 4 April in Year 9.

[44] The lower bar of *bet* is clearly visible especially in B+RFCUBECM3-MNFb-B3B5B9 and B+RFCUBECM3-MNFy-B5B9B13: see Figure 4. If these dates are from the Byzantine Easter cycle, then 7 April is wrong: it should be 9 April. In such a case, בשבע, 'on the seventh', would be a scribal error for בתשע, 'on the ninth', perhaps due to their similar ending. In principle 7 April would be possible in a lunar calendar, provided some flexibility is applied: from 4 April (year 9) to 7 April (year 14) there are 1829 days (or 1830 days if there are two leap years in this period), whilst five lunar years (including two intercalations) count on average 1831 days. But a scribal error is more likely, for as we shall see, 7 April does not agree with any known lunar calendar (e.g. rabbinic).

[45] Traces of letters at the end of the line (including the tantalizing appearance of a *heh* or *aleph*, which could have indicated Thursday or Sunday respectively) are only ink penetration from the verso, as made clear in MSI images such as F+IRCUBE-ICAb-B1B3B4.

[46] The confusing appearance of a final *nun* cutting across the foot of the *ayin* on the left is only ink penetration from a *heh* in the verso (verso left, line 6), as clarified in F+IRCUBE-ICAb-B1B3B4 where the *ayin* and the apparent final *nun* appear in different colours: see Figure 5.

[47] This character appears clearly in ultra-violet image F+W365O22_023 (Figure 6) and composite image F+RFCUBECM3-MNFb-B3B7B11 (Figure 7).

[48] The *samekh* is doubtful.

[49] Here begins *Masoret Ezra*.

that these calculations are firmly grounded in the specifically Byzantine tradition of the Julian calendar and Easter computation ('Computus').[50]

The calculation of the weekday of the beginning of any Julian year or month (recto left 13 – verso right 11), or indeed of any date in the Julian calendar, takes as reference point the first day of the 28-year cycle, which always returns to the same weekday. All that is needed is to count how many days have elapsed since this first day. Of the total number of days, multiples of seven are cast out. The remainder is the number of days to add to the first weekday of the cycle (more precision on this below); the result is the current day of the week.

This calculation is presented in this text in what might seem a reverse order. Firstly, one counts the number of days elapsed from the beginning of the year until the current day. This can be done month by month. Three days need to be counted for a 31-day month (as 28 days are cast out), 0 days for February, except in a leap year when 1 day is counted; etc. (recto left ll. 14-19). Secondly, one determines the number of years elapsed from the beginning of the 28-year cycle. For every year, one day is counted (since the Julian year counts 365 days, and 364 is a multiple of 7, leaving a remainder of 1); for every leap year, an extra day is added (verso right ll. 1-3). In order to know in which year the 28-year cycle began (and hence, how many years have elapsed since its beginning), it is enough to know that the year 4105 (since the Creation, as reckoned in the Palestinian Jewish tradition) was the beginning of a 28-year cycle, as it is also the beginning of a 532-year cycle (which, as the text puts it, is a combined cycle of 19 x 28 years; verso right ll. 7-11). All the days counted are added up, and all sevens are cast out (verso right l.4). The resulting number of days can be called the 'solar epact', which is apparently added to Sunday. Thus if this epact is 3, the current weekday is Wednesday (fourth day of the week); if 2, it is Tuesday; etc. (verso right ll.5-7).

A similar calculation is then carried out for determining the Julian date of any new moon. The text is too fragmentary to establish exactly how this calculation works, but it appears to be based on knowledge of the lunar epacts (age of the moon) on 31 December; to these epacts are added 31 days for January, 28 for February etc. until the new moon date that is sought. A list of lunar epacts for an entire 19-year cycle could have been provided for the purpose of this calculation, but that would have appeared on another folio that is now missing.

The calendar computations assumed in this text, and in particular the structure of the 28-year cycle, correspond in every detail to the Byzantine computational tradition, which would have been known and used in the medieval Byzantine Empire and the Near East (but not in Egypt, where the Coptic calendar was used).[51] Although the Byzantine New Year was on 1 September, the 28-year cycle (which was part of the Byzantine Easter computation) began on 1 October;[52] this explains why the sequence of months whose days are added up, in recto left l. 14, begins with Marḥeshwan, i.e.

---

[50] Similar calculations can be found in T-S K2.45 and JTS ENA NS 63.7 (discovered by Y.Y. Rottenberg).

[51] See in general F. Acerbi, *Byzantine Easter Computi*, Vatican: Biblioteca Apostolica Vatican, 2024, with comments on Stern, 'Eighth-Century Easter Cycle', on pp. 19-20.

[52] This 28-year cycle, beginning on 1 October, is attested in a number of anonymous ninth-century Byzantine treatises: see C. Gastgeber, 'Neue Texte zum Computus byzantinischer Zeit im Codex Ambrosianus A 45 sup.', in *Jahrbuch der Österreichischen Byzantinistik (JÖB)*, 71 (2021), pp. 193-258, https://doi.org/10.1553/joeb71s193, on p. 238 (this is Anonymus 830 in Acerbi, *Byzantine Easter Computi*, pp. 401-12); F. Acerbi, 'Byzantine Easter Computi. An Overview with an Edition of Anonymus 892', in *JÖB* ibid. pp. 1-62, https://doi.org/10.1553/joeb71s1, on p. 28 (section 1), see also p. 37 (also Acerbi, *Byzantine Easter Computi*, pp. 412-22). A 28-year cycle was already used by George the Monk (638/9 CE): ed. Fr. Diekamp, 'Der Mönch und Presbyter Georgios, ein unbekannter Schriftsteller des 7. Jahrhunderts', in *Byzantinische Zeitschrift,* 9 (1900), pp. 14-51; Acerbi, *Byzantine Easter Computi*, pp. 369-76; discussion in J. Lempire, 'Le calcul de la date de pâques dans les traités de S. Maxime le confesseur et de Georges, moine et prêtre', in *Byzantion*, 77 (2007), pp. 267-304.

October. For the calculation of the Julian date of the new moon, in verso right l. 13, the first month is January: this is again consistent with Byzantine Computus, in which the lunar epacts are defined as the age of the moon on 31 December, in relation to which subsequent lunar dates are calculated.[53]

In the Byzantine tradition, the 28-year cycle begins on a Monday, which corresponds to Monday 1 October 5509 BCE, year 1 of the Creation, the beginning of the first 28-year cycle. The Byzantine tradition considers further that the epact at that point is 1, which needs to be added to Sunday. If, elsewhere in the cycle, the epact is 3, the weekday will therefore be Wednesday.[54] Our text follows exactly this calculation,[55] whilst ignoring rabbinic tradition in which the 28-year cycle begins on a Wednesday.[56]

The year that is used as reference, for the beginning of the 28-year cycle, is not year 1 of the Byzantine world era, but rather what our text expresses according to the Jewish era of Creation as the year 4105.[57] This corresponds to 344/5 CE, which indeed, in Byzantine tradition, marks the beginning of a 532-year cycle (the twelfth such cycle since the Creation in 5509 BCE). This year would have been used as reference point in Byzantine Computus for as long as the cycle lasted, until 876/7 CE.[58]

Byzantine Computus is further evident in the 19-year cycle that appears on the second folio, as we shall now see. Although these texts may be of different authorship, their common use of Byzantine Computus (and not, for example, Coptic or Alexandrian) points in the direction of a Palestinian cultural provenance. The identification of these texts as specifically Palestinian (and not for example Syrian) is supported at least in this first folio (verso right, l. 13) by the use of Greek (or Hellenized Latin), and not Syriac, Julian month names.

The Byzantine Easter cycle of 725 CE

Most of the second folio is taken up with a 19-year list or cycle of Passover dates. The text is headed with a centred caption that likely reads: 'Cycle of 19' (though the word 'cycle' is not extant). It is followed by a list of 19 consecutive, numbered years, each mentioning Passover (פסח, *pesaḥ*) with its date (implicitly, Julian) and its day of the week. The date is written out in full words, whereas the day of the week is written as an alphanumeric.

---

[53] As can be inferred already from George's Computus (Diekamp, ibid., pp. 27-9; Lempire, ibid., p. 284, is a little misleading on this).

[54] A relatively early attestation of this Byzantine tradition is the first wheel in the prologue to the *Chronicon Paschale* and its accompanying commentary, which are an eleventh-century interpolation (ed. Dindorf, Bonn 1832, addendum to p. 25; brief description in Mosshammer, *Easter Computus,* p. 292). But already the ninth-century sources attest this tradition: Anonymus 830, fol. 39v ll. 7-12 (Gastgeber, 'Neue Texte', p. 239), and Anonymus 892 section 13 (Acerbi, 'Byzantine Easter Computi', p. 42). The *Chronicon Paschale* itself, dated 630 CE, has a different 28-year cycle which it calls 'according to nature' and begins in March 5509 BCE on a Sunday with an epact of 7 or 0 (*Chronicon Paschale* 23:15-27.3; Mosshammer, *Easter Computus,* pp.291-3, 300-10); this system could also be compatible to the calculation in our text, if we assume that 'year 1' marks the completion of the first year. I am grateful to Fabio Acerbi for clarifying the above with me.

[55] Verso right ll.5-7. I do not understand, however, why our text illustrates the results of the calculation by starting with epact 3 (Wednesday) and then reversing to epact 2 (Tuesday) and finally 1 (Monday).

[56] *bBerakhot* 59b; Eleazar be-Rabbi Qillir, e.g. *Eḥad be-eḥad gashu* ll. 80-2 (in S. Spiegel and M. Schmelzer, *Avot ha-Piyyut*, New York: JTS, 1996, pp. 97-123); *Pirqei de-Rabbi Eliezer* 6.

[57] Verso right ll. 7-11. But the text is partially lacunary and difficult to read, and the reading '4105' is not unproblematic: see note to text.

[58] It is used for example by George the Monk (Diekamp, 'Der Mönch', p. 27).

The list is initially laid out as a continuous text, but as it progresses the layout becomes increasingly tabular, with a separate line for each year of the cycle (from Year 4 onwards), the increasing use of abbreviations (e.g. פ̇ י̇ in Year 3, then יב̇ פס̇ from Year 5, for יבוא פסח; and from Year 5, a broken-off *shin* for שנה), and from Year 9 onwards, the weekday number positioned in a separate column in the centre-left.

The provision of dates and days of the week enables a precise identification of the cycle. Although the text is very fragmentary, enough survives of it to establish that despite the term *pesaḥ*, which might look misleadingly Jewish, this list of Passover dates is Christian, more specifically Byzantine Christian, and corresponds to the Easter 19-year cycle beginning in 725 CE.

In the Christian tradition, the date of Easter depends on when Passover falls, which is a lunar date (the 14th of the first month, as according to the Bible). Passover can fall on any day of the week; Easter is always on the following Sunday. The Julian date of Easter, in any given year, depends therefore on the Julian date of Passover and on its weekday. Christian Easter cycles provide the Julian dates of Passover, in March or April, that succeed each other in a fixed, reiterated cycle of 19 years. But Passover weekdays change from one 19-year cycle to the next; every 19-year cycle has its own, unique sequence of Passover weekdays. Only after 28 reiterations of the 19-year cycle, the sequence of Passover weekdays repeats itself: this is the grand cycle of 532 years.

Several contextual indications support the identification of the 19-year cycle in T-S NS 98.51 as Christian. As we have seen, the same bifolio contains a description of the Julian calendar, which is emphasized to be ‘theirs’ (i.e. of the Christians),[59] with calculations that are specific to the Byzantine Computus tradition, and with a reference to the Easter cycle of 532 (or 28 x 19) years.[60] Moreover, the practice of dating Passover according to the Julian calendar is standard in Christian Easter tables, but unattested in early medieval Jewish tradition: this also identifies the cycle as Christian.

A more systematic analysis of the dates in our text confirms that they only match the Christian Easter cycle, specifically its Byzantine version (in the Alexandrian tradition, the cycle is the same but begins three years earlier; the years are therefore numbered differently). In Table 1, the dates in our text are compared to those of the Byzantine cycle as well as to a sample of cycles in the fixed rabbinic calendar.

<u>Table 1: Passover dates in T-S NS 98.51: the Byzantine Easter cycle and the rabbinic calendar</u>

Year number in cycle	Passover dates in the Byzantine Easter cycle		**Passover dates in T-S 98.51**	Passover dates in the fixed rabbinic calendar			
				Cycle from 724/5 CE	Cycle from 819/20 CE	Cycle from 914/5 CE	Cycle from 990/1 CE
1	April	**2**	**2 or 3**	**3**	**3**	**2**	**2**
2	March	**22**	**22 (or 21, 23)**	**23**	**23**	**21**	**22**
3	April	**10**	**10**	**10**	**10**	**10**	9
4	March	**30**	**30**	**30**	31	31	29
5	April	18	**19 (March)**	**19 (March)**	**19 (March)**	20	**19**
6	April	**7**	**7**	8	6	6	**7**
7	March	**27**	**27**	**27**	**27**	**27**	**27**

[59] Recto left l.14, verso right l.12.

[60] This cycle is hardly attested in Jewish calendar sources.

8	April	**15**	**15**	**15**	16	16	14
9	April	**4**	**4**	**4**	**4**	5	**4**
10	March	24					
11	April	12					
12	April	1					
13	March	21					
14	April	9	7	10	8	10	8
15	March	29					
16	April	17					
17	April	5					
18	March	25					
19	April	13					
Match		8/10		8/10	6/10	4/10	6/10

Notes:
Passover dates in the Byzantine cycle, as in all Easter cycles, represent day 14 of the lunar month, whereas in the rabbinic calendar they represent 15 Nisan, which is the meaning that *pesaḥ* would carry (if 14 Nisan is assumed, the matches are generally worse).
Grey rows indicate intercalated years.
Bold numbers indicate agreement with at least one other column.

The Byzantine cycle dates are reiterative and true at all times; rabbinic dates are not reiterative, which makes it necessary to consider as many options as reasonable. Although I have checked the full range of rabbinic dates from the eighth to the tenth centuries, in this table only the closest matches are displayed. Wherever the reading in T-S NS 98.51 is uncertain (in Years 1-2), I have considered all options possible.

At first sight, both the Byzantine Easter cycle and the rabbinic calendar starting in 724/5 CE score equally high, with 8/10 matches. In addition, the rabbinic calendar agrees with T-S NS 98.51 in terms of the intercalated years, whereas the Byzantine Easter cycle differs in two instances (Year 5 and Year 16). However, the rabbinic calendar fails in other ways. Besides the historical unlikelihood that the fixed rabbinic calendar existed in the early eighth century,[61] the match between the rabbinic calendar and T-S NS 98.51 fails when it comes to the days of the week. As can be seen in Table 2, in only a minority of cases (4/9) the days of the week in the rabbinic calendar match those given in T-S NS 98.51. This eliminates the rabbinic calendar as an option.

Table 2: Passover weekdays in T-S NS 98.51 and the rabbinic calendar

Year in cycle	Day of week in T-S 98.51	Day of week in the rabbinic calendar, cycle starting from 724/5 CE
4	**3**	**3**
6	**6**	7
9	**7**	**7**
10	**3**	5
11	**3**	**3**

[61] The *molad* (new moon) calculation which the fixed rabbinic calendar is based on was evidently unknown to the authors of *Pirqei de-Rabbi Eliezer* (ch. 7) and *Baraita de-Shemuel* (ch. 5), both works dating from the late eighth centuries, and both employing much simpler schemes.

12	**1**	7
13	**5**	**5**
14	**3**	5
18	**1**	3
	Match	**4/9**

Let us consider now the Byzantine Easter cycle. As stated above, in the Easter cycle, sequences of weekdays are unique to every 19-year cycle, and do not repeat themselves until the reiteration of the 532-year cycle. If the dates in T-S NS 98.51 are Christian, the sequence of weekdays can only refer to one specific 19-year cycle in the entire 532-years period leading to the end of the tenth century. In Table 3, I list the 19-year cycles that provide the closest match, in terms of the weekdays, with T-S NS 98.51. Other 19-year cycles within this period are not worth considering, as their weekdays are completely different (although I did check them all).[62] The best match is the cycle beginning in 725 CE.

Table 3: Passover weekdays in T-S 98.51 and Byzantine Easter cycles (7th-10th centuries)

Year in cycle	Passover date	Day of week in T-S 98.51	**Cycle from 725 CE**	Cycle from 820 CE	Cycle from 915 CE	Cycle from 1010 CE
4	30 March	**3**	**3**	2	2	2
6	7 April	**6**	**6**	**6**	**6**	5
9	4 April	**7**	**7**	**7**	6	6
10	24 March	**3**	4	4	4	**3**
11	12 April	**3**	**3**	**3**	**3**	**3**
12	1 April	**1**	**1**	7	7	7
13	21 March	**5**	**5**	**5**	4	4
14	9 April[63]	**3**	4	4	4	**3**
18	25 March	**1**	**1**	**1**	**1**	7
Match			**7/9**	5/9	3/9	3/9

Note: the greyed dates are conjectural and assume that the text represents consistently the Byzantine cycle.

The Byzantine Easter cycle from the year 725 CE thus achieves the highest scores of 8/10 for dates (Table 1) and 7/9 for days of the week (Table 3). There are, however, a few discrepancies: two dates (in Table 1), and two days of the week (in Table 3). No matter how few, discrepancies have the potential of undermining the identification of this cycle, as really a perfect match is what would be expected – unless the discrepancies can be given a cogent explanation. But the discrepancies can in fact all be accounted for, as I shall explain.

[62] In the Easter calendar, cycles tend to recur on the same weekdays every 95 years (i.e. five 19-year cycles: see for example Acerbi, 'Byzantine Easter Computi', p. 22, end of n. 101; id. *Byzantine Easter Computi*, p. 148). The last two cycles in Table 3, of 915 and 1010 CE, are at 95-year intervals from the earlier cycles and the best match for the tenth century, even though they end up scoring only 3/9. An earlier cycle starting in 630 CE offers a reasonably good match (6/9), but I have not considered it as in this period the Byzantine Easter cycle was not well established, and possibly not yet in existence (see final section of this article), and there is no reason why a later author might have chosen to represent this earlier cycle retrospectively.

[63] The manuscript reads 7, but this is probably an error, as presently argued.

One discrepancy can be put down to a simple scribal error. The date of Year 14 is given in the manuscript as 7 (April). This disagrees with the Byzantine Easter cycle (9 April), but also with all the rabbinic cycles we have considered (8 or 10 April). This is probably a scribal error; the correct reading is probably 9, the error due to the similar ending of the Hebrew words for 'seven' and 'nine'.[64]

Two other discrepancies from the Byzantine Easter cycle appear at first sight as errors, but on further examination are deliberate, possibly authorial changes. The days of the week in Years 10 and 14 are both listed as Tuesday in our manuscript, instead of Wednesday (as per the Easter cycle). However, these entries are internally inconsistent. Given that in Year 6, 7 April is Friday (verso right l. 13), the Julian calendar demands that in year 14 (eight years later) 9 April be Wednesday.[65] The entry 'Tuesday' in Year 14 is thus necessarily an error. It is not a discrepancy from the Easter cycle as much as an internal inconsistency, which is problematic regardless of whether T-S NS 98.51 is identified with the Easter cycle or any other calendar.

The same is likely to apply to Year 10. According to the Byzantine Easter cycle, the weekday should be not Tuesday but Wednesday, 24 March (although in this case, the date of 24 March is not extant). The Julian calendar demands, again, that in Year 10 (four years after Year 6), 24 March be Wednesday.[66] Assuming the date is indeed 24 March (as according to the Easter cycle), the weekday error is the same as in Year 14.

The close similarity of both these errors suggests that they are not random, but rather deliberate. They arise in the context of an Easter calendar that has been translated into Hebrew, and that reflects concerns that are Jewish or more specifically rabbinic. In the rabbinic calendar, indeed, Passover is not allowed to fall on Wednesday.[67] Although Passover dates in T-S NS 98.51 are Christian, they have been modified in conformity with this rabbinic rule: Wednesdays have been shifted back to Tuesday. This modification can thus be explained as a Judaization, or one could say 'rabbinization', of the Christian Easter cycle.[68]

A similar phenomenon explains the last two discrepancies. The date in Year 5 (19 March) differs by a whole month from the Byzantine Easter cycle (18 April), because the latter intercalates Year 5, whereas in T-S NS 98.51 it is the following year, Year 6, that is intercalated. Similarly, Year 17 is marked as intercalated, whereas in the Byzantine cycle it is year 16. These two shifts bring the cycle in line with the rabbinic 19-year cycle (as later known). Here again, the Easter cycle has been Judaized.

In short, the Byzantine Easter cycle, more specifically the cycle beginning in 725 CE, is by far the best match to the Passover dates and days of the week in T-S NS 98.51. This identification is confirmed,

---

[64] See note on the text, verso left l. 21.

[65] Assuming, as argued above, that the correct reading is 9 April.

[66] If the date were Tuesday 23 March, then the discrepancy from the Easter calendar would not be the weekday but the day of the month, which would be more difficult to explain. My conjecture is more economical.

[67] The origin of this rule is Talmudic. According to *yMegillah* 1:2 (70b), Purim may not fall on Saturday or Monday, because then the following Yom Kippur will fall on Friday or Sunday; by implication, this also prohibits Passover from falling on Monday or Wednesday.

[68] The same concern would dictate the suppression of Passover on Monday, also prohibited in the rabbinic calendar (see previous note). In the dates that are extant in the manuscript, there happen to be no Passover on Monday or removed from Monday (e.g. to Sunday). The present-day rabbinic calendar further prohibits Passover on Friday – which the cycle in our manuscript allows, in Year 6 – but there is a strong case to argue that this particular rule did not come into force before the ninth century (see S. Stern, 'A primitive rabbinic calendar text from the Cairo Genizah', in *Journal of Jewish Studies*, 67 (2016), pp. 68-90, on pp. 73-4).

additionally, by the provision of Julian dates to Passover (which is distinctive of Easter cycles), and by the broader context of this cycle, namely the Julian calendar and the Byzantine computations that appear elsewhere in the bifolio. The few discrepancies from this cycle have explanations: they can be put down in one case to scribal error, and in the other cases, to an intention of Judaizing the Christian Passover dates and the structure of the Easter cycle.

Judaizing the Easter cycle

Why was the Easter cycle Judaized, when, and by whom? Judaization of the cycle could be attributed to a well-meaning tenth-century scribe, who thought he was copying a list of Jewish Passovers and did not understand that this was a Christian calendar; he corrected, therefore, whatever appeared to him erroneous. As I shall argue, however, the nature of these 'corrections' suggests more plausibly that they were carried out at an early stage, even by the author himself, and that they were executed with full awareness of the Christian identity of this 19-year cycle.

It should first be observed that whoever Judaized the Easter cycle did so with full understanding of how it functioned. This is evident from the modification of the date, in Year 5, from '18' to '19': the postponement of the intercalation to the next year meant that the date of Passover had to be changed from 18 April to 19 March. An ignorant scribe would not have worked this out, or indeed, might not have considered this change of number necessary (and would have been happy to leave '18' unchanged, thus 18 March). This change of date was executed with knowledge of the rules of the Easter cycle, which require that the solar date of Passover recedes by 11 days in an ordinary (non-intercalated) year, thus from 30 March (Year 4) to 19 March (in Year 5). The author of this correction knew not only that the cycle was Christian, but also how Easter cycles were constructed.

The earliness of the changes is evident from the fact that Wednesdays have been suppressed, but not Fridays (as Friday is recorded in Year 6). A tenth-century scribe should have been equally disturbed by Friday, since in his period, the fixed rabbinic calendar prohibited Passover on Friday as much as on Wednesday. In the eighth century, in contrast, there is good evidence that the prohibition of Friday was not yet in force; that would explain why the Friday date, in Year 6, was not modified.[69] This increases the plausibility that the corrections are of the eighth century and authorial, rather than the result of a later copyist's error.

Although Wednesdays have been changed to Tuesdays, the corresponding dates (days of the month) appear to have not. This cannot be verified for Year 10, as its date is no longer extant. But in Year 14, where the text is partially extant, it can be said at the very least that there is no evidence of any attempt to change the date to 8 (April), as would have been needed to bring it in agreement with the new weekday of Tuesday.[70] Leaving the date unchanged, whilst bringing forward the day of the week to Tuesday, appears at first sight like an aberration. But actually, it may have been a deliberate, judicious decision. If the author's intention was that the list of Passover dates be re-used in subsequent cycles, it was important to retain the Christian Passover dates unchanged – as indeed they are constant in the Easter calendar – whilst allowing the user flexibility to modify them as and

---

[69] See previous note.

[70] As has been noted more than once above, the entry for Year 14 is problematic, as the manuscript appears to read '7' instead of '9' (April). This apparent error could have resulted from someone's attempt to tamper with the date. However, changing the date from 9 to 8 (April) is such a simple operation that it is unlikely to have led to an error. It is more likely, as I have argued in my notes on the text, that 'seven' is no more than a scribal error (due its similarity with the Hebrew word for 'nine'), which could even have occurred at a later stage of copying. There is certainly no evidence in this part of the manuscript of any deliberate attempt to tamper with the date.

when needed in any iterations of the 19-year cycle, whenever the dates were to fall on weekdays forbidden for the Jewish Passover.[71]

We must go back, indeed, to the question of why the Passover dates were Judaized in this Hebrew text. If the author's intention, in producing this Easter cycle in Hebrew, was to inform the Jewish reader of how the date of the Christian Easter was calculated – much as the first folio informs the reader of calculations in the Julian calendar – then none of the data should have been changed. If the intention was to suggest improvements to the Easter cycle, then these changes would have been irrelevant to Christians and offered no improvement, as they only responded to Jewish, halakhic requirements (the prohibition of Passover on certain days of the week).[72] The Judaization of the Christian Easter cycle, if deliberate (as I have argued), could only have served one purpose: to make this cycle useful and relevant to Jews, by enabling its dates to be used for the Jewish Passover.

It may even be argued, therefore, that the author translated the Easter cycle with the intention to put it to Jewish use: namely, to use it for determining when the Jewish Passover should fall. That is why some of the intercalations, and some of the weekdays within the cycle of 725 CE, needed to be modified, in order to meet the structural and halakhic requirements of the Jewish calendar.

Historical context: the origins of the rabbinic calendar

Besides the likely Palestinian provenance of this text, the identification of the data in T-S NS 98.51 with an Easter cycle beginning in 725 CE indicates that this is when (or around when) the text was originally composed. It can be assumed, indeed, that anyone writing at any other time would have entered the Passover weekdays of his current 19-year cycle instead. Although 'calendrical dating' is not always entirely secure,[73] in this case there are strong reasons to support it. Firstly, the cycle of 725 CE had no special calendrical or historical significance that might have justified its description after it had elapsed.[74] Secondly, it is most unlikely that the author of this Hebrew translation was using an older Christian table that happened to contain the cycle of 725 CE. This is because only later

[71] It may also be noted that only later Byzantine Easter tables include the weekdays of Passover. This means that although the Jewish author of T-S NS 98.51 most likely used an existing model, he must have supplied himself the Passover weekdays (more on this below). This may have given him a sense of ownership over the weekdays and a certain freedom to modify them, in contrast to the dates that he was copying from his model and that he may not have felt entitled to alter.

[72] This stands in contrast to T-S Ar. 29.56, a tenth-century Coptic Easter calendar text in Judeo-Arabic where the corrections to the calendar were clearly designed to correct and improve its lunar, astronomical accuracy: see Vidro and Stern, 'A tenth-century Jewish correction'.

[73] See brief discussion in the webpages of Nadia Vidro's Cambridge University Library project 'Calendar Fragments as a Tool for Palaeography': https://www.lib.cam.ac.uk/collections/departments/taylor-schechter-genizah-research-unit/projects/calendar-fragments-tool-0 (accessed 18 September 2024). Calendrical dating tends to be more secure for ephemeral documents, less secure for transmitted literary texts. It is difficult to establish which category T-S NS 98.51 fits best, but the fact that this text was copied around 1000 CE (seemingly without updating, for example, the days of the week) suggests that it may have been treated as a literary source.

[74] In the early fourteenth century, Barlaam gives the 19-year cycle the epoch (starting point) of 6233 AM, which is 725 CE (A. Tihon, 'Barlaam de Seminara, Traité sur la date de Pâques', *Byzantion* 81 (2011) pp. 362-411, in section 24, pp. 376-7). But this epoch is apparently not attested in earlier sources, and could well be Barlaam's creation, based on the widespread attribution of an Easter canon to John of Damascus (e.g. in the text edited in *Patrologia Graeca* 95: 239-42). Moreover, this epoch serves a useful computational function in relation to Barlaam's own date and his calculation of the discrepancy between the Easter cycle and astronomical reality, which could further suggest that Barlaam was its creator (I owe this footnote entirely to Fabio Acerbi, email of 14/07/2022).

Christian Easter tables include the weekday of Passover;[75] it follows that the author of the Hebrew version did not copy his weekdays from any pre-existing Greek or Latin model, but most likely worked them out and supplied them himself. Again, he would have had no reason to calculate the weekdays of some earlier period, that were now obsolete.[76]

The uniqueness of this text is the detailed knowledge it displays, by a Jew, of the Christian 19-year Easter cycle. This level of knowledge of Christianity – including the implicit knowledge that Christians celebrate in a certain way Passover – is absent in early rabbinic literature, and probably also in Geonic-period literature that is extant. In this respect, the dating of our text to around 725 CE might appear extremely early.

However, this dating makes historical sense. The Byzantine cycle was first designed in the second quarter of the seventh century, and did not gain immediate acceptance;[77] but there is some evidence that it was formally adopted by the end of the century, and reached Palestine during the eighth century.[78] Its novelty may have sparked the interest of a Jew who translated it into Hebrew. The eighth century is generally known as a period of prolific activity among Jews (seemingly in Palestine) in the study of astronomy, astrology, calendar, and related sciences. This is evident in literary works such as *Pirqei de-Rabbi Eliezer* (chapters 6-8), *Baraita de-Shemuel*, as well as the recently published 'primitive rabbinic calendars' preserved in the Cairo Genizah.[79] A contemporary description of the 19-year Easter cycle, in T-S NS 98.51, sits well among these contemporary scientific endeavours.

In this period, the fixed Jewish calendar was not yet in existence, but various attempts were being made by Palestinian scholars to design one, as is evident in particular from the primitive rabbinic calendars. There is a strong case to argue that these first attempts were influenced by the Byzantine Easter cycle, which may in fact have been used as a model for the Jewish calendar makers. The very concept of a 19-year cycle is likely to have been borrowed from the Christians, who since the fourth century had been the only users and custodians of a 19-year cycle in the ancient world.[80] It is

---

[75] Easter tables in Antiquity and the early Middle Ages only include columns for the date of Passover, the date of Easter, and the age of the moon at Easter (see for example Mosshammer, *Easter Computus*, pp. 72-96, the Easter table of Dionysius; and Acerbi, *Byzantine Easter Computi*, 150-1, the Damascene tables). The weekday of Passover could be inferred from these columns, but was not explicitly presented in the tables.

[76] I owe this argument, again, to Fabio Acerbi (email of 14/07/2022).

[77] The Byzantine 19-year cycle, with Passover in Year 1 falling on 2 April (equivalent to Year 4 of the Alexandrian cycle) and an epoch in 5509/8 BCE, is first attested in George the Monk's treatise of 638/9 CE (see above, n. 52). But in 640/1 CE Maximus Confessor rejected it, objecting to those who added sixteen years to years of Adam and counted year 14 as year 11 (*Patrologia Graeca* 19: 1227-9: see Lempire, 'Le calcul de la date de pâques'; Mosshammer, *Easter Computus*, pp. 281 and 314).

[78] The evidence, however, is weak: there is actually no explicit evidence of the acceptance of the Byzantine Easter cycle before the ninth century. The use of the world era of 5509/8 BCE is sporadically attested earlier, first in Canon 3 of the Trullan Council (Constantinople) of 691 CE and in a few contemporary inscriptions. Palestinian evidence of this era is restricted to a dated inscription from near Mt Nebo, and another from Madaba (its dating, however, is less clear), both seemingly from the 760s (Mosshammer, ibid.). The Palestinian evidence is thus somewhat late, located in Transjordan (at some distance from the known Palestinian Jewish communities), and attesting the Byzantine era rather than the Easter cycle.

[79] S. Stern, 'A Primitive Rabbinic Calendar Text from the Cairo Genizah', *Journal of Jewish Studies*, 67.1 (2016), pp. 68–90; id. 'New light on the primitive rabbinic calendars: JTS ENA 1745', *Journal of Jewish Studies*, 39.2 (2018), pp. 262–279; id. 'Bad calculations: another missing link in the history of the rabbinic calendar', Genizah Research Unit: Fragment of the Month (February 2024), https://www.lib.cam.ac.uk/collections/departments/taylor-schechter-genizah-research-unit/fragment-month/fotm-2024/fragment-0

[80] As noted above (n. 4), the 19-year cycle is only attested in Jewish sources from the seventh century onwards.

notable that the 19-year cycle described in *Pirqei de-Rabbi Eliezer* matches exactly the sequence of intercalations in the Byzantine cycle.[81]

I have argued above that the Easter cycle was written out in Hebrew, and adapted in a few of its entries, with the intention of putting it to Jewish use. Rather than 're-invent the wheel' and design a new fixed calendar, the Jewish author of the T-S NS 98.51 text may have reasoned that the Easter cycle could be used directly by Jews, as long as it was adjusted to meet certain halakhic requirements, such as the prohibition of Passover falling on Wednesday. The Easter cycle could thus have been viewed as a useful foundation for the creation of a similarly fixed 19-year Jewish calendar.

The proposal to adopt, adapt, and use the Christian Easter cycle for determining the date of the Jewish Passover did not have a long-term historical effect: apart from using a similar 19-year cycle of intercalations, the *molad*-based, fixed rabbinic calendar that eventually emerged by the early tenth century was non-cyclical and operated in fundamentally different ways. Similarly to the primitive rabbinic calendars, the cycle of T-S NS 98.51 was a proposal that may never have been taken into effect. But this proposal was an important stage in the history and development of the rabbinic calendar. It has also much to teach us about Jewish-Christian relations in early eighth-century Palestine.

Jewish interest in the Christian Easter cycle may be taken as evidence of the cultural importance of Byzantine Christianity in early eighth-century Palestine, where it was still perhaps the majority religion. This does not necessarily mean that Jews were succumbing to Christian 'influence': on the contrary, the small modifications that were made in this text to the Easter cycle could be interpreted as an expression of intellectual and religious independence from the Christian model. It may also be argued, more generally, that in the political context of the early eighth century, attempts by Jews to turn their calendar into a fixed scheme responded to a desire of making common cause with Christians, whose calendar was cyclical and fixed, against the new Muslim rulers who insisted on empirical observation of the new moon crescent. But it is also conceivable, without resort to any notion of 'influence' or identity politics, that the Easter cycle was utilized by the author of the T-S NS 98.51 text in a rather neutral manner as a scientifically accurate scheme that could be legitimately re-deployed for the service of the Jews and the observance of Passover, and hence the other Jewish festivals, on their right dates.

[81] The most accurate and complete version of this passage of *Pirqei de-Rabbi Eliezer* (near the end of chapter 8) is in New York Ms JTS 3847, fol. 89r. In our text, two changes have been made to this cycle (as we have seen: the intercalations of years 5 and 16 have shifted to years 6 and 17), resulting in the 19-year cycle of the fixed rabbinic calendar as we now know it. When these changes were made – whether by the early eighth-century author of TS-NS-98.51, or by some later, learned copyist – remains an open question. This question is tied to the origins of the 19-year cycle of the fixed rabbinic calendar, which I hope to return to elsewhere.

Figure 1: Cambridge University Library (CUL) TS-NS-00098-00051-B+RFCUBECM3-MNFb-B3B5B9.
TS-NS-98.51 Back (verso), Minimal Noise Fraction (of the region of interest) marked in blue, composite colour image of Bands 3, 5, and 9.
Detail of verso right, ends of ll. 9-10.

Figure 2: CUL TS-NS-00098-00051-B+RFCUBECM3-MNFy-B5B9B13.
TS-NS-98.51 Back (verso), Minimal Noise Fraction (of the region of interest) marked in yellow, composite colour image of Bands 5, 9, and 13.
Detail of verso right, ll. 15-18.

Figure 3: CUL TS-NS-00098-00051-F+IRCUBE-ICAb-B1B3B4.
TS-NS-98.51 Front (recto), combined multi-spectral Cube of Infra-Red transmissive and reflective images processed with Independent Content Analysis algorithm on Bands 1, 3 and 4 of this rotation.
Horizontally flipped.
Detail of ink penetration from verso left, ll. 1-4, to recto right.

Figure 4: CUL TS-NS-00098-00051-B+RFCUBECM3-MNFb-B3B5B9 (see caption to Figure 1).
Detail of verso left, ends of ll. 18-21.

Figure 5: CUL TS-NS-00098-00051-F+IRCUBE-ICAb-B1B3B4 (see caption to Figure 3).
Detail of recto right, middle of l. 4.

Figure 6: CUL TS-NS-00098-00051-F+W365O22_023.
TS-NS-98.51 Front (recto), fluorescence image in 365nm (ultra-violet) combined with Orange 22 filter, image numbered 23 in sequence.
Detail of recto right, ends of ll. 4-6.

Figure 7: CUL TS-NS-00098-00051-F+RFCUBECM3-MNFb-B3B7B11 (compare caption to Figure 1).
Detail of recto right, ends of ll. 4-6.