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'Shana Meuberet,' 'Theory of Others', and The Origin of the Christian Ecclesiastical Calendar

Abstract. The 19-year cyclic epact-based calendar with an annual 11-day shift could have been used by the Alexandrian church since the third century. It was used by the Western Church for about 10 centuries, until 1582, within the 532-year Dionysian cycle, and it is still used by the Eastern Orthodox Church. In 1979, analyzing the Ethiopic Easter tables, Otto Neugebauer suggested that this calendar originated within the Alexandrian Jewish community. This paper describes the Jewish calendar that Neugebauer had anticipated.

A calendar, known in rabbinical literature as שיטת אחרים ('theory of others'), is also based on an annual 11-day shift. It is mentioned in the Tosefta and four Talmudic tractates, but has been grossly misunderstood at least since the time of Rabeinu Chananel and Rashi (both of 11th century), because over the years the meaning of the term שנה מעוברת ('shana meuberet') has changed. Though its present meaning is a Jewish intercalary year, its initial meaning in the second century was a *Roman (Julian) leap (bisextile) year.* Accepting this, the 'theory of others' immediately becomes intelligible and recognizable as the cyclic calendar with an annual 11-day shift, though in some important points it differs from the Alexandrian Church calendar. The author of the 'theory of others,' the famous Rabbi Meir (fl. 130-150), was a convert to Judaism and scion of a noble Roman family, possibly a remote descendant of Nero and thus of Julius Caesar.

As part of a new reading of the 'theory of others,' we explain that the term יום עיבור ('Yom Ibburo') meant Iyar 30, and advance a conjecture that the term אור עיבורו ('Or Ibburo') meant Nisan 30. The former is a direct analogue of the *leap day* in the Julian calendar.

'Theory of others' was likely meant to be an *emergency* calendar for use during a time of persecution, likely at the time of the Bar Kochba revolt, 132-135. Later, it may have been practiced by the Babylonian communities in Nehardea and Pumbedita until the mid-fourth century. That some Jewish communities indeed followed an epact-based calendar at some time in their history was stated by a Jewish leader, Hai Gaon, in his 992 epistle.

'Theory of others' might have been a local adjustment of the epact calendar used by the Alexandrian Jewish community centuries before Judean King John Hyrcanus could have been the first to introduce the epact-based calendar in Judea, which provoked a Pharisaic revolt in 94-88 BC, described by Josephus in the *Jewish Antiquities.*

Keywords: Otto Neugebauer, Epact calendar, Alexandrian Church, Tosefta, Rabbi Meir, theory of others, shana meuberet, Julian leap year, Yom Ibburo, leap day, King John Hyrcanus, Pharisaic revolt of 94-88 BC, Flavius Josephus.

Introduction

The contemporary Jewish calendar is based on counting the *Molad* (monthly calendar conjunction of the moon and sun) and has a fixed 19-year intercalation cycle 3-6-8-11-14-17-19, counted from Molad BaHaRaD (Molad Tishrei) in the year 3761 BC (further denoted as JE, Jewish Epoch). The discussions about its origin have been going on for at least a thousand years.

The head of the Talmudic 'Sura' Academy, Saadia Gaon (d. 942), in a 927 treatise, claimed that the contemporary Jewish calendar had been used since the Exodus (literally: 'from Mount Sinai'), though the precise meaning of his statement is widely debated.[1]

Later sages took a more cautious position. The head of the Talmudic 'Pumbedita' Academy, Hai Gaon (d. 1038) not only criticized Saadia Gaon's opinion,[2] but also, in a 992 epistle, wrote:

... ואנו יודעים כי ראשונים כבר עברו שלא כסדר הזה וצוו אותנו להיות אוחזין בחשבון תקופות לכל מחזור ומחזור שעה ותפ"ה, וגם בחשבון מולד אוחזין לכל מחזור בי"ו תקצ"ה...[3]

We know that already the **first sages** did not intercalate according to this **order** and ordered us to be aligned with the calculation of tekufot [and to add] in every lunar cycle of 235 months **one hour and 485 parts** to the calculating of time according to the lunar months, to get 19 solar years, and, at the end of a lunar cycle, the molad will fall **2 days 16 hours and 595 parts** later in the week as the one at the beginning of the lunar cycle.

The passage is difficult. Though the 'tekufot' are the equinoxes and solstices, the attributes of a solar year, it is not immediately clear who were 'the first sages' and what 'this order' was. The numbers decide the matter. The expression '2 days 16 hours 595 parts' discounting the number of weeks points uniquely to 6939d 16h 595p, which is the length of the 19 year cycle (29d 12h 793p * 235) based on *Molad*. From here, the meaning of the second number '1 hour and 485 parts' becomes transparent – it can only be the difference between 6939d 16h 595p and 6939d 18h, where the last number is exactly 19 Julian years. Thus, Hai Gaon acknowledged that at some time in Jewish history, the Jewish (lunar) calendar was *aligned with* the 19-year cyclic Julian calendar. Such a calendar is historically known – it is the epact-based calendar. The Alexandrian Church be-

1 Though Saadia Gaon's book is no longer extant, it could be ספר ההכרה (*Sefer Hahakara)*, mentioned by Abraham bar Chiyah Savasorda in ספר העבור (*Sefer HaIbbur),* (published by H. Filipowsky, London 1851), 96-7.

2 It seems that the only direct quotation of Saadia Gaon was preserved in *Sefer Mizvot LeKaraim,* see M. M. Kasher, תורה שלמה (*Torah Shlemah),* NY 1954, 43. The quote means that *Jews started computing their holidays at the time of the Exodus.* However, Hai Gaon, in one of his letters (*ibid,* p. 50), attributes to Saadia Gaon a stronger statement: that the 'contemporary calendar, with postponements and cycle of intercalation, comes from Mount Sinai.' Hai Gaon disagreed with this and suggested that Rav Saadia said it in defiance of the 'epicoros' (karaites).

3 As quoted by Araham Bar Chiyah in *Sefer HaIbbur*, 97.

gan to use a 19-year cyclic epact calendar for computing the Easter full moons in the third century. Otto Neugebauer credited Demetrius, Bishop of Alexandria in 190-232, for introducing an epact calendar into Church practices. Still, Neugebauer was convinced that the calendar originated within the Alexandrian Jewish community:

> And we now also see how the Jews in the Diaspora in Alexandria regulated their "lunar" calendar during the first centuries of our era. The fierce antagonism against Judaism which is evident in so many ways in our texts guarantees that the data of the Jewish feasts, in particular Passover, were the actual data of contemporary Jewish customs – otherwise the whole construction of the Christian rules would be pointless. [4]

The goal of this paper is to prove Neugebauer's conjecture based on indirect argument by showing that indeed a calendar identical to an epact calendar was *used*, or at least *discussed* as one of the possibilities, by the Jewish sages of the second century. This calendar is known in the Talmud as the 'theory of others.' It has been grossly misunderstood in the literature and, as a consequence, its historical role has been underestimated. The goal is to recover it from oblivion and to place it within a proper historical framework, illuminating Neugebauer's idea. The paper is organized as follows.

Part I is a thorough discussion about the 'theory of others.' Section 1 points to the moment in the Jewish history when the fixed calendar took the place of empirical practices. Section 2 introduces the 'theory of others' and lists a number of rabbis and modern scholars who tried to rediscover its rational. Sections 3-4 provide a *new* reading of the 'theory of others,' based on the original meaning, rediscovered here, of the term 'shana meuberet.' Section 5 clarifies the term 'Yom Ibburo.' Section 6 proves that the 'theory of others' was a calendar with an annual 11-day shift, while Sections 7-8 discuss its differences from and similarities to the calendar of the Alexandrian Church. Sections 9-10 discuss the remaining *nuances* of the 'theory of others.'

Part II is more *speculative*. Section 11 talks about possi4ble *Alexandrian* origin of the 'theory of others.' Sections 12-13 trace its possible *evolution* during the third and fourth centuries. Section 14 conjectures on the *historic* circumstances under which the 'theory of others' was born. Section 15 conjectures that the 'theory of others' could have been practiced in the Babylonian Talmudic academies of Nehardea and Pumbedita till the *mid-fourth* century. Section 16 discusses when the 'theory of others' was *forgotten*. Section 17 summarizes our findings.

4 O. Neugebauer, "Ethiopic Easter Computus," *Oriens Christianus*, 63 (4), 1979, 102.

Part I: 'Theory of Others' as a Jewish epact-based Calendar

1. Mid-second century: a crucial fact

Talmudic tractates B(avli) *Rosh Hashanah* (further: *RH*) 19b and B. *Arachin* 9b inform us of a Baraita relating a dispute between an *anonymous* Tanna[5] and Rabban Simon ben Gamliel concerning the length of the additional (thirteenth) month inserted in the Jewish intercalary year:

דתניא: כמה עיבור שנה? ל' יום. רשב"ג אומר חודש.

How long is the intercalated month? Thirty days. Rabban Shimon ben Gamliel says: a month.

The word חודש ('month') contraposed to '30 days' could mean here either a 'month of 29 days' or a 'generic' month of either 29 or 30 days. The latter reading was advocated by Rashi in his commentary on B. *Arachin* 9b:

ד"ה "במאי קמיפלגי":
רב הונא דמוקי למתני' בתרתי מילי סבר לה כרשב"ג דזימנין כ"ט וזימנין שלשים.

Rav Huna, who interprets the Mishna as referring to two separate issues, is of the same opinion as Rabban Shimon ben Gamliel, that [an intercalated month is] sometimes 29 and sometimes 30 [days].

Both interpretations suit our purpose. The conclusions, however, are striking.

If this were an empirical calendar, then the beginning of *any month* (an intercalary month in particular) would have to be decided by accepting the testimony of two witnesses, each of whom, independently, had seen the new moon. The dispute marked a complete break with that practice. The only way to handle this issue is to recognize that in the mid-second century, either a fixed calendar replaced a partially empirical calendar or there was a transition from one calendar system to another.

Another immediate corollary is even more striking. Rabban Shimon ben Gamliel argued for a 29-day intercalary month, which unequivocally proves that the Molad system (with its 30-day intercalary month) was not in use during the Mishnaic period.

Finally, it is impossible to construct a viable cyclical system by *always* intercalating a 29-day month. This means that the disputants did not debate a general rule, but rather a particular situation. We will come back to this point later, in Sections 11 and 14.

5 Anonymity implies that it was either Rabbi Nathan or Rabbi Meir. They were expelled from the Talmudic Academy at Usha, Galilee, and their names were excluded whenever laws were cited. See B. *Horayot* 13b.

2. 'Theory of Others' in the Tosefta and Talmud

The Tosefta, a corpus of the Jewish Oral Law, rival to the Mishnah, was composed c. 200 by Rabbis Chiya and Hoshaiah. The Tosefta closely corresponds to the Mishnah, with the same divisions into six *sedarim* ('orders') and subsequent *masekhot* ('tractates'). It is mainly written in Mishnaic Hebrew, with some Aramaic. At times, the text of the Tosefta agrees nearly verbatim with the Mishnah; at others, there are significant differences. The Tosefta augments the Mishnah with additional glosses and discussions though sometimes it contradicts the Mishnah in the ruling of *Halakha* (Jewish law), or in declaring in whose name a law was given. The Tosefta was neglected for many centuries, until it appeared in print in Venice in the 16th century. The first critical editions were published by Moshe Shmuel Zuckermandel in the 19th century; the one printed in Pasewalk, Germany, in 1880 is considered standard and we shall quote from it.

The first chapter of Tosefta *Arachin* (1:8-11) records a number of different calendar opinions, from which we now need only the last part (1:11):

אין עצרת חל אלא ביום הנף.
אין ראש השנה חל להיות אלא ביום הנף וביום עיבורו.
אחרים אומרים: אין בין עצרת לעצרת ואין בין ראש השנה לראש השנה אלא ארבעה ימים בלבד, ואם היתה שנה מעוברת – חמישה.[6]

Atzeret (Shavuot) always occurs on the same weekday as Yom Hanef [day of waving of the sheaf].
Rosh Hashanah always falls either on the same weekday as Yom Hanef or Yom Ibburo.
And Others say: from Atzeret to Atzeret and from Rosh Hashanah to Rosh Hashanah – 4 days **only**, though in a **shana meuberet** [lit: pregnant year] – 5 days.

The first two lines explain the expression 'Yom Ibburo,' which will be discussed at length in Section 5 and Appendix 1. Note that 'Yom Ibburo' appears here as a *special* day – not as the 30th day of each *long* (30-day) month, as has often been understood.

The last two lines are known among historians as שיטת אחרים (the 'theory of others'). Remarkably, this theory was repeated later, in four tractates of the Babylonian Talmud: B. *RH* 6b and 20a, B. *Sukka* 54b, B. *Shabbat* 87b, B. *Arachin* 9b. Even more remarkable, its author can be uniquely identified as the famous Rabbi Meir (fl. 130-160), disciple of Rabbi Akiba and Elisha ben Abuyah. Rabbi Meir, said to be a convert from a noble Roman family related to the Emperor Nero,[7] was second in authority during the era of Rabban Shimon ben Gamliel and was cited in the Mishna anonymously, as 'others,' because of his arguments with Rabban Shimon.[8]

6 M. S. Zuckermandel, תוספתא (*Tosefta*), Pasewalk, 1880, pp. 543-4. The text and translation can be found also in S. Stern, *Calendar and Community*, Oxford University Press, 2001, 159.

7 B. *Gittin* 56a claims that Rabbi Meir was a descendant of Nero (ונפק מיניה ר"מ) and therefore was a member of Julius Caesar's family.

8 B. *Horayot* 13b: אסיקו לרבי מאיר אחרים ("assigned 'others' to Rabbi Meir").

After the 'close of the Talmud' (c. 499), the 'theory of others' seems to have been forgotten for more than half a millennium. The first comprehensive commentators on the Talmud, Rabeinu Chananel Ben Cushiel and Rashi, took שנה מעוברת ('shana meuberet') in that passage to mean an *intercalary year of 13 months*.

Rabeinu Chananel Ben Chushiel (d. 1053) of Kairouan (Tunisia) wrote:

[רבנו חננאל, ראש השנה 20א] פי' אין בשנה לעולם אלא אחד מלא ואחד חסר וזהן שנ"ד ימים. יוצאין [נ' שביעיות] ישארו ד' ימים. ואם היא מעוברת חדש העבור כ"ט ימים הוא כ"ח ימים יוצאין [ד' שביעיות] נשאר יום הרי ה' ימים.

Namely, each year always has one 30-day [month] and one 29-day [month], which give 354 days. Take out [50 weeks] to leave 4 days. And if it is Meuberet, the month of Ibbur is 29 days, of which 28 [are 4 weeks] and 1 day is left, thus 5 days.

Rashi (Rabbi Shlomo Yitzchaki, d. 1105), a sage from the French city of Troyes, explained the 'theory of the others' as:

[רש"י, ראש השנה 20א] ד"ה "אחרים היא": דאמרי לעולם כל החדשים אחד מלא ואחד חסר כסדר מולד הלבנה שמתחדשת לעולם בסוף כ"ט ימים ומחצה שהן חמשים ותשעה לשני חדשים.

ד"ה "ארבעה ימים": אם נקבע עכשיו באחד בשבת יהא לשנה הבאה בחמישי בשבת שזה חשבון שנים עשר חדש אחד מלא ואחד חסר עולה לשנ"ד ימים והשלש מאות וחמשים כולם שבועים נמצא נדחה להלן ארבעה ימים.

ד"ה "ואם היתה שנה מעוברת חמישה": שמוסיפין עליה חדש חסר שדוחה להן מן שבועים שלימים יום אחד.

[Others] say that all months are always one 30-day and one 29-day, like the order of the molad of the moon, that always renews at the end of 29.5 days, adding up to 59 [days] in two months.

If we now determine [Rosh Hashana] on Sunday, next year it will be on Thursday, since the calculation of 12 months, one 30-day and one 29-day, is 354 days; of which 350 are full weeks. Thus it is postponed 4 days.

We add [for Shana Meuberet] a 29-day month, which causes a further postponement of 1 day from full weeks.

Summarizing what both sages said:

1. The regular Jewish calendar year (of 12 lunar months) must contain 4 days discounting the number of weeks. The only reasonable number is 354 days.

2. The Jewish intercalary year (of 13 months), must contain 5 days discounting the number of weeks. The only reasonable value would be 383 days.

However, Rashi's immediate successors, the Tosafot, were unhappy with that explanation. The idea of 30- and 29-day months following each other leads to an average 29.5 day month, while the (contemporary for Tosafot) calendar month was 29 days, 12 hours, 44 minutes and 1 part. Moreover, the 13th month, which could compensate for the disparity if it were of 30 days, would only aggravate the problem if it were of 29 days! Therefore Tosafot began looking for a way to account for the missing days:

[תוס', ראש השנה 20א, סוכה 54ב, ד"ה "אלא ד' ימים בלבד"] דקסבר אין מעברין את החדש לצורך וכולם הולכים לפי המולדות ובפרק ב' דערכין (דף 9ב ושם) פריך: "דאיכא יומא דשעי לתלת שנין ואיכא יומא דחלקים לתלתין שניז" לפי שיש עדיין שמונה שעות ותתע"ו חלקים ועולות השעות יום אחד לסוף שלש שנים והחלקים עולין ליום לסוף שלשים שנה ומשני כיון דליתא בכולי שני לא קחשיב.[9]

[He] thinks that one does not intercalate the month due to need, and they all follow the Moladot; and in Chapter 2 of tractate Arakhin a difficulty is posed: "there is a day of hours once every 3 years, and a day of Halakim once every 30 years," since there are still 8 hours and 876 Halakim, and the hours add up to 1 day at the end of 3 years, and the Halakim add up to 1 day at the end of 30 years; and the answer to the difficulty is that these are not counted, since they do not occur every year.

By using a quote from tractate B. *Arachin* 9b, belonging to the Talmudic fifth century sage Ravina, the Tosafot seem to recover 11 days – one day every three years and one day every 30 years, but within a 30-year cycle, which makes their argument worthless, aside from the fact that 876 parts do not add up to one day in 30 years; only 864 do. Besides, the argument is obviously farfetched: Ravina's statement is not necessarily an explanation for the 'theory of others.' Modern scholars usually take it as a contrary statement, מתקיף לה רבינא ('Ravina attacked him'), which was directed against the 'others.' Moreover, the two foremost scholars of the Hebrew calendar, Chayim Zelig Slonimsky and Chayim Yehiel Bornstein, were of the opinion that the second part of Ravina's statement (one day in 30 years) was a later interpolation, made as late as the 9th century.[10]

The major problem is that the Tosafot did not suggest a viable algorithm to add the missing days. The phrase: *"and the answer to the difficulty is that these are not counted, since they do not occur every year"* is but a patch for the poor.

Later Tosafists seemed to lose grasp of the 'theory of others' completely. Tosafot to *Shabbat* 114a[11] says:

[ד"ה חלבי שבת קריבין ביוה"כ] אומר ר"י דכל היכא דקתני תרי שבי דהוו בהדי הדדי אתיא כאחרים דאמרי אין בין עצרת לעצרת אלא ד' ימים בלבד והכי מפרש הש"ס בפ' בתרא דסוכה.

Rabbi Yitzchak says that wherever the Mishna refers to two consecutive Sabbaths (= Shabbat and Yom Kippur), it is according to Acherim [Others], who say that between Atzeret and Atzeret there are always only 4 days, and this is explained in the Talmud in tractate Sukka (54b).

Rabbi Yitzchak, Isaac Ben Samuel of Dampierre, usually is referred to by the initial letters of his name as *Ri* (Rabbi Isaac, d. ca. 1185), was one of the most important Tosafists and a leading authority among Franco-German Jewry in the se-

9 Strangely enough, Tosafot quotes *Arachin* 9b somewhat imprecisely, interpolating the words 'לתלת שנין' [in three years] and 'דחלקים' [of parts].

10 Ch. Z. Slonimsky, *יסודי העבור (Yesodey HaIbbur)*, Warsaw 1852, 32 ftn, and Ch. Y. Bornstein, *מחלוקת רב סעדיה גאון ובן מאיר (Makhloket Rav Saadyah Gaon u Ben Meir)*, Warsaw 1904, 130. Cf. S. Stern, *Calendar and Community*, 202-3.

11 Actually in the Mishna, 113a: "Fat of Shabbat is sacrificed on Yom Kippur that falls on Sunday, but fat of Yom Kippur that falls on Friday is not sacrificed on Shabbat."

cond half of the 12th century. He seemed to believe that the 'others' were guilty of neglecting the postponements of Rosh Hashanah, which effectively prohibited Yom Kippur from falling on Friday or on Sunday. This is true though a minor consequence of the 'theory of others.' Rabbi Yitzchak, however, provided an important guess why the 'theory of others' could have lost a historical competition to the so-called 'four gates' calendar, which is now in use: the former could not accommodate the postponements, while the latter could.

Though Tosafot pointed to some difficulties in the established tradition, the 'theory of others' seemingly was forgotten for eight centuries. Only in the twentieth century was it recovered from oblivion. Modern scholars of the calendar unanimously accepted Rashi's and Rabeinu Chananel's explanation, though all of them encountered serious difficulties in its interpretation. It is instructive to see how they reasoned around it.

Chayim Yehiel Bornstein, in his seminal מחלוקת רב סעדיה גאון ובן מאיר ["A Dispute between Rav Saadia Gaon and Ben Meir"] (1904), discussed the opinion that it was exactly the calendar of 'others' that Ben Meir tried to reinstate in his 922-24 polemics against Saadia Gaon (see Section 16). Being obliged to discuss the 'theory of others,' Bornstein did not advance beyond Rashi. Having noticed that the 383 days in the intercalary year (with a rigid 354 day regular year) implies that the 13th month should have 29 days, he further observed that this data precluded forming a reasonable cyclic lunisolar calendar. For example, a 19-year cycle would experience complete fiasco: by simple arithmetic, we get 6929 (354 * 19 + 29 * 7) days in the lunar cycle, while the Julian calendar has 6939¾ days in 19 years. The difference of almost 11 days shows that "this calendar has no meaning" (כי חשבון כזה נמנע ומופרך מעיקרו), and the 'theory of others' seems completely untenable.[12]

Later, in the article "פליטה מני קדם" ["Stories from older days"] (1908), Bornstein tried to explain 'Yom Ibburo' but being unable to grasp its meaning within the 'theory of others,' ended with a suggestion that it was "Nisan 31," an imaginary day – a purely fantastic idea![13]

The next effort to understand the 'theory of others' was made by Zvi Hirsh Jaffe, a friend of Bornstein, in his book קורות חשבון העבור ["History of the Calendar"] (1931). Jaffe sensed that the theory must be operational. To find the 11 "missing" days, he suggested amending its first part to "אין בין ר"ה לר"ה פחות מארבעה ימים"[14] ("between Rosh Hashanah and Rosh Hashanah is no less than

12 See *Makhloket*, 31 and note 1 there.

13 Ch. Y. Bornstein, פליטה מני קדם ("Pleita Minni Qedem"), in D. N. Gunzburg and I. Markon (eds.), ספר א.א. הרכבי , St-Petersburg, 1908, 91-93. Bornstein's idea is obviously "far-fetched," as Stern justly remarked in *Calendar and Community* 159, note 11.

14 צבי הירש יפה *קורות חשבון העבור*,(*Qorot Heshbon HaIbbur*). Jerusalem: Drom, 1931, page יז (not to be confused with page 17 of the introduction by Aleph Akavia).

four days"), thus allowing a regular year to have 354 or 355 days, while an intercalary year would have 383 or 384 days.

But after this initial insight, Jaffe pursued in earnest the simplistic idea that the year was counted from Rosh Hashanah to Rosh Hashanah without counting either "the first or the last days," and discussed an imaginary reading of the 'others' with 'five' instead of 'four' and 'six' instead of 'five.'[15] Though his insight regarding regular years is close to the true meaning of the 'theory of others,' he was unable to reevaluate the meaning of 'shana meuberet.' The price was extreme *emendation of the text.*

The insistence on amending the text as the only reasonable solution (Jaffe) and fantastic elements in such a mundane thing as the calendar (Bornstein) are especially remarkable – they acknowledged a complete stalemate in this discussion.

In the last decade, two modern scholars have also tackled the problem. Moshe Weiss, in the paper "ניסן שיצאו בו ישראל ממצרים" ["Nisan in which Israel left Egypt"] (1995), was at a loss to explain the large discrepancy between the modern lunar cycle and the 'others' as well. Suggesting the 'others' used a month of 29.5 days to get exactly 354 days in the regular year, he further acknowledged that this cannot be squared with 29 days added as the 13th month. Then, calling the 'theory of others' a "schematic" – and what calendar is not? – Weiss advanced a peculiar argument: the Egyptian civil calendar of 365 days, used by Ptolemy for his *Chronological Canon*, was also imprecise, but was, according to Otto Neugebauer, "the only intelligent calendar that ever existed in human history." [16]

Weiss, however, failed to explain how the calendar of 'others' was able to play the same role in the Jewish history as the Egyptian calendar did in theirs. But, *inter alia,* he suggested that the 'theory of others' was designed "for the place where the true calendar was not known" (במקום שאין מכירים זמנו)[17] and this is similar to our "emergency" theory (see Chapter 13).

Sacha Stern, in *Calendar and Community* (2001), after discussing the 'theory of others' for a whole page, first suggested that "a calculated calendar of this kind would hardly have been functional" and concluded that "it might represent a marginal opinion."[18]

This is the bottom line of a thousand years of efforts to recover the meaning of the 'theory of others.'

15 *Ibid,* page יח. For this Jaffe even tries to find support in *Mishnei Torah.*

16 M. Weiss, ניסן שיצאו בו ישראל ממצרים ("Nisan SheYatzu Israel MiMizraim"), *Bar-Ilan Annual,* 26-7, Ramat Gan 1995, 188, note 14 there.

17 Weiss, ibid, p. 189. The quote is taken from Tosefta *Arachin* 1:8.

18 See *Calendar and Community,* 159-60.

3. The Term 'Shana meuberet'

To solve the puzzle, we suggest reevaluating the meaning of 'shana meuberet'. It could have meant *a leap year in the Roman (Julian) calendar* (further: Julian leap year), i. e., literally, a year 'pregnant' with one extra day. Then, according to the 'others,' a Jewish calendar year, that overlaps with the Julian leap year, must have five days discounting the number of weeks, i. e., 355 days, and hence consist of seven 30-day and five 29-day months.[19]

There is a variant reading. It is equally possible that in Talmudic times 'shana meuberet' designated a *leap Jewish year* (of 355 days), which now is called 'full'. Which of the two meanings was assumed by the term 'shana meuberet' greatly depends on the role of the word 'only' in the 'theory of others' (see Section 9). Notice that even when accepted as the *Jewish leap year*, 'shana meuberet' in the 'theory of others' must be closely linked to the Julian leap year, overlapping it in a special way.

The word 'meuberet' occurs in the Talmud in a number of places. Its precise meaning, however, can be discerned only with difficulty. In one difficult passage in B. *Arachin* 9b, on the same page that also deals with the 'theory of others,' Rabbi Mashrashia (fl. fourth century),[20] explained how it could have happened in the past that there were *eight* 30-day months in one year:

א"ר משרשיא] כגון שהיתה שנה מעוברת ועיבור שנה ל' יום.

For example, if it were 'shana meuberet,' and the additional month [ibbur shana] was of 30 days.

It was tacitly assumed by Rashi and the Tosafot that the second part of this statement ['*ibbur shana* was of 30 days'] is a gloss on the first part [*shana meuberet*]. However, it is clear that to get eight 30-day months, one cannot simply add an intercalary month of 30 days to a regular pattern of long and short months with its six 30-day months. Thus, Rabbi Mashrashia added a 13th month of 30 days to "shana meuberet" with its seven 30-day months.

To summarize: the expression 'shana meuberet,' until at least the fourth century, had to mean a *Julian leap year* or, alternatively, a *Jewish leap year* (of 355 days). The 'chodesh ibbur' (30 days) was a different entity, counted separately from the rest of the year.

19 Ari Belenkiy, "Secret of intercalation: three Jewish calendar systems in the first centuries CE" ("סוד העיבור: שלוש שיטות בלוח העברי במאות הראשונות לספירה") in *Proceedings of the 11th Conference on the History of Judea and Samaria* (in Hebrew), ed. Y. Eshel, Tel-Aviv 2002, pp. 275-86.

20 While speaking in the text after Ravina, who usually is placed in the end of the fifth century,, Rabbi Mashrashia seems to come from the generation of the fourth century sage, Rava, since they conversed several times (see Weiss 192, note 31).

4. 'THEORY OF OTHERS' RECOVERED

Assuming that 'shana meuberet' refers to a Julian leap year, the 'theory of others' immediately becomes clear: it suggests adding a day ('Yom Ibburo') to a Jewish calendar year which overlaps a Julian leap year, thus allowing every fourth Jewish lunar calendar year to contain 355 days.

Let us show that this system fits well into a 19-year cycle (with its seven intercalary and 12 regular years). First, notice that without adding an additional day every Julian leap year, the calendar has in the lunar part only 6936 (354 * 19 + 7 * 30) days, whereas the Julian solar calendar has 6939 ¾ (365 ¼* 19) days during the 19 years. To make the lunar calendar match the solar, we have to change the number of days in the lunar part. In every 19 years there are, on average, 19/4 Julian leap years.[21] With these additional 4 ¾ days added to the lunar calendar, we can get 6940 ¾ (6936 + 4 ¾) days in the lunar cycle.

We see that the 19-year lunar cycle is one day longer than the 19-year solar cycle. Though the way to solve the problem is obvious (omit one day from the lunar calendar), the 'theory of others' is silent on this. The reason for this silence will be discussed below.

5. THE TERM 'YOM IBBURO'

The 'theory of others' seems to be also silent on which calendar month must be augmented by 'Yom Ibburo', an extra day; however, detailed study unveils the facts. Having pointed to the annual 11-day shift for the Jewish festivals, 'others' also specified in a succinct way *when* to add the extra day.

In Talmudic times, 'Atzeret' meant *Shavuot* (Feast of Weeks), the festival of the giving of the Torah, which falls in the month Sivan and literally means "stop" – stop seven weeks after "Yom Hanef", the day of waving the sheaf on the eve of Nisan 16. Saying 'from Atzeret to Atzeret' *before* 'from Rosh Hashanah to Rosh Hashanah' necessitates the addition of one day in the period when the two intervals *overlap*: from Rosh Hashanah to the following Atzeret, or in the months Tishrei, Cheshvan, Kislev, Tevet, Shevat, Adar, Nisan, or Iyar. If a day were added in Sivan, Tamuz, Av, or Elul, then between Atzeret and following Atzeret there would be 355 days, while before the next Rosh Hashanah and the following Rosh Hashanah, there would be only 354 days.

The second observation is that the omission of Passover in the statement of 'others' is too conspicuous – it implies that 'Yom Ibburo' was added somewhere between Passover and Shavuot. Let us prove that 'Yom Ibburo' was *Iyar 30* (see also Appendix 1).

21 Of course, every 19-year cycle contains either four or five leap years. However, four cycles, i. e., 76 years, contain exactly 19 leap years.

Tosefta *Arachin* 1:9 says:

עצרת פעמים שחל להיות בחמשה ובששה ובשבעה לא פחות ולא יותר ר' יהודה אומר חל להיות בחמשה סימן רע לעולם בששה סימן בינוני בשבעה סימן יפה לעולם אבא שאול אומר כל זמן שיום טוב של עצרת ברור סימן יפה לעולם׃

Atzeret falls either on the fifth, or on the sixth, or on the seventh [of Sivan], not earlier or later. R. Yehuda said: if on the fifth – it is a bad sign; on the sixth – mediocre; on the seventh – a good sign. Aba Shaul said: each time that we know [in advance] the day of Atzeret is good.

Between 'Yom Hanef' (Nisan 16) and Atzeret there must always be 49 days (אין עצרת חל אלא ביום הנף) leading to the following three options. Atzeret on Sivan 5 could have only meant both Nisan and Iyar had 30 days, which Rabbi Yehuda considered a 'bad' sign. Atzeret on Sivan 7 could have only meant both Nisan and Iyar had 29 days, which Rabbi Yehuda considered a 'good' sign. Atzeret on Sivan 6, as it is nowadays, however suggests *not* that Nisan had 30 days and Iyar had 29 days, as it nowadays, but *vice versa*. Let us prove this.

The second line (אין ראש השנה חל להיות אלא ביום הנף וביום עיבורו) in Tosefta *Arachin* 1:11 says that Rosh Hashanah might fall on the same weekday as Yom Hanef (Nisan 16) – this is possible if both Nisan and Iyar have 29 days and among the next four months – Sivan, Tammuz, Av and Elul – two months have 30 days. Therefore all four together have 118 days. As we shall see, any other number leads to a contradiction. Note: the same weekday as Rosh Hashanah also would be Iyar 1 and Iyar 29. Therefore, Nisan 30, if added, could not possibly fall on the same weekday as Rosh Hashanah. To the contrary, Iyar 30 could fall on the same weekday as Rosh Hashanah since there were exactly 119 days between them, and this happens independently of whether Nisan 30 was added or not.

Moreover, if both Iyar 30 and Nisan 30 were added, then Rosh Hashanah would be two days off 'Yom Hanef', and therefore Bornstein's second interpretation (also adopted by S. Stern) of 'Yom Ibburo' in Tosefta *Arachin* 1:11 as the "following day"[22] is untenable.

The assumption of constancy of the total length of Sivan, Tammuz, Av and Elul (118 days) is a key for our argument. S. Stern[23] wonders at such an assumption, asking "why other options were not considered", "as would be expected of an empirically reckoned calendar." Though the calendar was *not* "empirically reckoned" as Stern's own book testifies on virtually *all* occasions, the "other options" indeed must be considered.

If between Atzeret and Rosh Hashanah there were 119 or 120 days, then Rosh Hashanah would never fall on the same weekday as Nisan 16 – even with both Nisan and Iyar having 29 days. If between Atzeret and Rosh Hashanah there were 117 days then, when both Nisan and Iyar had 29 days, Rosh Hashanah would

22 See פליטה מני קדם, p. 93, note 1, and *Calendar and Community* 159, note 11.
23 *Calendar and Community* 159.

neither fall on the same weekday as Nisan 16, nor is there a good candidate for 'Yom Ibburo'.

Since sage Rava (d. 350) postulated (B. *Sanhedrin* 10b): קידוש ביום עיבור ("kiddush be on Yom Ibbur"), that is a special prayer (kiddush) ought to be said on a flickering (leap) day (while general ruling forbids this on the 30th day of other months), 'Yom Ibburo' kept its meaning until the mid-fourth century.

Our solution for 'Yom Ibburo' also means that Nisan 30 was added only if Iyar 30 were to be added. In a sense, the former *anticipated* the latter or, metaphorically, "gave [a green] light" to it. Thus Nisan 30 was אור עיבורו ('Or Ibburo') which immediately signaled the exact day when Atzeret would occur. This then is what Abba Shaul might actually mean in Tosefta Arachin 1:9.

Conjecture. The day אור עיבורו ('Or Ibburo') was Nisan 30.

Remark. The idea of *anticipation* has been preserved in the modern rabbinical calendar: the 30th of the second month, Cheshvan 30, is added only if the 30th of the third month, Kislev 30, is also added.

6. The Epact system

Remarkably, the 'theory of others' is known in world history, though in disguise. In one of his last papers, 'Ethiopic Easter Computus' (1979), Otto Neugebauer described the calendar that could have been used by the Alexandrian church in the fourth century.[24] Ethiopic calendar tables were organized in 19-year cycles, and 28 consecutive tables comprise a 532-year Easter table, the *Dionysian cycle*. The dates and the weekday of the Easter full moon fix the year uniquely within the Dionysian cycle. Since all of the Ethiopic tables came from fifteenth century scribes, there were three candidates for the historic time period they describe: 1-532, 533-1064, and 1065-1596.

Uncertainty in the dating of these tables was broken due to a fortunate accident. In 1976, Ephraim Isaac published a catalogue of Ethiopic manuscripts in the library of the Armenian Patriarchate in Jerusalem. Two manuscripts are related to the Easter computus: one was a 19-year table, another – a 532-year table. The latter table contained a column with *indictions,* a count of the years in cycles of 15 years introduced by Emperor Diocletian c. 300. Since 15 is prime to 19 and 28, the known *indiction* of the year allows fixing the year in a 532-year table uniquely within 7980-year period. The *indiction* of the years in the Jerusalem manuscript overlapped with those from the annual *Festal Letters* written by the Alexandrian

24 O. Neugebauer, „Ethiopic Easter Computus, " *Oriens Christianus*, 63 (4), 1979, 87-102. Or: O. Neugebauer, *Ethiopic astronomy and computus*, Österreichische Akademie der Wissenschaften, philosophisch-historische Klasse, Sitzungsberichte. Vienna: Austrian Academy of Sciences, philosophy-history division, Proceedings 1979, Band (volume) 347.

Bishop, Athanasius, from 328 to 373. This allowed Neugebauer to date the fragment of the table to 310/1-367/8.[25]

The significance of the Ethiopic calendar tables for this discussion stems from the fact that, unlike Athanasius' *Festal Letters*, they contain not only the dates for Easter, but also the dates of all major Jewish festivals (see Appendix 2), and Neugebauer was convinced that the tables (and the underlying calendar) had their origins in the Alexandrian Jewish community. In Greek and Medieval Latin literature, the system was given the name *epact*, which meant *the age of the moon* in days with respect to some fixed date.

The civil calendar used in Alexandria during the Roman period, known as the Alexandrian calendar, from the time of Caesar Augustus, was a combination of the old Egyptian calendar and the Julian calendar. In the latter, all the months except February have 30 or 31 days, and the additional 366th day is February 29. In the Alexandrian calendar, all the months had 30 days, and the extra, *epagomenal* 5-6 days were tacked on at the end of the year, in August. The first day of the Alexandrian civil year, Thoth 1, usually began on August 29, except in the years preceding Julian leap years, when an extra, 366th day was added to the previous civil year on August 29, making the year start on August 30.[26]

The Alexandrian church adopted the simplest epact calendar with an 11-day shift. The Easter full moon each year moved, with regard to the Alexandrian calendar, 11 days forward; in the intercalary year, they were additionally moved up 30 days.[27] According to the Ethiopic calendar tables they were on:

10, *29*, 18, 7, *26*, 15, 4, 23, 12, 1, 20, 9, *28*, 17, 6, *25*, 14, 3, 22

where dates higher than 24 (in italics) stand for the seventh month, Phamenoth; dates lower than 24 belong to the eighth month, Pharmouthi; and the 13th month Elul II is intercalated before the beginning of years counted by the pattern **3-3-2-3-3-3-2** from the first year of Diocletian, 284 (= JE –3 mod 19), or by the pattern **3-2-3-3-3-2-3** from JE.

Seven intercalary months add up to 210 days, whereas nineteen 11-day shifts comprise only 209 days. The cycle was restored by moving the Easter full moon down by 12 days in the last year of the cycle. In medieval literature, the 12-day shift was called 'saltus lunae' – literally, the 'jump of the moon.'

25 In the paper in *Oriens Christianus* (p. 101), Neugebauer displays only a seven-year fragment, while in the book (p. 100) he speaks of the 59-year fragment.

26 E. G. Richards, *Mapping Time: The Calendar and Its History,* Oxford: Oxford University Press, 1998, 157.

27 After establishing the date of Passover and its day of the week, it is easy to find the date of Easter.

7. 'Theory of others' vs. Alexandrian epact calendar

The *epact* calendar, in principle, is equivalent to the 'theory of others.' Indeed, an 11-day shift forward with respect to the Alexandrian calendar year of 365 days leads to a 354-day lunar calendar year. This is exactly what the 'theory of others' suggests in its first part: the festival in a regular year follows the previous one by *four days*, 50 weeks being discounted. The same 11-day shift in the Alexandrian civil leap year of 366 days leads to a lunar calendar year of 355 days. This is exactly what the 'theory of others' suggests in its second part: a *leap* year makes a *five day* separation, 50 weeks being discounted.

There is a nuance, however. Because Rosh Hashanah in the epact calendar fell no earlier than September, and thus was always *later* than the Alexandrian 366th extra day (August 29), the only way for the Alexandrian Jewish community to keep the 11-day shift uniform for all Jewish festivals *from Rosh Hashanah to Passover* was to add the 355th day to the lunar calendar *before* Rosh Hashanah, but close to it; for example, in the preceding month of Elul, which regularly contained 29 days. This is what we see in the Ethiopic calendar tables.[28]

The addition of an extra day to Iyar immediately spoils this uniformity of Jewish festivals within the Alexandrian calendar: there will be only 10 days difference in between two consecutive festivals of Shavuot, though between two consecutive Rosh Hashanah, still 11 days. It means that the addition of an extra day in Iyar was oriented, not toward the Alexandrian calendar, but toward another one. The only civil calendar with the 366th day close to Iyar that comes to the mind is the Julian calendar with its leap day on February 29.

The Julian calendar is the only one known to respect a uniform 11-day shift with Yom Ibbur in Iyar (and later in Adar). This means that the 'theory of others' was tied to the major Roman calendar system and thus was independent of the Alexandrian epact calendar.

8. Did it start as a 30-year cycle?

Because the 'others' are silent about 'saltus lunae,' let us look for another calendar with an annual 11-day shift that does not need it. The closest is a 30-year cycle. Subtracting 11 days each year, with the addition of 30 days in the intercalary years, after 30 years (with 11 intercalary years) one comes to the same starting date.

28 In the Ethiopic tables, and, likely, the calendar of the Alexandrian Church, between Rosh Hashanah and the 'Passover feast' (Nisan 14) there were always 190 days, so the intercalary month in the lunar calendar was Elul II. The system of intercalations of the second Elul goes back to the ancient Babylonian calendar. The 190 stands for 177 + 13 days. The 177 days before Nisan 1 show that the previous six months included three long months and three short months. See "Ethiopic Easter Computus", 97.

The 30-year cycle is known in history: it was championed by one Eastern church, as implied by the *Sardica Document,* submitted by a bishop of Antioch to the Sardica Council in 343 AD.[29] The bishop apparently tried to prove that Jews used a 30-year cycle and – stretching his intentions beyond the text in our hands – argued that this cycle was preferable to the Alexandrian calendar. In that document, the dates of Easter full moons (Nisan 14) are parallel to Jewish Passovers for the 16 years after 328; these dates coincide, except for cases when Passover fell before the vernal equinox, in early March.

One cannot conclude from a 16-year period whether Jews actually used a 30- or a 19-year cycle, or whether the latter was a part of the *Molad* or the *Epact* system. The Antiochean bishop could have heard that Jews had used a 30-year cycle in the past, prior to the 19-year cycle. The bishop could have assumed further that the former cycle had been in use as long ago as the time of Jesus; therefore his proposal.[30]

To reiterate, the Sardica Document hints *only* that a 30-year cycle *might* have been in use by the Jews sometime before 343. The fact that the bishop was unable to point with certainty to the date of Passover in 344, suggests that not only was a 19-year Epact used, but that a 'saltus lunae' was anticipated in that leap Julian year.

9. The word 'only' in the 'theory of others'

'Only,' a seemingly accidental word in the first part of the statement about regular years, could indicate the cycle behind the 'theory of others' and the true meaning of 'shana meuberet.' There are two ways to read it, and each has its own problems.

In de-emphasizing 'only,' the 'theory of others' sounds like a trivial statement about the length of the Jewish regular and leap years with NO need for a 'saltus lunae.' This speaks strongly in favor of a 30-year cycle Epact calendar, where, after 30 years, the Jewish date would fall on the same Julian date without any adjustment. With this reading, 'shana meuberet' can designate either the *Jewish leap year* or the *Julian leap year*. The only feature missing in the former case is an indication of how often Jewish leap days have to be inserted.

29 First analyzed by E. Schwartz, *Christliche und jüdische Ostertafeln,* Berlin, 1905; cf. *Calendar and Community,* 124-132.

30 Ch. Y. Bornstein, aided by his great intuition, supported (though with a 20-year delay) the idea of a 30-year cycle used by the Jews in the beginning of the fourth century; see his עיבורים ומחזורים ('Ibburim veMahzorim'), HaTequfa, 20, 1924, 319. His arguments, however, were purely Talmudic: references to Ravina's words in B. *Arachin* 9b and the 60-year calendar sent c. 240 by Shmuel Yarchinai to Rabbi Yochanan (B. *Hulin* 95b), where the "60" is nothing more than "double 30," yet divisible by 4, and thus a *true* cycle, independent of the position of the first leap year. What Bornstein missed was the relationship of Shmuel's activity with that of Rabbi Chanania.

In emphasizing 'only' in the first part, its omission in the second part (about leap years) indicates that there are times when a Julian leap year of 366 days does *not* meet a Jewish year of 355 days, but meets a year of different length, likely of 354 days. This implicitly points to a *masked* 'saltus lunae' and speaks in favor of a 19-year cycle. This interpretation suggests that the 'Julian leap year' is the only true meaning for 'shana meuberet.' With this, the system of 'others' becomes complete, except for an indication of how the 'saltus lunae' should be applied.

10. 'Saltus lunae' in the 19-year cycle

If the Jewish authorities did use the 19-year cyclic calendar with an annual 11-day shift in practice, one has to explain what they did with the 'saltus lunae,' because there is no place for a year of 353 days in a calendar that has Iyar (Adar) as the only variable month. The only solution is that the day was dropped, not in the last year of the cycle, but in *any Julian leap year* of the cycle: for example, the 30th day in Iyar (and later in Adar) simply was not added.

There is another way to implement a 'saltus lunae': intercalate a month of 29 days once in a cycle. This could have been exactly what Rabban Shimon ben Gamliel suggested in his dispute with Tanna Kamma. Therefore the 'theory of others' could have been the major Jewish calendar in the mid-second century.

II. Roots and Branches: 'Theory of Others' Throughout History

While the similarity between the 'theory of others' and the Epact system of the Alexandrian Church is firmly established, a direct link is missing. Otto Neugebauer believed that the Alexandrian Jewish community could have had a pattern for both. Let us look at another feature that makes both calendars similar: an intercalation pattern.

If our identification of Hai Gaon's 'first sages' as Shmuel Yarchinai and Abaye, sages of the third and fourth centuries, is correct, then the 'theory of others' could have been practiced in Babylonian communities as well. Let us trace the semi-visible signs of the 'others' through Jewish history after the second century.

11. The intercalation principle

The Alexandrian Church calendar shared with 'others' the same principle of intercalation of the 13th month. Indeed, Tosefta *Sanhedrin* 2:7 lists opinions of four rabbis:

[תוספתא סנהדרין פ"ב] אין מעברין את השנה אלא א"כ היתה תקופה חסירה עד רובו של חודש. וכמה הוא רובו של חודש? ששה עשר יום. ר' יהודה אומר שתי ידות בחדש. כ' יום. ר' יוסי אומר: מחשבין את השנה ואם היתה חסירה ששה עשר יום לפני הפסח מעברין אותה, ששה עשר לפני החג אין מעברין אותה. ר' שמעון אומר: אפילו היתה חסירה ששה עשר יום לפני החג מעברין אותה.[31]

One intercalates the year only if the Tequfa misses most of a month. And how much is most of a month? 16 days. R. Yehuda says: two-thirds of a month. [Which is:] 20 days. R. Yose says: compute the year and if it misses (1) 16 days before Pesach – intercalate it; (2) 16 days before the Chag – do not intercalate it. R. Shimon says: Even if it misses 16 days before the Chag – intercalate it.

The Talmud (B. *Sanhedrin* 13b) adds to the four opinions an opinion of 'others':

תלמוד בבלי מסכת סנהדרין דף יג עמוד ב:

אחרים אומרים: מיעוטו, וכמה מיעוטו - ארבעה עשר יום. מאי קסברי? אי קסברי יום תקופה גומר, וכוליה חג בעינן - האיכא! אמר רב שמואל בר רב יצחק: אחרים בתקופת ניסן קיימי, דכתיב +דברים ט"ז+ שמור את חדש האביב - שמור אביב של תקופה שיהא בחדש ניסן. - וליעבריה לאדר! - אמר רב אחא בר יעקב: תנא מלמעלה למטה קחשיב, והכי קאמר: עד מיעוטו מעברין, וכמה מיעוטו - ארבעה עשר יום. רבינא אמר: לעולם אחרים בתשרי קיימי, וקסברי אחרים: כוליה חג בעינן ויום טוב ראשון. - יום טוב ראשון? חג האסיף כתיב! - חג הבא בזמן אסיפה.

Rashi, in the commentary to B. *Sanhedrin* 13b, interpreted this passage as follows:

According to *Others* [*intercalation is necessary]*, when *Tequfat Nisan* falls on Nisan 16. But if it falls on Nisan 15, the month is not intercalated, but to Adar is added 1 day to have 30 days, so that the Tequfa falls on *Nisan 14 as it needs to be* in order that the Tequfa falls into the *waxing moon* in Nisan and the new Tequfa quarter begins with Nisan 14, so that the Pesach sacrifice and the whole Pesach holiday will be done in the new Tequfa quarter [season].

Hence 'others' argue for intercalation if Tekufa Nisan was missing Nisan 14. If the Tekufa was supposed to fall on Nisan 15, to avoid intercalation, 'others' proposed a trick of adding an extra day in Adar, Adar 30, which would place the Tekufa on Nisan 14 and would not require intercalation. But effectively, for 'others,' Nisan 14 was the boundary for intercalation. The same basic principle was upheld by the Alexandrian Church.

Indeed, Nisan 14 is what the Christian Church calls the 'Easter full moon.' In the mid-third century, Dionysius, Bishop of Alexandria in 250s, argued that Easter Sunday must be celebrated after the equinox. But already in the late third century, Anatolius of Alexandria, later Bishop of Laodicea (d. 283), in his *Paschal Canon*, III, written c. 270, citing Philo of Alexandria and Josephus Flavius, emphasized that 'Jews of old' had observed the 'equinox rule,' and therefore the Easter full moon itself must follow the equinox.[32]

31 Zuckermandel, *Tosefta*, 417. Deciphering this Tosefta will be the subject of another paper.

32 See Eusebius, the *Church History* (*HE* 7.20 and 7.32.15-17). Anatolius places the equinox on Phamenoth 26 = March 22. The Alexandrian church computed the date of the vernal equinox in

There is no positive data to confirm whether or when the Alexandrian Jewry observed the 'equinox rule' and what the latter actually meant. However, the Talmud mentions several Alexandria-related episodes that can shed some light on their calendar.

An interesting episode is recorded in the Palestinian Talmud, Y(erushalmi) *Erubin* 21c:

רבי אבהו אזל לאלכסנדריאה ואטעינון לולבין בשובתא.שמע רבי מי, מר מן מייבול להון רבי אבהו בכל שתא? רבי יוסי מישלב כתיב להון אף על פי שכתבנו לכם סדרי מועדות – אל תשנו מנהג אבותכם נוחי נפשו!

Rabbi Abahu went to Alexandria and they raised lulavin [palm branches] on Shabbat. Rabbi [A]mi heard and said: who will bring them Rabbi Abahu every year? Rabbi Yose sent them a message: even though we wrote to you the dates of the festivals, keep the customs of your fathers, whose souls are at rest.[33]

Rabbi Ami (a disciple of Rabbi Yochanan) and Rabbi Abahu lived in the late third century. Rabbi Yose probably lived at the same time or slightly later. It is clear that the Alexandrian Jewish community kept a different calendar than the Jews in Eretz Israel. The fact that they raised palm branches on the first day of the Feast of Tabernacles (which fell on Shabbat) shows that Rabbi Abahu informed them of the exact time of Rosh Chodesh.[34] Therefore, in the late third century, the calendar of Alexandrian Jewry was different than the Molad calendar.

This story suggests that the Alexandrian Jewish community could have practiced an epact-based calendar, which was different from the Molad calendar practiced by the Jewish community in Eretz Israel. We do not know, however, when the Alexandrian Jews began using the epact-based calendar and how well it was originally adjusted to the true moon positions.

All we know about the calendar of Alexandrian Jewry is that it was linked to the Alexandrian calendar. A letter from Peter of Alexandria, a would-be Alexandrian bishop c. 300, defines the boundaries of Passover in terms of the local spring months, Phamenoth and Pharmuthi:

They [Jews] celebrate [Passover] by necessity twice in Phamenoth and once every third year in Pharmouthi; for it is from the beginning even before the advent of Christ, that they have plainly always done so.[35]

This means that c. 300 in Alexandria, Nisan 14 fell as early as Phamenoth 10. Let us show that the intercalation cycle of the Alexandrian Jewish community

the third-sixth centuries from Ptolemy's *Syntaxis (Almagest)* as shall be discussed in a separate paper.

33 Cf. *Calendar and Community,* 173. On p. 174, Stern suggests that a fixed calendar was sent.

34 Rabbi Yose's remark could mean that the Alexandrians, knowing exactly the day of Rosh Chodesh Tishrei and of the first day of Sukkot, decided to cancel the celebration of the second day.

35 Cf. *Calendar and Community,* 72; and further discussion.

might have been established at the turn of the first century BC. Indeed, at that time the old Egyptian calendar, with a 365-day year, slipped away from the vernal equinox: one day every four years. After Augustus' reform in 26 BC, this motion was checked and the vernal equinox was thought to fall on Phamenoth 29 (March 25). Assuming that initially the intercalation principle was identical to what was claimed later by the Alexandrian Church, that is Nisan 14 (Easter full moon) could not fall prior to the vernal equinox, we have to explain how, historically, it could slip down by 19 days. This could have happened if at some point the lower boundary for Nisan 14 was set to Phamenoth 10. Counting back 76 years from 26 BC, the year of Augustus' reform, points to 102 BC, the beginning of the tenure of Judean King Alexander Janneus (103-76 BC), who had strong ties with Egyptian Jewry.[36] It is plausible that at that time the Judean and Alexandrian intercalation principles were synchronized, but later the Jewish Alexandrian system eroded, being attached to the old Egyptian calendar.

This guess is supported by the chain of events surrounding the 94-88 BC Pharisaic revolt against King Alexander Janneus. In an unprecedented incident, Pharisees invited the Seleucid King Demetrius III Eukerus to overthrow Alexander Janneus *(Jewish Antiq.*, 13:376). The only rational explanation for inviting a foreign king to replace a native one is that the Pharisees viewed the replacement of the Molad calendar by the Epact-based calendar as national treason. Indeed, the former calendar, which they had learned about in the Babylonian exile, represented in their eyes, authentic Jewish practice. Seleucid kings used the old Babylonian calendar with Macedonian names for the months, and the Pharisees saw in them a reliable partner.

The fact that during the revolt the Jewish crowd threw citrons at King Janneus (*Jewish Antiq.*, 13:372) shows that they did not think the day for the Feast of Tabernacles was assigned correctly. Indeed, King John Hyrcanus (d. 104 BC) is known to have broken his life-long alliance with the Oharisees at the end of his life. A remark in the *Jewish Antiquities* that on the death of King Alexander Janneus (d. 76 BC), his widow, Queen Salome Alexandra, "reestablished old Pharisaic practices, according to the traditions of their forefathers, which her father-in-law, Hyrcanus, abrogated" (*Jewish Antiq.*, 13:408), certainly refers to the *calendar* practices. Therefore, after a short period (c. 104-76 BC) of practicing perhaps another epact-based calendar, Judean Jewry returned to the Molad calendar.

If King John Hyrcanus borrowed the calendar from the Alexandrian Jewry, then the latter had practised the epact-based calendar since at least 104 BC – in line with Neugebauer's conjecture.

36 Josephus Flavius, *Jewish Antiquities*, 13:352-5, brings a story in which Egyptian Jewish leaders warned Cleopatra against conquering Judea as she would make all Egyptian Jews her enemies.

12. Late second – early third centuries

Let us list the calendar references in the Talmud from the lips of the third century sage, Rabbi Sim[l]ai, and show that they can be interpreted in terms of 'others.'

First, we see that during the tenure of Rabbi Yehuda ha-Nasi, Adar took the role of the variable month, played until then by Iyar. According to the same page of the Talmud (B. *RH* 19b) where Rabban Shimon ben Gamliel argued for the intercalation of 'a month' (29 days), Rabbi Sim[l]ai testified that in the past the Bet Din allowed the pair of Adar I and Adar II to be either both long (30+30), both short (29+29), or one long and the second short (30+29).

לאפוקי מדדרש רב נחמן בר חסדא העיד רבי סימאי משום חגי זכריה ומלאכי על שני אדרים שאם רצו לעשותן שניהן מלאין עושין שניהן חסרין עושין אחד מלא ואחד חסר עושין וכך היו נוהגין בגולה ומשום רבינו אמרו לעולם אחד מלא ואחד חסר עד שיודע לך שהוקבע ר"ח בזמנו שלחו ליה למר עוקבא אדר הסמוך לניסן לעולם חסר

Contrary to Rav Nachman Bar Hisda, testified Rabbi Sim[l]ai that, in the name of Haggai, Zacharia, and Malachi on two Adars, that if they wanted both long– do, if they wanted both short – do, and if they wanted one long and another short – do. And this way they behaved in the Diaspora. But in the name of our Rabbi they said: 'Always one long and another short until you are informed that Rosh Chodesh was fixed in the Land of Israel on time' [i. e. on the 30th day of the past month.] They sent to Mar Uqba [a message]: 'Adar adjacent to Nisan is always short.'

The third option is for a *regular intercalary* year. The second option could reflect the 'saltus lunae' in Adar I, i. e., intercalation of a 29-day month, the proposal of Rabban Shimon ben Gamliel as explained above. The first option points to an *intercalary leap* year within the *Epact* system, with an extra, 355th day added in Adar II.

It is unclear how long this version of the 'theory of others' survived because later sages said that, *according to our rabbi* (Rabbi Yehuda ha-Nasi? Rav Arikha?), the first two options were forbidden. The ban on the second option (29+29) means that saltus lunae could no longer be applied using an intercalation of 29 days, as Rabban Shimon ben Gamliel suggested.

The ban on the first option (30+30) is more puzzling, yet it was confirmed by a later, c. 250, statement (B. *RH* 19b):

שלחו ליה למר עוקבה: אדר הסמוך לניסן לעולם חסר

They sent a message to Mar Uqba: Adar adjacent to Nisan is always short.

We can guess why this happened. In the time of Rabbi Yehuda haNasi, messengers were sent to Babylonia to inform them of the date for Rosh Chodesh. The most *vulnerable* (closest to Rosh Chodesh) of all festivals, aside from Rosh Hashanah, was Atzeret (Shavuot) and it was decided to permanently fix Nisan and Iyar. Nisan was fixed at 30 days and a new problem arose – four 30-day months in a

row, from Shevat to Nisan, if the second Adar was added, and 'Yom Ibburo' was added as the 30th day of the first Adar.

Clearly the sages did not want to have four long months in a row. But how could they further handle the *intercalary leap* years, which came as often as seven times every 76 years?

13. 'Yom Ibburo' in Elul

The only way to avoid four 30-day months in a row was to play the Elul option. Instead of two long Adars, the sages may have used the scheme 30+29 for the Adars, while Elul of that year became long. B. *RH* 19b states that:

א"ר מימות עזרא ואילך לא מצינו אלול מעובר, לא מצינו דלא איצטריך, הא איצטריך מעברינן ליה.

Said the Rabbi: the addition of an extra day to Elul [instead of Adar] was not done since the days of Ezra. It was not done – since it was not needed; thus if it is needed – we can make Elul full.[37]

Though during every 76 years there could be *seven* occurrences of four long months in row, the Talmud (B. *RH* 20ab, 21ab) speaks about only *four cases* in which the month Elul was made long. These four cases occurred during the generations between Rav (Rabbi Arikha) (d. 247) and Rava (d. 340). Therefore, we must explain three additional cases when Adar II was made short. The answer is obvious from what we have already learned – such a circumstance could come from manipulating the 'saltus lunae' by placing it in any *leap* year of the 19-year cycle.

14. Back to the Second Century

The academic argument in Section 1 between Rabban Shimon Ben Gamliel and the anonymous Tanna shows that the 'theory of others' most likely originated at the Talmudic academy in Usha, Galilee, where Rabban Shimon and Rabbi Meir taught in the mid-second century. However, several pieces of evidence point to an even earlier period – the time of the Bar Kochba revolt, 132-135. The first is historical: Rabbi Meir began calendar activity during the leadership of Rabbi Akiba, a strong supporter of the Bar Kochba revolt. The second is substantial: the simplicity of the 'theory of others,' especially without the 'saltus lunae' feature. Both arguments are backed by activities of another sage, Rabbi Chanania of Nehardea.

37 An immediate remark, הא מיקלקל ר"ה מוטב תיקלקל ראש השנה ולא יתקלקלו כולהו מועדות., "But it will make uncertain [spoil] the day of Rosh Hashanah!" was answered by: "it is better to spoil Rosh Hashanah than all holidays." If "all holidays" here means Passover and Atzeret, then the answer is concerned with a violation of the basic formula of 'others': "from Atzeret to Atzeret and from Rosh Hashana to Rosh Hashana, 4 days only."

Tosefta *Megilla* 2:5 tells of the simultaneous journeys of Rabbi Akiba to Nehardea and of Rabbi Meir to Asia לעבר את השנה ('to intercalate the year'). Because intercalation outside Eretz Israel was formally prohibited, and because a rank-and-file messenger was enough to announce the addition of 30 days, the expression לעבר את השנה regarding the above journeys of the Jewish leaders must mean something different. S. Stern remarks: "the purpose of these journeys is somewhat unclear, as it would have been perfectly possible and normal to intercalate the year in Palestine."[38]

We suggest that the journey could mean only one thing – a *break* with the old tradition and the establishment of a new one. Accordingly, the above expression, לעבר את השנה, in this context must mean not an addition of a month, but a formula of how to add 'Yom Ibburo' in the Julian leap years.

The last argument has support from another source. The Palestinian Talmud (Y. *Ketubot* 2:6) hints that the misfortunes that befell Shmuel Yarchinai (d. 250), a sage from Nehardea, a Babylonian city, stemmed "from the same sin as committed by another rabbi from the same city, Chanania (מן חטאת דחנניה בן אחי ר' יהושוע שעיבר את השנה בח"ל). On the other hand, we know from B. *Berakhot* 63a that Rabbi Chanania *intercalated years and fixed months* (מעבר שנים וקובע חדשים). This suggests that *two* techniques were involved, but considered separately: adding one day (לעבר שנים) and adding a month (לקבוע חדשים).

Because Shmuel Yarchinai had come forward with a 60-year calendar table (which is a double 30-year cycle), and moreover, explicitly equated (B. *Eruvin* 56a) the solar year with the Julian year – a major benchmark in the 'theory of others,'[39] one can reasonably expect that Rabbi Chanania used the 30-year cycle within the 'theory of others' or just neglected 'saltus lunae.' There is little difficulty required to imagine that Rabbi Chanania learned the 'theory of others' from Rabbi Akiba on the latter's visit to Nehardea. Accepting this, the only reason for such a hasty teaching was to prepare Jews in the Diaspora for an *emergency* situation, such as when the Bet Din *ceased to function*, for example, during the last year, 135, of the Bar Kochba revolt. The 'saltus lunae' could have been dropped to keep the calendar from being too complex.

We also know from the Palestinian Talmud (Y. *Sanhedrin* 1:2, Y. *Nedarim* 7:13) that messengers from Eretz Israel sent by Rabban Shimon ben Gamliel stopped Rabbi Chanania's calendar practices. Again: a *messenger* means a *change of the calendar*. As we suggested in Section 10, Rabban Shimon could have ordained a strict implementation of 'saltus lunae' and, therefore, a 19-year cycle.

38 *Calendar and Community,* 238.

39 Stern (*Calendar and Community*, 258, ftn. 166) is right in his guess that Julian year "may have been instrumental in setting his 60-year schedule of intercalations" – the Julian year is an important part of the 'theory of others' and of any other epact system.

15. Which calendar was practiced in Nehardea and Pumbedita?

The subsequent fate of the 'theory of others' is not very clear. We know about the staunch opposition of Rabbi Yochanan, head of the Bet Din (c. 220-250) at Tiberias (a Jewish political center in Eretz Israel and seat of the Jewish Patriarch), to Shmuel Yarchinai's calendar. Rabbi Yochanan also sent two messengers to Asia concerning some calendar matters (B. *Sanhedrin* 26a).

ר' חייא בר זרנוקי ור"ש בן יהוצדק הוו קאזלי לעבר שנה בעסיא, פגע בהו ריש לקיש, איטפיל בהרייהו, אמר איזיל איחזי היכי עברי עוברא.

R. Hiyya Bar Zarnuki and R. Simeon Ben Jehozadak once went to Asia to intercalate the year. They were met by Resh Lakish, who joined them, saying, 'I will come and see their procedure.'

This could mean another change to the calendar; therefore, it is impossible to say in which form the 'theory of others' could have been used, or if it was used at all in Eretz Israel after 220. But it could have been practiced in Babylonia – in Nehardea, and later in Pumbedita where Rav Judah, Shmuel's disciple, taught. Since the head of the Talmudic academy in Pumbedita, Abaye (d. 339), declared the importance of a 28-year cycle, and therefore of a Julian year, he was surely in favor of the 'theory of others.' His colleague, Rava (d. 350), could have also followed the 'others' since he used the expression 'Yom Ibbur' in a *halakha*. But in the post-Rava era, in 358/9, the Eretz Israel sage, Hillel Bar Yehuda, decided in favor of the Molad system and at this point the academy in Sura attained predominance. Ravina, a sage of Sura (fl. 5th century), already speaks about the 'theory of others' as something alien. Rav Ashi, another man of Sura, the 'editor' of the Talmud, has obliterated any essential vestige of the 'theory of others' in the Talmud, except for several cases when it was quoted in conjunction with another *halakha*.

16. When was the 'theory of others' forgotten?

Giving comment to *Arachin* 9b, Rashi allowed himself to correct the 'others':

ד"ה "אחרים מנינא אתא לאשמועינן":

בתמיה כיון דכסדרן אית להו פשיטא דאין בין זה לזה אלא ארבעה והכי איבעי להו למימר אין מעברין את החדש [אלא] לצורך וממילא ידענא דאין בין זה לזה אלא ארבעה.

Why do ['others' hold] "in order"? Clearly the difference is just 4; while they **should** say as follows: one intercalates the month [only] because of need, and it follows that the difference is only 4.

Rashi is wrong – the difference is sometimes five days, not four, while 'in order' must mean an application of an 11-day shift. It seems that neither Rashi (d. 1105) nor Rabeinu Chananel (d. 1053) received the authentic tradition for the 'theory of others' and led everyone after them astray. It is interesting to spot the precise

moment when the true meaning of the 'theory of others' was lost from the Jewish world.

Though Hai Gaon did not mention it explicitly in his 992 letter, it was *implied,* as we discussed in the Introduction. A partial answer to the above question comes from reading the documents pertaining to the 922-924 dispute between Saadia Gaon of Baghdad and Aaron Ben Meir of Tiberias. The dispute was the subject of Bornstein's 1904 book, with the exact quotation from the extant pieces of the original letters found in the Cairo Geniza.

At one point, according to Bornstein, the Jewish sages of Baghdad who vied against Ben Meir suggested that the latter wanted to *restore in practice* the 'theory of others.' Bornstein's commentary is singularly important as it shows the depth of misunderstanding of the 'theory of others' by a foremost scholar of the Jewish calendar:

בהודע הדבר, כי בן מאיר, בנטותו מקביעת הבבלים, עשה את שנת תרפ"ב המעוברת לחסרה, ואומר כי בינה ובין השנה שאחריה ששה ימים (לפי דרך חשבוננו חמשה :Bornstein), ועל שנת תרפ"ג הפשוטה הוא אומר שהיא כסדרה, ובינה ובין השנה שאחריה חמשה ימים (לפי דרך חשבוננו ארבעה :Bornstein), חיש קל עברה השמועה במחנה (בלי שום לב כי שנת תרפ"ד לדברי בן מאיר שלמה :Bornstein), כי הוא אומר לעשות את כל המעוברות חסרות וכל הפשוטות כסדרן, כדעת אחרים האומרים: אין בין פסח לפסח ואין בין עצרת לעצרת אלא ארבעה ימים וכשנה מעוברת חמשה.

When it became known that Ben Meir, in opposition to the Babylonian sages, made intercalary year 922 'deficient' [of 383 days total] and said that between it and the next year there are six days (Bornstein: according to our tables — five); and about non-intercalary year 923 that it is 'normal' [of 354 days] and between it and the next year there are five days (Bornstein: according to our tables – four). A rumor quickly passed through the camp (Bornstein: with no regard that year 924, according to Ben Meir, must be 'full' [of 355 days]) that he wants to make all intercalary years 'deficient' and make all common years 'normal,' as was the opinion of 'others,': between Passover and Passover and between Atzeret and Atzeret four days only, while in the intercalary year — five.[40]

Remarkably, in the text of the letter of the 'Babylonian sages' there was no definite reference to the 'theory of others,'[41] perhaps because half of the text is not extant. However, accepting Bornstein's interpretation, his last remark, *'with no regard that year 924 according to Ben Meir must be 'full'* [of 355 days],' implies that the Jewish sages in Baghdad did know that 924 was a Julian *leap* year, and therefore, according to the 'others,' must be 'full.' The sages also sensed that Ben

40 *Makhloket* 32, last paragraph. Our comments are in brackets. There was no reason for Bornstein to quote the 'theory of others' incorrectly (Passover instead of Atzeret), unless he was thinking of a leap day in Adar.

41 *Ibid.*, p. 80, ftn. 2. In the extant pieces of the text of the second letter (ב) the sages discuss the possibility of two consecutive years being separated by *seven* or even *eight* days. The last number is astonishing since neither the modern Molad system nor the 'theory of others' allow for more than seven-day difference!

Meir applied 'saltus lunae' in the *intercalary* year 922 – the 'unwritten rule' discussed above.[42]

Therefore, the true meaning of the 'theory of others' never died in the eastern part of the world. In his 992 epistle, Hai Gaon chose not to mention it explicitly by name, probably being unwilling to discuss the change in the meaning of 'shana meuberet.' In another hundred years, its first meaning was completely lost, at least by the European Jewish community.

17. Summary

1. In the second half of the second century, the Jewish community in Eretz Israel used a fixed calendar, as seen from the dispute between Rabban Shimon ben Gamliel and the anonymous Tanna in the Baraita quoted in B. *RH* 19b and B. *Arachin* 9b.

2. The term 'shana meuberet' originally meant the *Julian leap year*.

3.'Theory of others' suggested adding in such a year an extra (leap) day to the regular lunar year of 354 days. At first, the 355th day ('Yom Ibburo') had been added every fourth year as Iyar 30; later, as the 30th day of Adar II.

4. 'Theory of others' is identical in principle to the 19-year cyclic epact calendar used by the Alexandrian Church since the third century. The difference was in the position of the leap day, which the Church inserted in the fall while 'others' added in the spring.

5. 'Saltus lunae' seems to be absent in the original 'theory of others.' However, the difficulty largely disappears when we stress the word 'only' in the 'theory of others.' The Church applied 'saltus lunae' always in the end of their 19-year cycle, while the 'others' seemingly proposed to apply it in any Julian leap year, by skipping Iyar 30.

6. Retrospectively, in the above Baraita, Rabban Shimon ben Gamliel could have argued for implementation of 'saltus lunae' by intercalating a 29-day month.

7. 'Theory of others' was introduced by Rabbi Meir as an *emergency* calendar at the time of Bar Kochba revolt, 132-135.

8. The 992 epistle of Hai Gaon confirms that the Jewish community in Babylonia used a variant of the 'theory of others' in the time of the 'first sages' who settled in Babylonia: Rabbi Chanania and Shmuel Yarchinai of Nehardea.

9. The reason for the Pharisaic revolt against King Alexander Janneus in 94-88 BC, given by Josephus in the *Jewish Antiquities*, suggests that his father, King John Hyrcanus, introduced an epact-based calendar in Judea. If the King switched to the

42 In the beginning of the third letter (ג) that Bornstein brings, *ibid.*, p. 87, there is an accusation against Ben Meir's plans: ויוסיפו על כל שנה פשוטה חמשה ימים ועל כל שנה מעוברת כדבריו [בורנשטיין: ששה] - as though he intended to add five days after every regular year, and [Bornstein: six] every 'shana meuberet.' These words raise a difficulty though much of the text is missing.

calendar of the Alexandrian Jewish community, then the latter used an epact-based calendar from at least 104 BC – in line with Otto Neugebauer's conjecture.

10. Every time messengers were sent outside Eretz Israel concerning calendar matters, an important change of the calendar system is implied. The Talmud reports four such events, which took place in c. 135 (journeys of Rabbi Meir and Rabbi Akiba), c. 150 (messengers from Rabban Shimon ben Gamliel to Rabbi Chanania), c. 220 (in time of Rabbi Yochanan), and c. 300 (Rabbi Abahu's visit to Alexandria).

11. The Talmudic references admit the possibility that the 'theory of others' may have been used by Jewish community in Judea and Galilee as late as 220, during the tenure of Rabbi Yehuda ha-Nasi. However, it could have been abolished in Eretz Israel in favor of the Molad system immediately after his death, when Rabbi Yochanan assumed the leading role in Tiberias Academy.

12. The addition of an extra day ('Yom Ibburo') in Elul four times at the turn of the third-fourth centuries could have been an effort to prevent the occurrence in the Spring of four long (30-day) months in row (Shevat-Adar-Adar-Nisan). It also could have been an attempt to adjust the calendar in Eretz Israel to the Alexandrian one, following Rabbi Abahu's trip there.

13. The (Antiochian?) 19-year Jewish intercalation cycle in the *Sardica document* remained unfinished, because the exact place for 'saltus lunae' was unknown to the Christians.

14. The 'theory of others' could have been practiced in the Talmudic academies at Nehardea and Pumbedita at least until the mid-fourth century. The memory of it was adequately retained until the tenth century. Later, its original meaning was lost. It could have lost a historical competition to the so-called 'four gates' calendar, which is now in use, since it was too rigid to accommodate the postponements of Rosh Hashanah. [43]

15. One can only guess when the meaning of 'shana meuberet' changed, but the following scenario is plausible. With postponements of Rosh Hashanah imposed upon the Molad system, a special word had to be coined for the 353-day year, but there was no convenient inversion for the word 'meuberet' ['pregnant']. This had dramatic philological consequences. 'Shana meuberet' slipped into its current meaning of the Jewish *intercalary* year, while the year of 355 days acquired a new name, *shelemah* [full], leaving for years of 353 and 354 days the names *chaserah* [deficient] and *kesidra* [normal].

16. Not being concerned with these particularities, the Alexandrian Church opted for the epact calendar with the 'saltus lunae' fixed at the end of the 19-year cycle and used it in this form since the third century. Circa 532, Dionysius Exiguus introduced the Alexandrian calendar within the 532-year cycle for all of the Chri-

43 First discussed in Ari Belenkiy, "A Unique Feature of the Jewish Calendar – Dekhiyot," *Culture & Cosmos* 6 (1), 2002, 3-22.

stian Church on the authority of a (spurious) Nicean decree.[44] The Catholic Church used it continuously until the Gregorian Reform of 1582, and the Eastern Orthodox Church still uses it.[45]

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APPENDIX 1. SOLUTION FOR 'YOM IBBURO' AND 'OR IBBURO'.

Tosefta Arachin: 1:11

Atzeret (Shavuot) always occurs on the same [weak]day as *Yom Hanef.*
Rosh Hashanah always falls either on the same [week]day as *Yom Hanef* or as *Yom Ibburo.*
'Others' say: from Atzeret to Atzeret and from Rosh Hashanah to Rosh Hashanah – 4 days only, though in a *shana meuberet* [lit: pregnant year] – 5 days.

Tosefta Arachin 1:9

Atzeret falls either on the fifth, or on the sixth, or on the seventh [of Sivan], not earlier or later. R. Yehuda said: if on the fifth – it is a bad sign; on the sixth – mediocre; on the seventh – a good sign. Abba Shaul said: each time that we know [in advance] the day of Atzeret is always a good sign.

"Rosh Hashanah on Yom haNef"& "Atzeret on Sivan 7"	"Rosh Hashanah on Yom Ibburo"& "Atzeret on Sivan 6"	"Rosh Hashanah on Yom Ibburo" & "Atzeret on Sivan 5"
'Yom HaNef' = Nisan 16	'Yom HaNef' = Nisan 16	'Yom HaNef' = Nisan 16
Nisan 29 days	Nisan 29 days	Nisan 30 days 'Or Ibburo' = Nisan 30
Iyar 29 days	Iyar 30 days 'Yom Ibburo' = Iyar 30	Iyar 30 days 'Yom Ibburo' = Iyar 30
Atzeret on Sivan 7 "Good sign"	Atzeret on Sivan 6 "Mediocre sign"	Atzeret on Sivan 5 "Bad sign"
Sivan 30 days	Sivan 30 days	Sivan 30 days
Tamuz 29 days	Tamuz 29 days	Tamuz 29 days
Av 30 days	Av 30 days	Av 30 days
Elul 29 days	Elul 29 days	Elul 29 days
Rosh Hashanah: Tishrei 1 161 days from 'Yom haNef'	Rosh Hashanah: Tishrei 1 162 days from 'Yom HaNef' 119 days from 'Yom Ibburo'	Rosh Hashanah: Tishrei 1 163 days from 'Yom HaNef' 119 days from 'Yom Ibburo'

44 See "Ethiopic Easter Computus," p. 100.

45 *Gregorian Reform of the Calendar.* (1983) Proceedings of the Vatican conference to commemorate its 400th anniversary. Edited by G.V. Coyne, M.A. Hoskin, and O. Pedersen.

TABLE 1. 'YOM IBBURO' = IYAR 30, 'OR IBBURO' = NISAN 30.

c	e	m	yk	tb	p
1	0	30	9	14	10
2	11	19	28	3	*29*
3	22	8	17	22	18
4	3	27	6	11	7
5	14	16	25	30	*26*
6	25	5	14	19	15
7	6	24	3	8	4
8	17	13	22	27	23
9	28	2	11	16	12
10	9	21	30	5	1
11	20	10	19	24	20
12	1	29	8	13	9
13	12	18	27	2	*28*
14	23	7	16	21	17
15	4	26	5	10	6
16	15	15	24	29	*25*
17	26	4	13	18	14
18	7	23	2	7	3
19	18	12	21	26	22

"Table XIX"

Figure 2. A "Jewish" part of a "XIX" Ethiopic Easter table. In column 1: the number of the year within the cycle; in column 2: epact; in columns 3-6: dates of Rosh Hashana (**m**), Yom Kippur (**yk**), Sukkot (**tb**), and Passover feast (**p**). Passover feast's dates in *italics* correspond to month Phamenoth, in regular style – to month Pharmouthi (where Phamenoth X = March X-4 and Pharmouthi Y = April Y – 5), with Phamenoth 25 = March 21 as the earliest Easter full moon (**p**) in line 16. The intercalation pattern is 3-2-3-3-3-2-3 from 3761 BC. (From O. Neugebauer, "Ethiopic Easter Computus," *Oriens Christianus*, 63 (4), 1979, p. 94).