Tosafot (d.h. Litekufot) on b. Rosh Hashanah 8a, translated with notes

The division into paragraphs of the Hebrew text of this Tosafot comment is my own – Motti Yarchinai.

1) **לתקופות** כר"א דאמר בתשרי נברא העולם. ומונין מולד הלבנה והתקופה מאחד בתשרי ורבי יהושע מונה מניסן ויש נפקותא מרובה בדבר במה שקודם מנין של זה למנין של זה חצי שנה

2) והא דקיימא לן פרק כיצד מעברין (עירובין ד' נו. ושם) דאין תקופת ניסן נופלת אלא בארבעה רבעי היום אם בתחילת היום וכו' היינו משום דהתם כולהו כר' יהושע דתניא בברייתא כוותיה דשמואל סבר כר' יהושע דלר"א בכ"ה באלול נברא העולם ולר' יהושע בכ"ה באדר היינו דכשנברא אדם בששי קדש החדש

3) וזה טעם למחשבי העבור לאחר שצרפו כל השעות והקפה של כל מחזורים שמסירין ז"ט תרמ"ב פי' ז' ימים תשע שעות תרמ"ב חלקים דרגילים לומר לפי שהיתה הלבנה נזופה ע"י שקטרגה ונהגה נזיפה בעצמה ז"ט תרמ"ב *

4) ולא מצינו טעם זה בכל מקום אלא זהו הטעם לפי שהמונה מבריאת העולם לא מונה ר"ה עד יום ששי שנברא אדם הראשון ובשעה תשיעית נצטווה כדאמר פרק אחד דיני ממונות (סנהדרין ד' לח:) ומסתמא אז קדש החדש ומשקדש החדש ע"כ היה המולד ו' שעות קודם דשית שעי מכסי סיהרא ונמצא המולד בתחילת שעה ט"ו דהיא שעה שלישית של יום וסימן וי"ד פי' ביום ו' בסוף שעה י"ד היה המולד מאחר שלא היה ר"ה עד יום ו' שקידש אדם הראשון החדש נמצא שנברא העולם בכ"ה באלול ואותה שנה של תוהו שמונין משום דיום אחד בשנה חשוב שנה

5) וכשתדקדק על מולד ניסן של תוהו שלפני תשרי של יישוב שבו נברא אדם תמצא מולד ניסן ברביעי בתשע שעות תרמ"ב חלקים שאתה צריך להשליך ב' ד' תל"ח *[ממולד תשרי ש]*לאחריו *[פי']* ב' ימים ד' שעות תל"ח חלקים ו*[כן ל]*מולד תשרי של תוהו שלפניו שנמצא ב' ה' ר"ד

6) ולתקופה מניסן של תוהו מונין שהיתה התקופה בתחילת ליל ארבעה ונמצאת תקופת תשרי של יישוב של אחריו ביום ד' ט"ו שעות כדאמרינן בפרק כיצד מעברין אין בין תקופה לתקופה אלא תשעים ואחד יום וז' שעות ומחצה נמצא דשתי תקופות ט"ו שעות ונמצא דקדמה תקופת תשרי למולד א' כ"ג פי' יום אחד כ"ג שעות ונמצא דקדמה תקופת ניסן את המולד ז' ט' תרמ"ב דל חצי ~~(שעה)~~ עודפת התקופה על המולד ה' י' תרמ"ב פי ה' ימים י' שעות תרמ"ב חלקים וכשתצרף ה' י' תרמ"ב עם א' כ"ג עולה ז' ט' תרמ"ב

7) והרי עכשיו נוהגין למנות מתשרי של תוהו שנות העולם כדפי' דיום אחד בשנה חשוב שנה ותקופת ניסן מונין מולד תשרי ב' ה' ר"ד וזקוקים להסיר ז' ט' תרמ"ב

8) ודבר תימה הוא במה נחלקו ר"א ור' יהושע דתניא לקמן (דף יב.) מונין לתקופה מניסן ולמולדות מתשרי והלא היו יכולים לברר הדבר דכ"ד שעות מיכסי סיהרא בין חדתא לעתיקא כדאיתא בסוף פ"ק דערכין (דף ט: ושם) והם מרחיקין המולד זה מזה ב' ד' תל"ח כולי האי אין ראוי לטעות דאיך יטעו בו שני ימים.

* Since the Tosafot preface this comment by saying that this whole discussion is from the viewpoint of Rabbi Eliezer, I am wondering if paragraph 3 should perhaps be amended to read as follows. (The quantities mentioned in the insertions and the amended quantity at the end of the paragraph are explained in paragraph 6 of this Tosafot.)

וזה טעם למחשבי העבור לאחר שצרפו כל השעות והקפה של כל מחזורים שמסירין ז"ט תרמ"ב פי' ז' ימים תשע שעות תרמ"ב חלקים ***ולא ה' י' תרמ"ב שהיא חצי עודפת התקופה על המולד*** דרגילים לומר לפי שהיתה הלבנה נזופה ע"י שקטרגה ונהגה נזיפה בעצמה ***א' כ"ג***

Notes:

1. Times of week are expressed here as **w,hh:pppp**, where:
   w = weekday 1 to 7 (Sun to Sat), **hh** = 00 to 23 hours and **pppp** = 0 to 1079 parts (1hr = 1080p).
   A time span is expressed in the same units, but the notation is: days,hh,pppp.

2. All times are expressed in **Jewish Mean Time (JMT)**, which numbers the hour according to how the hours of the day are counted in the Jewish calendar, in which the date changes at mean sunset, not six hours later at midnight, when the civil date changes. For example, zero hours on Wednesday, JMT = 18:00 on Tuesday, civil time, and in general, JMT (anywhere) = (your local) civil time + 6 hrs.

3. We use **Jerusalem time** in all calculations for the Jewish calendar of the times of occurrence of global astronomical phenomena like equinoxes and lunar phases. The times of local phenomena like sunrise and sunset are calculated in the observer's local time.

4. Traditional **Jewish chronology** supposes the **creation** of the world as described in chapter one of Genesis (the first book of the Torah) to have begun in the last week of Jewish year 1, and the sixth day of creation, the day on which Adam was created, is the first day (1 Tishrei) of year 2. Therefore, by that chronology, year 1 is largely theoretical (a mathematical construct), as most of it predates the creation of the world. It is therefore called here the **"year of *Tohu*"** (from the expression *tohu vavohu* in Gen. 1:2, describing the amorphous state of the world at the beginning of its creation). And since, by that chronology, the first man was created on 1 Tishrei of year 2, that Tishrei is called here the **"Tishrei of population"**.

5. A **molad** is a mean New Moon (AKA lunar conjunction). The astronomical New Moon is the notional beginning of a **synodic**[1] **lunation** (**L**), meaning a full cycle of lunar phases. The moladot (plural) of the Jewish calendar govern the commencements of the months, which always begin on or soon after the day of a calendric molad. These calendric moladot are *mean* New Moons, which occur at constant intervals of 4 weeks, 1 day, 12 hours and 793 parts (1p = 1/18 minute). This is the value adopted by the Jewish calendar as the mean length of **L** and it is the mean length of a Jewish calendar month. Traditionally, a molad occurrence is specified as a time of week (given as weekday, and time of day), where the week begins at zero hours (JMT) on Sunday, and the time is for the meridian of Jerusalem. (It is not necessary to specify a date, since a celendric molad always falls on the first of a month or within the preceding three days.)

6. The **molad** of Tishrei at the beginning of year 1 is called ***Molad Tohu*** (see note 4 for explanation). It is also called Molad **BHRD** (ב-ה-ר"ד). Those letters form the numbers 2, 5, 204 in Hebrew numerals, and the name formed from those letters is a Hebrew mnemonic indicating the weekday and time of day at which that molad is computed to have occurred – day 2 (Monday) at 05:0204 (JMT). The molad of the following Tishrei at the beginning of Jewish year 2 is called **Molad VYD** (ו-י"ד), another mnemonic indicating that it occurred on weekday 6 (Friday) at 14:0000.

7. A **tekufah** (plural tekufot) is, depending on the context, a season, or one of the four "turning points" in the tropical year at which a season begins – the two equinoxes and the two solstices. (A tropical year is a full cycle of seasons as measured from the March equinox.) These four times of the year are "turning points" in the Sun's apparent annual path around the sky from west to east – apparent motion caused by the Earth's orbital motion around the Sun. The tekufot mentioned in this Tosafot are **Shmuelian tekufot**, meaning calendric tekufot whose occurrences are calculated according to a method devised by Shmuel Yarchinai (a rabbi and astronomer of the Talmud in the third century). Shmuel's method, designed for calendric convenience, ensures that his tekufot (equinoxes and solstices) always fall on consistent dates in the solar (Julian) calendar. The Shmuelian tekufah system is based on a mean solar year length of 365.25 days, which is also the mean year length of the Julian calendar, and the Shmuelian tekufot occur at constant intervals of exactly one quarter of that length – 91 days and 7.5 hours, which is the duration of a Shmuelian season. The Shmuelian tekufot are therefore only approximations of the corresponding real solstices and equinoxes, because the seasons are not of equal length and the true length of the solar year is only about 365.2422 days.

8. The phrase in Tosafot **חצי עודפת התקופה על המולד** means **D/2**, where **D** is the difference between a Shmuelian solar year (365¼ days) and 12 synodic months (354 days, 8 hrs, 876 parts). **D** = 10 days, 21 hours, 204 parts, and **D/2** = 5 days, 10 hours, 642 parts.

1 The name synodic comes from the Greek "synodos", meaning meeting. It is called so because this type of lunation is counted from the time at which the Sun and Moon appear (from Earth) to meet at the same celestial longitude (at the time of the astronomical New Moon).

To understand this Tosafot, one must know the following facts about the Jewish calendar

Metonic Cycle and Jewish Leap Years: In 432 BCE, the Greek astronomer Meton, publicized the fact (already known earlier to Babylonian astronomers) that 19 solar years are almost equal in length to 235 synodic lunations. The total length of the latter is only about 2 hours longer than the former. Meton used this correlation in a reformation of the Greek luni-solar calendar, and the leap-year cycle of 19 years in Meton's revised Greek calendar was named the Metonic cycle in his honour.

Centuries later, when the Jewish calendar was undergoing a transition from the older, empirical calendar based largely on observation, to a fixed, rule-based calendar based solely on calculation, a similar cycle of 19 years was implemented in the Jewish calendar to regulate the incidence of its leap years. They are designed to keep its months, which are lunar, in approximate correlation with the seasons of the solar year. The leap years cause the mean year length of the Jewish calendar to approximate the length of a solar year. This is achieved by inserting an extra (thirteenth) month of 30 days into seven out of every nineteen years. They are the leap years of the Jewish calendar and they occur at intervals of three or sometimes two years apart. The other twelve years are common years of twelve months. In this way, nineteen Jewish years contain 235 months.

Length of Solar Year: That transformation of the Jewish calendar began around the middle of the fourth century of the common era with a calendar reform which Jewish tradition attributes to Hillel II. By that time, a more accurate year length than Meton's was known. It had been discovered several centuries earlier (about 146 BCE) by the Greek astronomer, Hipparchus. The values found by Hipparchus for both the synodic lunation and the solar year are the mean month length and the mean year length of the present-day Jewish calendar.

Jewish tradition attributes to Rav Adda bar Ahava the proposal that Hipparchus's year length be adopted as the mean year length of the Jewish calendar. Rav Adda's proposal was eventually adopted, but an alternative value for the seasonal year proposed by his contemporary, Shmuel Yarchinai (a third century rabbi and astronomer of the Talmud), was used for other purposes.

Shmuelian Tekufot: Shmuel Yarchinai devised a system of calculating the seasons based on the Julian calendar's less accurate (slightly longer) year length of 365¼ days. His system was adopted for the purpose of regulating the occurrence of two seasonal, liturgical observances: the annual commencement of the diaspora sh'elah period, during which we insert a request for rain in the daily prayers, and Birkat Hachama, which occurs once in 28 years when the Shmuelian March equinox falls at zero hours on a Wednesday (JMT). Being seasonal, these two observances have no fixed dates in the Jewish calendar, whose months are lunar, and Shmuel's method ensured that these two observances were pegged to consistent dates in the Julian calendar, the solar calendar then in widespread use. For its calendric convenience, Shmuel's system was retained for the purpose of those two observances even after Rav Adda's proposed year length was adopted for the fixed Jewish calendar.

Quantities: There are 1080 parts (*halakim*) in an hour, and 25920 parts in a day. The present day estimate of the mean length of a solar year is 365.2422 days. Therefore 19 mean solar years is about 6939.6018 days. The Jewish calendar's mean month length is 29.5 days and 793 parts. When this value is multiplied by 235 months, the result is the length of a Metonic cycle of the Jewish calendar, which is 6939 days, 16 hours and 595 parts (≈6939.689622 days). As mentioned above, this is about two hours longer than the true length of 19 solar years. The Jewish calendar's mean year length is one nineteenth of the length of a Metonic cycle of the Jewish calendar, i.e. about 365.2468222 days. 76 Shmuelian seasons (19 × 365.25 days) come to 6939.75 days, which is longer than 235 lunations of the Jewish calendar by **1 hour and 485 parts**. It is very important to remember this last quantity (the difference between 19 Shmuelian years and the length of a Metonic cycle of the Jewish calendar) in order to understand this Tosafot.

Table: The table below shows moladot and Shmuelian tekufot for Tishrei and Nisan of Jewish years 1, 2, 20, 21 and 5758. As well as dates, that table uses another method of indicating days by means of a day count, which I have called the **Shmuelian Day Number (SDN)**. This is a continuous count of the days of the Jewish calendar commencing with its first day, Tishrei 1 of Jewish year 1 (the day of Molad Tohu), as SDN 1. (The previous day is the theoretical date, SDN zero.) This day count is my own invention, modelled on the Julian Day Number and named in honour of Shmuel Yarchinai. The Julian Day Number (JDN) is a similar day count used in astronomy, but commencing much earlier. SDN 1 = JDN 347998, so SDN = JDN − 347997. This method of indicating dates makes calendar arithmetic much simpler. The first date in the table, SDN −12, is a theoretical date, 13 days before the beginning of the Jewish calendar.

Moladot and Shmuelian Tekufot of Tishrei and Nisan: dates and times

Year Month	Event	SDN	Time (JMT)	Date
1, Tishrei	(a) Molad (b) Tekufah (c) Tekufah minus (a)	1 −12	Mon,05:0204 Tue,09:0000 −12d,20,0204	11 Elul, 0 1 Tishrei, 1
1 Nisan	(a) Molad (b) Tekufah (c) Tekufah minus (a)	178 171	Wed,09:0642 Wed,00:0000 −7d,09,0642	29 Adar, 1 22 Adar, 1
2 Tishrei	(a) Molad (b) Tekufah (c) Tekufah minus (a)	355 353	Fri,14:0000 Wed,15:0000 −1d,23,0000	29 Elul, 1 27 Elul, 1
20 Tishrei	(a) Molad (b) (a) + 1hr, 485p (c) Tekufah (d) Tekufah minus (b)	6940 6940 6928	Wed,21:0799 Wed,23:0204 Fri,03:0000 −12d,20,0204	29 Elul, 19 29 Elul, 19 17 Elul, 19
20 Nisan	(a) Molad (b) (a) + 1hr, 485p (c) Tekufah (d) Tekufah minus (b)	7118 7118 7110	Sat,02:0157 Sat,03:0642 Fri,18:0000 −7d,09,0642	1 Nisan, 20 1 Nisan, 20 22 Adar, 20
21 Tishrei	(a) Molad (b) (a) + 1hr, 485p (c) Tekufah (d) Tekufah minus (b)	7295 7295 7293	Mon,06:0595 Mon,08:0000 Sat,09:0000 −1d,23,0000	1 Tishrei, 21 1 Tishrei, 21 28 Elul, 20
5758 Cycle 304, yr 1 Tishrei	(a) Molad (b) (a) + (303 × 1:0485) (c) Tekufah (d) Tekufah minus (b)	2102727 2102745 2102732	Thu,04:0129 Mon,11:0204 Tue,15:0000 −12d,20,0204	1 Tishrei, 5758 19 Tishrei, 5758 6 Tishrei, 5770

Rows 1 to 3 of the table contain three alternative epochs (mathematical commencements) that can be used for calculations of moladot and tekufot. Rows 4 to 6 show the corresponding moladot and tekufot 19 years later at the beginning of the 2nd Metonic cycle of the calendar, as counted, respectively, from those three epochs. Row 7 shows the molad of Tishrei and tekufat Tishrei (the Shmuelian September equinox) of year 5758, the first year of the current cycle, counting from Tishrei of year 1. (By that count, the current year, 5769, is the 12th year of Metonic cycle 304.) Refer to this table in the following explanation.

This Tosafot refers (in paragraph 3) to a method of computation used by calendar computists of old for calculating the Shmuelian tekufot. The Chazon Ish on Rosh Hashanah, ch 138, interpreting this Tosafot, explains that those computists used certain arithmetic shortcuts to simplify the arithmetic and to avoid having to deal with very large numbers. This applies to both the calculation of moladot and tekufot. In both cases, the method of calculation rests on the fact that we are calculating the day and time at which a certain length of time has elapsed from a known commencement date and time, which is called the epoch (the mathematical starting point) for the calculation. The time elapsed from that epoch is a multiple of a certain fixed interval.

When calculating moladot, since we calculate *mean* (not real) moladot, they occur at constant intervals. That interval is the value adopted by the Jewish calendar as the mean length of a synodic lunation (a full cycle of lunar phases from one New Moon to the next). That value (**L**) is 29.5 days plus 793 parts.

The first molad of the Jewish calendar (known as Molad Tohu) is the epoch of our molad calculations. It is calculated to have occurred on Monday, 1 Tishrei of Jewish year 1, at 05:0204. From that, the molad of any subsequent month, n months later, can be found by adding to the day and time of Molad Tohu the time quantity (n × L). The procedure for doing so can be further simplified as explained below.

Similarly, when calculating tekufot, we are not calculating the occurrence of a real equinox or solstice, rather we are calculating a nominal, calendric approximation of a tekufah according to the system devised by Shmuel, in which the seasons are all of equal length – exactly one quarter of the length of a Julian calendar year, which is 365¼ days. Therefore, the Shmuelian equinoxes and solstices occur at constant intervals of 91 days plus 7.5 hours from one to the next. This interval makes the tekufah calculations slightly easier in respect of the time units used, as the smallest time unit needed for a Shmuelian tekufah calculation is half an hour.

The first March equinox (tekufat Nisan) of the Jewish calendar is calculated, by Shmuel's method, to have occurred at zero hours on Wednesday, Adar 22 of Jewish year 1. In the Julian calendar (the solar

calendar in widespread use in Shmuel's day and for many centuries after) that was Tuesday, March 25 of year −3759, at 18:00. If we take that day and time as the epoch for the calculation of the Shmuelian tekufot, any subsequent tekufat Nisan n years later can be found by adding to that epoch an amount of time equal to n × 365.25 days.

The above is the principle on which the molad and tekufah calculations of the Jewish calendar operate. However, there is an important difference between these two calculations in the method used. A molad occurrence is traditionally specified only as a time of week (given as weekday and time of day). It is not necessary to supply the calendar date of the molad day or to specify which week that weekday occurs in because a molad is the notional beginning of a lunation and because the Jewish calendar months are lunar, their commencements are governed by the moladot. A Jewish month always begins on the day of the molad of the corresponding lunation or within the next three days. Therefore, although only the weekday of the molad is given, there can be no ambiguity as to which day it refers to.

A tekufah, on the other hand, has no connection at all with the dates of the Jewish calendar because a tekufah is related to the seasons of the solar year, not to the Jewish months, which are lunar. This difference affects the calculations of the moladot and tekufot as follows.

As mentioned above, we add the quantity n × L to Molad Tohu to obtain the molad of some subsequent month, n months later. Since all moladot are traditionally expressed only as a time of week without specifying which week, all whole weeks in the sum may be discarded. This does not affect the result because a time of week plus n whole weeks is the same time of week, n weeks later. Therefore: instead of using the whole quantity L mentioned above, we use L − 4 weeks, which comes to 1.5 days plus 793 parts. Also, after multiplying that quantity by n, we remove all whole weeks from the product. Finally, when that product is added to Molad Tohu, if the sum exceeds one week, we reduce it by one week, leaving us with the time of week of the desired molad. (As mentioned above, the weekday is not ambiguous since it is either the first of the month or within the preceding three days.) This greatly simplifies the arithmetic by reducing the quantities being used in the various stages of the calculation. (The traditional method consists of slightly different procedures, but the result is the same and we are concerned here with the principle of the method, not its procedural details.)

This kind of simplification cannot be applied to the tekufah calculations because the tekufot are not connected with any Jewish date; they are connected with the solar dates. For example, the Shmuelian tekufat Nisan has not always occurred within the month of Nisan, and even when it does, it does not occur on consistent dates in Nisan. But it consistently occurs on either the 25th or 26th of March in the Julian calendar. Nevertheless, owing to the fact (mentioned above in our discussion of the Metonic cycle) that 19 solar years are almost equal in duration to 235 synodic lunations, another shortcut was available to the computists when calculating a tekufah that occurs exactly n × 19 years after the corresponding epochal tekufah, where n = 1 or any greater integer.

It must be remembered at this point (from the information given above in the paragraph headed "quantities") that, although 19 solar years is about two hours shorter than 235 lunations, since the Shmuelian year (365¼ days) is slightly longer than a true solar year, 19 Shmuelian years exceeds 235 lunations by 1 hour, 485 parts. Therefore, if we use the same epoch for both our molad and tekufah calculations, and we find that the molad of the same month in year Y, exactly n × 19 years later, occurs on day D, at time T, then the occurrence in year Y of the same tekufah as that of the epoch will succeed day D, time T by (n x 1 hr, 485 parts). However, an adjustment must be made because the epochal tekufah did not coincide with the epochal molad, but preceded it. The amount by which the epochal tekufah preceded the epochal molad must be deducted from the initial result found by this method for the relevant tekufah in year Y.

The amount that must be deducted depends on the epoch used for the calculation, as follows:

(a) Tishrei of year 2 1d, 23h, 0000p
(b) Nisan of year 1 7d, 09h, 0642p
(c) Tishrei of year 1 12d, 20h, 0204p

The difference between adjustments (a) and (b) and between adjustments (b) and (c) is the same: 5 days, 10 hours and 642 parts. This Tosafot calls this quantity חצי עודפת התקופה על המולד (i.e. D/2 where D = the amount by which one Shmuelian year exceeds 12 synodic lunations). This is because (b) precedes (a) by six months and (c) precedes (b) by six months.

Before the age of electronic or mechanical computers, a computer was a person who was adept with numbers and who made a living by performing complex or large-scale or repetitive calculations. These human computers were trained in the methods to be followed but not necessarily in the theory behind those methods. However, an arithmetic procedure is far easier to remember and follow if the person performing it can attribute some reason to it that can be remembered.

Therefore, it was common, this Tosafot says, for the computists whose job it was to perform these calculations for producers of Jewish calendars to attribute this adjustment to a variation of the legend told

about the Moon in the Talmud (Hulin 60b). In that legend, the Sun and Moon were originally created equal to one another but the Moon was later diminished in size for being jealous of the Sun. In the variation of this legend told by the computists, the Moon hid herself in shame at this for an initial period before she began to shine or before she began to orbit the Earth. This accounted for the fact that the epochal molad occurs some time after the epochal tekufah, which is when the Sun and Moon were believed to have been created.

This Tosafot gives no credence to the story told by the computists and proceeds to explain the real reason for the adjustment they performed. This Tosafot mentions only the adjustment amount (b) because it corresponds to the epoch traditionally used for tekufah calculations, and he explains the reason for it by working backwards, mathematically, from what the adjustment would have been if the epoch (a) was used. He uses (a) as the starting point for his explanation because that is when the world was created according to Rabbi Eliezer, which became the accepted view.

As the Tosafot point out in paragraph 7, by their time, the years of the Jewish calendar were being counted from Molad Tohu. Consequently, the calendar computists had become accustomed to using molad Tishrei of year 1 and tekufat Nisan of year 1 as the mathematical epochs for their molad and tekufah calculations, but for any of them using molad Tishrei and tekufat Tishrei of (what we now call) year 2 as the epoch for those calculations (both occurring during the week in which the world was believed to have been created), the legend as told by those computists would certainly have been that the Moon hid herself for 47 hours ending at molad VYD (i.e. the amount of time by which molad Tishrei of year 2 succeeded tekufat Tishrei of year 2), rather than the version mentioned in this Tosafot that she hid herself for 7d, 9h, 642p (the amount of time by which molad Nisan of year 1 succeeded tekufat Nisan of year 1).

Translation of Tosafot

1) For tekufot: This is according to Rabbi Eliezer, who said that the world was created at Tishrei [near the Autumnal equinox]. Accordingly, the mathematical beginning of our molad and tekufah calculations is the 1st of Tishrei. Rabbi Yehoshua [on the other hand] would regard [the preceding] Nisan [near the Spring equinox] as the mathematical commencement of those calculations. The fact that one of these two epochs precedes the other by six months creates a significant difference in this matter. [*This seems to be referring to the "distance" of 2d, 4h, 438p mentioned in the final paragraph.*]

2) The principle established in chapter *Keitzad Meabrin* (Eruvin 56a) that the [Shmuelian] tekufat Nisan only occurs at [the beginning of one of the] four quarters of the day [i.e. at either 00:00, 06:00, 12:00 or 18:00], is from the perspective of Rabbi Yehoshua's view. Indeed, the entire discussion there is conducted from that perspective and the Beraita's teaching presumes that Shmuel follows Rabbi Yehoshua's view. On Rabbi Eliezer's view, the creation of the world commenced on 25th Elul [five days before 1st Tishrei]. On Rabbi Yehoshua's view, the creation of the world commenced on 25th Adar [five days before 1st Nisan]. Accordingly, when Adam was created on day six, he sanctified [that day as the first of] the [new] month.

3) For this reason it has become common practice for calendar computists who deal with the tekufah cycles, to deduct 7d, 9h, 642p from the sum of all the cycles and periods being counted and their accumulated [excess] hours. They are wont to attribute this deduction to the Moon having been reprimanded for her accusation [against the Sun], saying that she underwent a self-imposed reproach [hiding herself] for a period of 7 days, 9 hours, 642 parts [which is the amount of time by which tekufat Nisan of year 1 preceded the molad of that Nisan].

4) But we do not find that reason given anywhere. Rather, this is the reason for the above deduction: In our numbering of the years from creation, the first Rosh Hashanah after creation is reckoned as having occurred on the 6th day of creation, when Adam was created. As mentioned in chapter *Echad Dinei Mamonut* (Sanhedrin 38b), he was enjoined [against eating the fruit of the tree of knowledge] in the 9th hour [of daytime] on that day [commencing at 20:0000] and presumably it was at that time that he [saw the first appearance of the waxing crescent Moon and] sanctified [that day as the first of] the [new] month. If so, the molad [of that new month] must have occurred six hours before that time, because for [at least the first] six hours [after conjunction] the [waxing crescent] Moon is not visible. So we find that that molad must have occurred at the beginning of the 15th hour [of that 24-hour day], i.e. at the beginning of the third hour of daytime. That molad is notated as VYD (6,14:0000), meaning that it occurred on weekday 6 [Friday], at the end of the 14th hour, since Rosh Hashanah was not until day 6 [of creation], when Adam sanctified [that day as the first of] the [new] month. Thus, the creation of the world must have commenced [five days earlier] on 25th Elul of [the preceding year, which is largely theoretical as most of it preceded the creation of the world which occurred in its last week, so it is therefore known as] the year of Tohu. Our year count commences with that year as year 1 because [even] a single day [preceding the first Rosh Hashanah following creation] must be accounted as [belonging to] a year [so the first five days of creation must belong to the last week of year 1].

In the previous paragraph, the author lays the foundation for the belief that the world was created in the last week of year 1 and that the molad Tishrei of year 2 occurred on the Friday of that week, the day that Adam was created. He also specifies when, on that day, the molad Tishrei is

computed to have occurred, according to the molad calculation of the present-day Jewish calendar. Now, he shows how, from that molad, the moladot of Nisan and Tishrei of year 1 may be derived.

5) Let us now focus our attention on the [theoretical] molad of Nisan six months prior to the [first] Tishrei of population on [the first day of] which Adam was created. The molad of Nisan [of that year 1] was Wednesday [29 Adar] at 09:0642. This is found as follows: [The excess (**E**) of 12 synodic lunations above 50 whole weeks is 4 days, 8 hours and 876 parts. Therefore, halving those quantities, six synodic lunations exceeds 25 whole weeks by half of **E**, and this amount (**E/2**) which is] 2 days, 4 hours, 438 parts must be subtracted [from the molad of the following Tishrei (Molad VYD), i.e. from weekday 6 at 14:0000 to obtain the molad of the previous Nisan]. And [by the same method] we find that the molad of Tishrei [of year 1] which precedes that Nisan is on weekday 2 [Monday], at 05:0204 [and is therefore notated as Molad] BHRD.

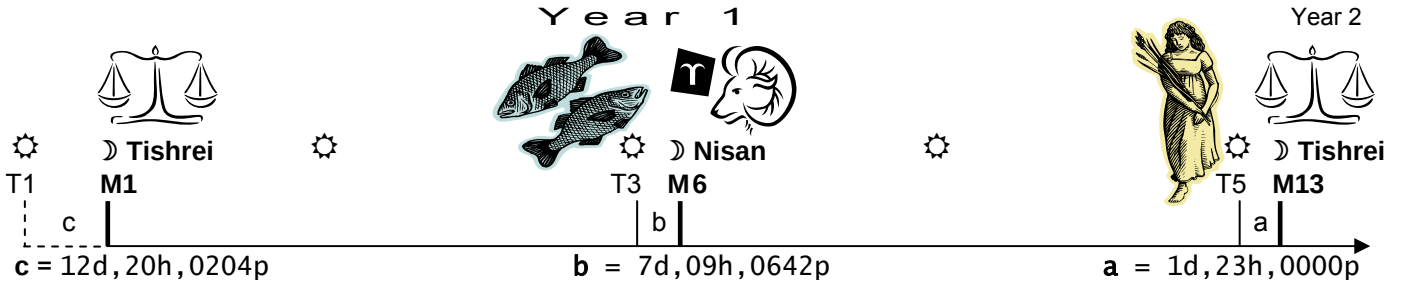
Having shown how we arrive at the epoch of our molad calculaions, the author now shows how we do the same for the epoch of the Shmuelian tekufot.

6) Now the mathematical beginning of our [Shmuelian] tekufah calculations is from [the theoretical] Nisan of Tohu [i.e. of year 1, and that tekufat Nisan occurs] at the beginning of the night [i.e. at zero hours] on Wednesday [22 Adar]. As stated in chapter *Keitzad Meabrin* [ibid], the period between one [Shmuelian] tekufah [equinox or solstice] and the next is [a constant] 91 days [which equals 13 weeks] and 7½ hours. Therefore, [the excess of] two [Shmuelian] seasons [above 26 whole weeks] is 15 hours. Thus, we find that the tekufah of the following Tishrei of population occurs on Wednesday, [Elul 27] at 15:00, which precedes the molad of that Tishrei by **1 day, 23 hours**. [Let us call this quantity **P**.] And [by the following method, working backwards from Molad VYD] we find that tekufat Nisan [of year 1] preceded the molad [of that Nisan] by **7 days, 9 hours, 642 parts**. [This quantity (**Q**) is made up of two components as follows:] Take half of the difference (**D**) between a Shmuelian solar year (365¼ days) and twelve synodic lunations, [D = 365,06,0000 – 354,08,0876 = 10,21,0204, so **D/2**, which is the difference between two seasons and six lunations is] 5,10,0642. Add [**D/2** to **P**,] 5,10,0642 + 1,23,0000, and you get [**Q**, which is the amount,] **7,09,0642**, that must be subtracted [from the molad Nisan of year 1 to obtain the tekufat Nisan of year 1].

7) The way we number our years nowadays, the chronological epoch of the calendar is the [theoretical] Molad Tohu (BHRD), and that [year commencing with Molad Tohu] is counted as year 1 of the calendar, because [as mentioned above, even] one day must be counted as [part of] a [whole] year. And Tekufat Nisan of year 1 (4,00:0000) is the epoch of our tekufah calculations and [to obtain that tekufah epoch] we must subtract 7d, 9h, 642p [from the Molad Nisan of year 1].

The intent of the next paragraph is unclear to me, so the translation (or possibly our version of the original text) may be in error.

8) It is a strange thing that Rabbi Eliezer and Rabbi Yehoshua were in dispute [as to whether the world was created at the Autumnal or Spring equinox] [which is why] as stated later (on page 12a), the epoch of our tekufah calculations is from Nisan [of year 1] and the epoch of our molad calculations is from [the previous] Tishrei. They could have resolved the question empirically. As stated at the end of chapter one of Arakhin (9b) {?}, the Moon is invisible for a period of 24 hours between the last appearance of the old moon's waning crescent and the first appearance of the new moon's waxing crescent, whereas their respective molad epochs differ by [the excess of six synodic lunations above 25 whole weeks, which is] 2 days, 4 hours and 438 parts [i.e. half of the excess of 12 synodic lunations above 50 whole weeks]. It is not possible to be mistaken by such a large amount as two days.



M1 = SDN 1, 05:0204, **T3** = SDN 171, 00:0000, **M6** = SDN 178, 09:0642, **T5** = SDN 353, 15:0000, **M13** = SDN 355, 14:0000

*Interval **T1** to **T5** = 365, 06,0000, Interval **M1** to **M13** = 354,08,0876, Difference (**D**) = 10,21,0204, **D/2** = 5,10,0642, **D/2 + a = b***

Discussion

To be continued ...

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