Another reaction to the article of Prof. Ariel Cohen: תוספת השניות לשעון הבינלאומי בד"ד 24.

I read with much attention and interest the article of Prof. Cohen and Dr. Fixler's reaction. I fear that the latter did not address clearly the point.[1]

The paper of Cohen is constructed on the paradox of the situation in Iyar 5794 when the Molad will be $4 - 0 - 5$. However at this time the number of leap seconds to subtract from the atomic clock TT to get UTC will certainly exceed these 5 halakim and therefore the Molad will already occur on Tuesday. In fact this is ab initio a false problem.

From the beginning of the 20th century onward, and perhaps even before, the astronomers know that the earth is slowing down. Therefore any amateur calculator or astronomer knows that an astronomical calculation for the past is performed in a uniform time (in the past Ephemeris Time ET and today Terrestrial Time TT[2] which is measured in atomic SI seconds) and at the end we transform TT into Universal Time UT1 by the equation UT1 = TT – delta T.[3] The magnitude of delta T is fixed empirically and distributed by official international agencies. However our civil time today, UTC, is still connected to the Universal Time but the second is SI, very near to 1/86400 of a mean solar day.

The only new element justifying Cohen's paper is the political decision, that can be questioned and is still debated, to calibrate the civil time on the atomic clock and then to stop the clock during leap seconds in order to wait for the delayed terrestrial clock in order to get UTC.[4]

The decision to calibrate the civil clock on the atomic clock is a purely administrative decision. It has no influence on the calculation of the Molad. There isn't any reason to calculate it today otherwise than in 1960 for example, when we were also aware of the non uniform character of the Universal Time. Therefore at the beginning of Iyar 5794 the Molad will be on $4 - 0 - 5$ of the terrestrial clock[5] and the subtraction of leap seconds will have no influence on it.[6]

Later when the frequency of the leap seconds will increase, the leap seconds will be replaced by leap hours. The difference between the time of our clocks i.e. the civil time and the terrestrial clock UT1 could reach nearly an hour. This adaptation imposed by the computer world will not be acclaimed by the population and it will assert itself with more difficulty than the transition from true time to mean time. Anyhow, by contrast with the assertion of Prof. Cohen (see p. 114), this adaptation won't have any implication on the calculation of the Molad and the Jewish calendar. The time of the Molad must be considered as an abstract time independent from the time of our clocks and from the legal regulations of the society.

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[1] However, a careful reading of the third point of his note shows that he shared the argumentation of the present note.

[2] See http://asa.usno.navy.mil/SecM/Glossary.html for a definition of all the astronomical concepts and the different abbreviations. The denomination TT Terrestrial Time is very confusing because it represents the uniform time measured in atomic time. However this denomination can be confused with the terrestrial clock UT1.

[3] For example at the time of Ptolemy, in about 150 C.E. delta T = 135.8 m.

[4] Corrected Atomic Time: UTC is maintained within 0.9s of UT1.

[5] Bound to UT1. In fact UT1 + constant; see infra. This constant is not known with certainty; it depends on some assumptions.

[6] If the state of science had allowed introducing TT in Ptolemy's time, the terrestrial clock UT1 would have today a delay of 135.8 minutes with regard to TT and we would perhaps already have introduced leap hours. This would not have changed anything on the calculation of our Jewish calendar. However people would probably be aware that there is no correlation anymore between the time of our clocks and the time of the Molad. The good understanding of this simulation for the past must convince the reader for the future.

Already in the past the time of the Molad must be considered as an abstract time independent from the time of the clocks.

Indeed the Molad is the conjunction time given by Ptolemy's conjunction table (see Ptolemy's Almagest, G. J. Toomer, pp. 180-187) from which 850 halakim are subtracted. The Molad is supposed to correspond to Jerusalem but this is a pure assumption and it could rather correspond to Tiberias. Anyhow it is likely that the Molad is given in Ptolemy's local mean time of the Almagest.[7] Thus the time of the Molad was never the time of our clocks.

Moreover Israel Standard Time IST is UT1 + 2 hours or + 3 hours, connected to UT1 and different from the local mean time. In the past the difference was still more important: before the 19th century, the civil time was estimated in true time.[8] The time of the Molad was thus never identical to the civil time in use in the surrounding society.

When in the future the frequency of the leap seconds will increase and become difficult to manage, the leap hours will be introduced and the difference between the time of our clocks UTC*[9] and the terrestrial clock UT1 will reach until nearly an hour. The time of the Molad will become more and more an abstract time without connection with our clocks. And this will not prevent the Jewish calendar from working.

The perverted way of proclaiming the Jewish calendar according to the civil time is certainly one of the factors of the confusion. If it depended on me I would suppress the proclamation of the Molad, especially with regard to the last developments. This can be only the source of confusion. If we must behold it, at least let us proclaim it in Jewish time.[10] We have a tremendous chance: we have the *Helek* which allows us making easily the difference between the second, now connected with the atomic time and the *Helek*, still 1 /25920 of the mean solar day.[11] In other words the whole problem raised by Prof. Cohen appears artificial.

We must consider that the length of the mean Jewish month 29 – 12 - 793 remains constant in UT1[12] and the time of the Molad is expressed in UT1 + constant. The appearance of new times like TT, UTC and later UTC* don't change the working of the Jewish calendar.

If we have a real difficulty with our Jewish calendar, it is the problem resulting of the shift of the calendar with regard to the sun (today slightly more than 6 days delay with regard to the sun) and the shift of the Molad with regard to the mean conjunction of the moon (today about 2 hours delay of the Molad with regard to the mean conjunction). The first problem is important because we want that the beginning of Pessah remains within the first month of spring[13]. The second is important because we want to avoid as much as possible that the new moon becomes visible on the day before the Neomenia. The first problem presents more urgency than the second. These are the challenges that we are facing and it is more than enough.

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[7] By contrast with Ptolemy's mean time of the Handy Tables and our modern mean time. The difference between the two times used by Ptolemy was 33minutes. The difference between Ptolemy's mean time of the Almagest and modern mean time (as defined by Flamsteed [1646 – 1619]) is about 17 minutes.
Ptolemy's mean time of the Almagest + ~ 17 m = modern mean time.

[8] True time considered in temporary hours until the 15th century and in equinoctial hours from the 15-16 century onward. At the inception of the Jewish calendar, the time of the Molad was a revolutionary concept.

[9] UTC after the introduction of leap hours.

[10] Engineer Yaaqov Loewinger wrote a paper about this in The Hakirah Journal , vol 6, Summer 2008, available at  the URL: http://www.hakirah.org/Vol%206%20Loewinger.pdf.

[11] Otherwise we would be obliged to consider two types of second, the second SI and for the time of the Molad, the ancient rotational second i.e.1/ 86400 of a mean solar day.

[12] As delta T in the time of Ptolemy was ~ 135.8m, it follows that this was the cumulated delay of UT1 with regard to TT in the last 1862 years = 23030 Jewish months corresponding to an average lengthening of the Jewish month by 0.35s in TT. But as already mentioned above the Jewish calendar remains completely indifferent to the scale of time TT and ignores it.

[13] ניסן של תקופה