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Talmudic Metrology II The Mile as a Measure of Time

In the Talmud, the mile, which is basically a unit of length, is also often used to represent a lapse of time, corresponding theoretically to the time needed to cover this distance. This unit of time was subject to important discussions and controversies between the rabbis. Nearly all the *rishonim* (rabbis from the 10th to 15th centuries) evaluated this time to be 22.5 minutes, but Maimonides considered the span of time to be 24 minutes. R. Joseph Karo in his *Shulhan Arukh* and Rema in his notes followed R. Israel Isserlein, and adopted a span of 18 minutes. During the 17th century (R. Yom Tov Lipman Heller and R. Jacob Reicher), the 18th century (R. Nathanel Weil and the Gaon of Vilna) and the 19th century (R. Moses Sofer), the value of 22.5 minutes was still used. Nowadays, the value of 18 minutes seems to be generally accepted. The present paper aims to reexamine the problem on the basis of the available data concerning the length of the mile, and of the analysis of the talmudic passage. It will prove that the span of time of 18 minutes is the only acceptable measurement. The development of the paper will allow us also to examine the apparent contradiction between the position of Maimonides in his commentary to Mishna Berahot I: 1 and his position in Mishna Pesahim IX: 2 and Hilkhos Korban Pessah V: 9, and to give a definitive solution to this old problem.

I. EXAMINATION OF THE PASSAGE IN B. PESAHIM 93B-94A¹

Mishnah. What is “a journey afar off”? From Modiim and beyond, and the same distance on all sides of [Jerusalem]: This is Rabbi Akiva’s opinion. Rabbi Eliezer said: from the threshold of the temple court and without. Said Rabbi Jose to him: For that reason the ׀ is dotted in order to teach: Not that it is actually far away, but

* I want to express my indebtedness to R. Y.G. Weiss. Although he does not always share my views, he read a draft of this paper and made many valuable remarks and objections. I have not always followed him, and therefore the paper and its content remain my responsibility.

¹ Departing from the Soncino translation, with many improvements, most of them by R. Y.G. Weiss. The translation and discussion in this paper are based on the standard reading of the printed Talmud. There are variant readings, but all the commentators had a reading similar to ours. See however notes 58 and 66.

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[when one is] beyond the threshold of the temple court and without [he is regarded as being “afar off”].

Gemara. Ulla said: From Modiim to Jerusalem is fifteen miles. He holds as Rabbah bar Bar Hanah said in Rabbi Johanan’s name: What is an [average] man’s journey in a day? Ten *parasangs*: five miles from daybreak until sunrise, [and] five miles from sunset until the stars appear. This leaves thirty: fifteen from morning to midday and fifteen from midday to evening [i.e. sunset]. Ulla is consistent with his view, for Ulla said: What is a “journey afar off”? Any place whence a man is unable to enter [Jerusalem] at the time of slaughtering.² The Master said: “Five miles from daybreak until sunrise.” Whence do we know this? – Because it is written, And when the morning arose [i.e. at daybreak] then the angels hastened Lot, saying etc.;³ and it is written, “The sun was out upon the earth when Lot arrived at Zoar”;⁴ while Rabbi Hanina said: “I myself saw that place and it is five miles [from Sodom].”

The [above] text [stated]: “Ulla said, what is a ‘journey afar off’? Any place from where a man is unable to enter [Jerusalem] at the time of slaughtering.” But Rav Judah maintained: Any place whence one is unable to enter [Jerusalem] at the time of eating. Rabbah said to Ulla: On your view there is difficulty, and on Rav Judah’s view there is a difficulty. On your view there is a difficulty, for you say, “Any place whence a man is unable to enter at the time of slaughtering”: yet surely a man unclean through a reptile is unable to enter [the temple] at the time of slaughtering, yet you say, one slaughters and sprinkles on behalf of a person unclean through a reptile?⁵ On Rav Judah’s view there is a difficulty, for he says, “Any place whence one is unable to enter at the time of eating”: but surely he who is unclean through a reptile is able to enter at the time of eating, yet he says, one may not slaughter and sprinkle on behalf of a man unclean through a reptile?⁶ Said he to him: neither on my view, nor on Rav Judah’s view, is there a difficulty. On my view there is no difficulty: “A journey afar off” [is stated] in reference to a clean person, but “a journey afar off” is not [stated] in reference to an unclean person. On Rav Judah’s view there is no difficulty: When one is unclean through a reptile,

2 I.e., so far that if a man started walking at sunrise, he could not reach it by midday (Maimonides) or, according to Rashi, so far that if a man started walking at midday, which is the earliest time for sacrificing the Passover offering, he could not reach it by sunset, which is the latest time allowed.

3 Genesis 19: 15.

4 Ibid., 23.

5 B. Pesahim 90b.

6 Ibid.

the Divine Law relegated him [to the second Passover], for it is written, “If any man shall be unclean by reason of a dead body.” Does this not refer [even] to one whose seventh day falls on the eve of Passover? Yet even so, the Divine Law said: Let him be relegated [to the second].

Our Rabbis taught: if he was standing beyond Modiim and is able to enter by horses and mules, you might think that he is culpable. Therefore it is stated “and is not on a journey” whereas this man was on a journey. If he was standing on the hither side of Modiim, but could not enter on account of the camels and wagons which held him up, you might think that he is not culpable. Therefore it is stated “and is not on a journey,” and lo, he was not on a journey. Rava said: “The world is six thousand *parasangs* and the thickness of the heaven [*rakia*] is one thousand *parasangs*.” The first one [of these statements] is a tradition while the other [is based] on reason. [Thus] he agrees with Rabbah bar Bar Hannah’s dictum in Rabbi Johanan’s name: What is an average man’s journey in a day? Ten *parasangs*: from daybreak until the first sparkling of the rising sun five miles, and from sunset until the stars appear five miles; hence the thickness of the heaven is one-sixth of the day [’s journey]. An objection is raised: Rabbi Judah said: The thickness of the sky is one-tenth of the day’s journey. The proof is this: what is an [average] man’s journey in a day? Ten *parasangs*; and from daybreak until the rising sun four miles, [and] from sunset until the stars appear four miles. Hence, the thickness of the sky is one-tenth of the day [’s journey]. The refutation of Rava and the refutation of Ulla are indeed refutations! Shall we say that this is [also] a refutation of Rabbi Johanan? He can answer you: I spoke only of [an average man’s journey] in a [complete day], and it was the Rabbis [Rava and Ulla]⁷ who erred by calculating [the distance for] pre-dawn and after nightfall. Shall we say that this is a refutation of Rabbi Hanina [who confirmed that the distance walked by Lot is five miles]? No, “and the angels hastened”⁸ is different.⁹

A. The Location of Modiim

The above passage raises the question of the distance between Modiim and Jerusalem. Anyone who is beyond Modiim on the eve of Passover at sunrise¹⁰ can

7 This is the explanation of Rashi. Rabbi Johanan did not actually know Rava. The latter was probably born after Rabbi Johanan’s death. I prefer Rabbah bar Bar Hannah and Ulla.

8 Genesis 19: 15.

9 From daybreak until sunrise, one normally walks four miles, but, hastened by the angels, they walked five miles.

10 This is the opinion of Maimonides. According to Rashi, the traveler begins his walk at noon and must reach Jerusalem before sunset, at about 6 p.m.

be considered as being a long way away.¹¹ He is then exempt from coming to Jerusalem to sacrifice the Paschal lamb. He is allowed to postpone the sacrifice until the next month (*Pessah Sheni*).

From the Talmud it appears clearly that the time necessary to walk from Modiim to Jerusalem is six hours. So what is the distance between Modiim and Jerusalem? The Talmud brings the opinion of Ulla that the distance between Modiim and Jerusalem is 15 miles. Probably due to the fact that Ulla traveled often and was therefore reliable, and also due to the fact that this data can be verified,¹² it has generally been accepted that the distance between Modiim and Jerusalem is 15 miles, despite the fact that the other part of Ulla's statement was refuted.¹³

Modiim is also mentioned in B. Hagiga 25b, where Rashi writes that Modiim is a town distant from Jerusalem by 15 miles, as mentioned in B. Pesahim.¹⁴ It is also mentioned in B. Kiddushin 66a.

In *Kaftor Vaferah*, Modiim is mentioned as follows:¹⁵

למערב בית שאן כמו שעה היא מודיעית הנזכרת במסכת קידושין פרק האומר גבי אמו של ינאי המלך, דאמרינן אמו נשבת במודיעית. ואין זה מודיעים הנזכר סמוך לירושלם, שהרי מודיעית לחוד ומודיעים לחוד, וקורין לה מידעה, ואמרינן פרק מי שהיה טמא, אמר עולא מן המודיעין ולירושלם חמישה עשר מילין הויא, והוא קרוב למהלך חצי יום, כי היום כלו הוא מהלך מ' מיל.

Modiim is identified there¹⁶ with the Arab village of Middah. Modiim is also

11 See Num. 9:10.

12 See the commentary on the Mishnah: *Shoshanim le David* by R. David Pardo. He uses exactly the same expression.

13 The opinion of Ulla, according to which a traveler can walk 30 miles from sunrise until sunset, five miles during astronomical dawn and five miles during astronomical twilight was generally rejected, but the distance of 15 miles between Modiim and Jerusalem was accepted.

14 According to the conclusions of Rashi and *Tosafot*, one can walk 16 miles in six hours. Nevertheless they accept that the distance is only 15 miles. Therefore, *Tosafot* suggests that there was a border to cross between the two towns where the traveler lost time.

15 *Kaftor Vaferah* was written in Palestine by R. Estori ben Moses ha-Parhi from Florenza (Perah); Andalusia, southern Spain 1280-1355. He was the scion of a prestigious Provençal family: grandson of R. Nathan of Trinquetaille (the teacher of Nahmanides) and great grandson of R. Meir of Trinquetaille (the most important pupil of R. Abraham ben David of Posquière). He was the pupil of R. Jacob ben Machir in Montpellier and later, after he left France during the expulsion of the Jews in 1306 for Perpignan and Barcelona, he was the pupil of R. Asher ben Yehiel (Rosh) in Toledo. In 1313, he was in Egypt on his way to Palestine.

16 See chapter 11, paragraph beginning with: נחזור לבית שאן. He makes the distinction between Modiiit, or Har Modiiit (mentioned in B. Kidushim 66a), which he situates at one hour's walk west of Beit Shean, and Modiim (considered in B. Pesahim 93b), which is near to Jerusalem and is called Middah with a guttural *ayin*: מידע.

mentioned by A. Neubauer,¹⁷ at the place called el-Medyeh, east of Lod. According to him, the locality of Modiim mentioned in the Talmud can be identified with the town of the Maccabees. As the place is situated on a hill, it is compatible with a passage in the Book of the Maccabees, according to which the monument built by Simon the Hasmonean could be seen by the sailors in the Mediterranean Sea.¹⁸ Modiim was already mentioned to be east of Lod (Diaspalis) by the early Christian writer Eusebius,¹⁹ and it was located east of Lydda on the Madaba map.²⁰

Today, it is accepted that Modiim, mentioned in Pesahim and in B. Kiddushin, is the historical town of the Maccabees situated near to the Arab village of el-Midieh, about ten kilometers east of Lod.²¹ The historical site of Modiim is represented on the new road atlas of Israel (scale 1: 100000): 28, J 17, east of Maccabim Junction. The distance, as the bird flies, between Modiim and Jerusalem is about 28 km²² and the true distance, taking into account the arterial deviations, is about 30 to 31 km or more. This corresponds to a distance of about 20 Roman miles.²³ At a speed of 18 minutes a mile,²⁴ it takes six hours to travel this distance.

The conclusion, therefore, is that the distance between Modiim and Jerusalem is 20 Roman miles, and people walking on the eve of Passover walk 20 miles in six hours at the speed of one mile in 18 minutes.

R. Y.G. Weiss wants to understand that Middah refers to Modiit, west of Beit Shean and not to Modiim near to Jerusalem. I am less certain of this. A careful reading brings me to think that both remarks, first about the denomination of Middah and second about the dictum of Ulla, refer to Modiim. This seems also to be the understanding of R. Joseph Schwartz, who understood that Modiim of Pesahim is called Middan.

17 *La Géographie du Talmud*, p. 99.

18 I Macc. XII: 29

19 Eusebius (260-339) wrote the *Onomasticon* in around 324. It contains place-names mentioned in the Bible and Gospels, which he arranged alphabetically by books of the Bible, following the Septuagint spelling of the names. He identifies them with places existing in his time and sometimes adds their distance from the nearest city. At the end of the fourth century, the *Onomasticon* was translated into Latin by Jerome (Hieronimus).

20 Mosaic map discovered in 1884, representing the biblical holy land and neighboring regions.

21 See Pinhas Neeman in *Encyclopedia le Geographia Talmudit*, Modiim, and Prof. Zeev Vilnai in his book *Lidiat Israel*, Midiah. See also *Kaftor Vaferah* (Beit Hamidrash Lahalaha Behityashvut), p. 62, note 129.

22 Hanokh Albeck, in his commentary on the Mishna Pesahim IX: 2 notes that Modiim is at a distance of 28 km north-west of Jerusalem.

23 The length of a *mil* was always considered to be 1478m. In the last edition of the French encyclopedia *Larousse*, the length of the *mil* is given as 1481.5 m or 1481.75 meters.

24 This corresponds to a velocity of a little less than 5 km per hour.

Therefore, when Rabbi Judah says that the thickness of the heaven is one-tenth of a day's journey, he adopts the solution offered by column C of the explanatory table that follows. This table presents all the possibilities of covering 40 miles in one day, according to all the possible interpretations, i.e. covering 40 miles between sunrise and sunset, between daybreak and night, or even in a complete day of 24 hours, walking before daybreak and after the beginning of night. Each column represents an additional possibility for the division of the day. In each column, we have also calculated the ratio of dawn to day counted from sunrise to sunset, and the ratio of dawn to day counted from daybreak to night. This table will enable us to clarify the different interpretations of the talmudic passage.

According to column C, the day's journey between sunrise at 6 a.m. and sunset at 6 p.m. is 40 miles, and the distance covered during dawn or twilight is four miles. The thickness of the heaven, which means the length of twilight, is one-tenth of the day's journey. In other words, the length of twilight and dawn is $(1/10) \times 12 \text{ h} = 1.2 \text{ h} = 72 \text{ m}$. On the other hand, when Rava said that the thickness of heaven is one-sixth of the day's journey, he thought that the length of twilight or dawn was $(1/6) \times 12 \text{ h} = 2 \text{ h}$.

B. The Standard Analysis of the Talmudic Passage

1. The Position of Rabbi Judah

It appears from the text of the *Gemara* that the *amoraim*, including Rabbi Johanan and Rabbi Hanina, no longer knew the distance between Modiim and Jerusalem,²⁵ probably because of the political situation,²⁶ the limitations on their movement, and the difficulty Jews faced in visiting Jerusalem.²⁷

Ulla considered the distance between Modiim and Jerusalem to be 15 miles.²⁸

25 R. Y.G. Weiss suggests that they were not more aware of the exact location of Modiim. Rabbi Judah and Rabbi Akiva knew the town of Modiim near Lod, but the *amoraim* thought it was another town nearer to Jerusalem, as R. Estori ha Parhi suggests in his book, *Kaftor Vaferah*.

26 *Tosafot* B. Pesahim 93b, Rabbi Judah says, in a first answer, that the way was blocked. This could mean that there was a border to cross on the way or that the route had to change.

27 Nevertheless, we know that Rabbi Hanina bar Hama, his colleague Rabbi Joshua ben Levi and Rabbi Johanan, Rabbi Hanina's pupil, visited Jerusalem (Y. Ma'aser Sheni 3:3).

28 Because of a bad estimate of the distance, resulting from political reasons that prevented him from traveling it. It is also possible that the exact location was forgotten and Ulla placed Modiim in the wrong place. So, either he had an erroneous estimate of the distance between the two places or he had a correct evaluation of the distance between a false location of Modiim and Jerusalem. It is also possible that he didn't know the location of Modiim, and he evaluated the distance by multiplying the speed of an average walker, which he estimated to be 2.5 miles per hour, according to the statement of Rabbi Johanan, by six hours.

This supports the dictum of Rabbah bar Bar Hannah that the day's journey is 30 miles, and the length of each dawn and twilight is five miles. Therefore, the distance walked from daybreak until the end of twilight is 40 miles. The opinion of Rabbah bar Bar Hannah corresponds to column B of our table, in which the thickness of heaven is one-sixth of the day's journey, and the length of dawn and twilight is two hours. The dictum of Rava is parallel to that of Rabbah bar Bar Hannah, but it is refuted because Rabbi Judah²⁹ said that the thickness of heaven is one-tenth of the day's journey, and consequently the length of dawn and twilight is 1.2 h, not 2h.

Rabbenu Hananel and Rashi, followed by nearly all the rabbis, for an incomprehensible reason explained the opinion of Rabbi Judah according to column D of our table. The reason was probably because they thought that 40 miles a day is a fixed quantity that could not be overstepped. Another reason is perhaps that they could not imagine a difference of 33.3 percent between the speed of Rabbi Judah's and Ulla's walkers, and preferred a difference of 6.67 percent. But, in so doing, the ratio of the length of dawn to the length of the day becomes unrealistic. The figure to compare to 1/6, with respect to a day of 12 hours (we are near the equinox) is not 1/10, as required, but 1/8, corresponding to 4/32. The length of dawn is not 1.2 h, as required by Rabbi Judah, but 1.5 h.

2. The Distance between Modiim and Jerusalem

According to the generally accepted conclusion, Rabbi Judah's opinion is reflected in column D: the distance covered by the walkers during a six-hour walk is 16 miles, and the distance between both towns should be considered 16 miles. This is exactly the way Rashi and R. Hananel explain the refutation of Ulla. The refutation of Ulla results from the fact that the travelers walk four miles during twilight (corresponding to a ratio of 1/10), not five miles during twilight (corresponding to a ratio of 1/6). Consequently, the distance covered in six hours, between 6 a.m. and noon, is 16 miles, not 15 miles.

Rashi does not conclude whether the distance is actually 16 miles or if it is still 15 miles, but the travelers must cover an additional mile. This problem has preoccupied many commentators. R. David Corinaldi, in his commentary to the Mishnah, *Beit David* (Amsterdam, 1738), has suggested that in both manuscripts of Maimonides, the commentary on the Mishnah and the larger composition, the

29 Rabbi Judah bar Illai was a *tanna* of the fourth generation. His father was a pupil of Rabbi Eliezer and was close to Rabban Gamliel from Yavneh. Rabbi Judah was the pupil of his father, of Rabbi Tarfon and mainly of Rabbi Akiva. He was the colleague of Rabbi Meir, Rabbi Nehemiah and Rabbi Simeon. Among his pupils was also Rabbi Judah the Prince.

Hibbur, the distance was 16 miles, but it was then corrupted to 15.³⁰ Rabbi David Pardo,³¹ in his commentary on the Mishnah, *Shoshanim le-David* (Venice, 1752), cites the former opinion irreverently,³² and notes that he would have left the problem unsolved rather than writing such a thing in a book and falsely accusing the scribe or the editor. Rabbi Pardo suggests that 15 miles is the distance to Jerusalem, but that there is another mile to walk until the entrance of the *azharah*, so the true distance is 15+1=16 miles.³³ R. Pardo thinks, therefore, that although Rabbah bar Bar Hannah and Rava were refuted, Ulla's proposition, which can always be checked, is true. Strangely, the Talmud does not mention Rabbah bar Bar Hannah, but writes that Rava and Ulla were refuted even when, according to our texts, Ulla spoke only about the distance from Modiim to Jerusalem.

Rabbi Pardo mentions that the great authority of the preceding generation, Rabbi Moses Zacuto,³⁴ arrived at the same conclusion in his own commentary on the Mishnah. It is likely that this was also the thought process of Rashi, who writes in Mishna Hagiga III: 5 that Modiim is 15 miles distant from Jerusalem. As far as Maimonides is concerned, the problem is even more complex because he also seems to accept the rejected opinion of Rabbah bar Bar Hannah, that the distance covered in a 12-hour day is 30 miles. Therefore, he identifies a mile with 2/5 hour or 24 m.³⁵

30 This is a strange explanation when we know that Maimonides mentions that a mile corresponds to 24 m on a number of occasions.

31 He is one of the great authorities of the 18th century, who originated in Venice. He was rabbi in Spalato (Split) in Dalmatia and then in Saraj (Sarajevo) in Bosnia. Finally, he was head of the tribunal of Jerusalem. He wrote important books in all fields of Jewish scholarship, especially on the *Tosefta*.

32 Because of his irreverence toward other contemporary authors, he came under criticism, and, in the second volume of his commentary on the Mishnah, he was obliged to apologize in the introduction of his book in order to receive an imprimatur.

33 This seems far-fetched because there is no need for the man to go to the Temple. He must only arrive in Jerusalem in time.

34 Rabbi Moses ben Mordehai Zacuto (1620-97) wrote notes on the Mishnah in his book *Kol ha Remez* (Amsterdam, 1714).

35 Commentary on the Mishna Pesahim III: 2 and IX: 2. In both cases he considers that walking one mile in 24 m represents average speed. In *Hilkhot Korban Pessah* V: 9 he considers it a slow walk.

Table 1
Different Possibilities for Day Division

Case:	A	B	C	D	E	F
From dawn until sunrise, in miles	5	5	4	4	3	3.75
From sunrise until sunset, in miles	40	30	40	32	30	30
From sunset until end of astronomical twilight, in miles	5	5	4	4	3	3.75
From beginning of astronomical dawn until end of astronomical twilight, in miles	50	40	48	40	36	37.5
Complete day time + prolongations before the beginning of dawn and after the end of twilight, in miles	–	–	–	–	40	40
Ratio $\frac{\text{twilight}}{\text{day (short)}}$	$\frac{1}{8}$	$\frac{1}{6}$	$\frac{1}{10}$	$\frac{1}{8}$	$\frac{1}{10}$	$\frac{1}{8}$
Ratio $\frac{\text{twilight}}{\text{day (long)}}$	$\frac{1}{10}$	$\frac{1}{8}$	$\frac{1}{12}$	$\frac{1}{10}$	$\frac{1}{12}$	$\frac{1}{10}$
Duration of a mile, in minutes	18	24	18	22.5	24	24
Duration of astronomical twilight, in minutes	90	120	72	90	72	90

Day (short) = day between sunrise and sunset.

Day (long) = day between the beginning of astronomical dawn and the end of astronomical twilight.

3. The Position of Rabbi Johanan

The Talmud considers that the refutation of the dictum of Rava and of Rabbi Johanan's pupil, Ulla, does not imply the refutation of Rabbi Johanan's opinion. Rabbi Johanan can say in his defense that he was misunderstood by his pupils. Rashi understands that Rabbi Johanan simply said that one day's journey is 40 miles and that the ventilation of these 40 miles was the responsibility of Rabbah bar Bar Hannah (and Ulla). Rava does not seem to have been the pupil of Rabbi Johanan, and does not seem to be concerned by this discussion.

Rashi's explanation does not fit perfectly with the talmudic text, and does not explain why the wordsדקא חשבן דקרמא וחשוכא were attributed to Rabbi Johanan on a subject that he had even not considered. He should simply have said that he had taught them only about the 40 miles a day.

Secondly, how does Rashi³⁶ know that Rabbi Johanan's opinion is the same as that of Rabbi Judah?³⁷ If this were the case, Rabbi Johanan could simply have answered that he shares the position of Rabbi Judah and was misunderstood by his pupils. I assume that Rabbi Johanan not only taught that a day's journey is 40 miles, but he probably also said that people generally walk five miles before sunrise and after sunset and that the distance that an average walker covers in six hours, between 6 a.m. and noon, is 15 miles. He may also have endorsed the dictum of Ulla regarding the distance between Jerusalem and Modiim. Rabbah bar Bar Hannah and Ulla did not invent the five miles by themselves, therefore Rashi's explanation seems too complicated. Their mistake, in the words of Rabbi Johanan, was to have considered that the five miles are covered after daybreak and before the end of twilight. That means that the opinion of Rabbi Johanan cannot agree with that of Rabbi Judah because Rabbi Johanan considers that the day's journey, between sunrise and sunset, is 30 miles. For more precision about Rabbi Johanan's position, let us examine columns E and F of our table. Column E solves the problem: it satisfies the condition of 1/10 imposed by R. Judah and it gives a length of dawn and twilight of $3 \times 24 = 72$ m or $(1/10) \times 12 = 1.2$ h.

If we accept that the ratio 1/10 is to be considered relative to the length of the complete day, dawn and twilight included, but night excluded, as Rashi and nearly all the rabbis³⁸ did, then column F can also work. Now, if we accept column F, then column A can also enter into consideration. But column A has one disadvantage: the length of dawn and twilight is five miles and such a distance is excluded by the answer attributed to Rabbi Johanan. The conclusion is that, contrary to what Rashi and R. Hananel explain, the position of Rabbi Johanan seems to be independent of that of Rabbi Judah and can correspond to column E and, possibly, in the frame of the standard exegesis, to column F. Regarding the distance between Modiim and Jerusalem, the position of the main commentaries is not clear. In explaining the refutation of Ulla, Rashi and R. Hananel state clearly that the average walker covers 16 miles in six hours, not 15 miles, and, therefore, that the distance between Modiim and Jerusalem must be 16 miles, not 15 miles. This does not prevent Rashi from writing in B. Hagiga III: 5 that Modiim is 15 miles away from Jerusalem. On the

36 And Rabbi Hananel.

37 Rashi probably assumes that Rabbi Johanan, an *amora*, does not contradict a *tanna*.

38 All the *rishonim*, with the exception of R. Israel Isserlein, shared this opinion. Later authorities like R. Yom Tov Lipman Heller and R. Jacob Reicher in the 17th century, R. Elijah of Vilna in the 18th century and R. Moses Schreiber in the 19th century also shared this opinion.

other hand, some other commentators, including Maimonides, have also adopted 15 miles as the distance from Modiim to Jerusalem.

4. The Position of Rabbi Hanina

Until now, the discussion has centered on the ratio of dawn to day and, indirectly, the length of the dawn. For example, in columns C and E of our table, the length of the dawn is 1.2 h, and in columns D and F the length of the dawn is 1.5 h, although the corresponding numbers of miles are not equal. Nevertheless, Rava was refuted on the basis of the inequality of the ratio of dawn to day as 1/6 being different from 1/10, i.e. because of the inequality of the length of dawn and twilight (two hours as opposed to 1.2 hours), and not because of the discordance between five and four miles.

Now the Talmud asks whether the physical distance of five miles can still be in accordance with Rabbi Judah, when we know that Rabbi Johanan explicitly refuted the possibility of dawn corresponding to five miles. To this it responds that Lot was pushed by the angels and therefore covered five miles at an abnormal speed.

5. The Discussion between Ulla and Rav Judah³⁹

Ulla says that a man is considered to be on a “journey afar off” if he cannot arrive at the time of the slaughtering. Rav Judah, on the contrary, says that this is the case only if he cannot reach Jerusalem in time to eat the Paschal lamb.

Maimonides apparently understood that the man must be there at the beginning of these events. According to Ulla, whom he follows, the man must leave Modiim at 6 a.m. and he will then be in Jerusalem at noon, which is the theoretical time to begin the slaughtering. On the contrary, according to Rav Judah, the man should leave Modiim at noon and reach Jerusalem at 6 p.m. This time is approximately sunset, the beginning of *bein ha-shemashot*, which lasts about 20 minutes⁴⁰ and can be considered the beginning of the night. This corresponds to the beginning of the eating period. The time when we decide if a man is on a “journey afar off” is then for Ulla at 6 a.m. and for Rav Judah at noon.

Rashi, followed by *Tosafot*⁴¹ and Nahmanides,⁴² understands that the important moment is not the beginning time but the ending time of slaughtering or of eating.

39 Rav Judah bar Ezekiel was a Babylonian *amora* of the third century. He was the pupil of Rav and Samuel. He died in 299.

40 See *Hilkhot Terumot* VII: 2 and *Hilkhot Kiddush ha Hodesh* XIV: 6.

41 *Ad locum*.

42 Num. 9: 10.

Therefore, for both Ulla and Rav Judah, the man leaves Modiim at noon⁴³ and must be in Jerusalem at 6 p.m., which corresponds to sunset and therefore to the end of the slaughtering time. We know that if someone enters the *tchum Shabbat* at the beginning of the Sabbath, he is allowed to continue on to the town.⁴⁴ Therefore, if a man leaves Modiim a little later than noon and arrives at 6 p.m. (the beginning of Sabbath twilight) at the entrance of the *tchum Shabbat* of Jerusalem, he will be able to participate in eating the Paschal goat. Thus, it seems that the moment when we decide if one is on a “journey afar off” is at noon according to Ulla, and a mile later according to Rav Judah.

6. The Definition of the Day According to *Tosafot*

It is well known that *Tosafot* were puzzled by the contradiction between the dictum of Rabbi Judah in Pesahim 94a, saying that the dawn and twilight last four miles, and the dictum of Rabbi Judah in Sabbath 34b, saying that Sabbath twilight lasts 0.75 miles. R. Tam solved the problem by saying that the Sabbath’s twilight is situated at the end of astronomical twilight.⁴⁵ This little *Tosafot* of twelve lines in both Pesahim and Sabbath had an exceptionally resounding impact in rabbinical literature and in the Jewish Halakhah and *Ma’aseh* (theoretical and practical rules of conduct). It is also at the origin of the extension of the halakhic day (at least *להומר*) from daybreak until the end of astronomical twilight⁴⁶ and of the creation, *ex nihilo*, of a new way of counting temporary hours, *the long temporary hours*, that were never known or even imagined before. R. Tam’s position is actually founded on an old fashioned and incorrect cosmographical system,⁴⁷ which has been precisely described by R. Hananel *ad locum*,⁴⁸ and of which a good schematic representation is made in B. Pesahim, ed. Steinzalts, *ad locum*. According to this

43 The position of Rashi was perhaps influenced by Y. Pesahim *ad locum*.

44 Maimon. Hilkhot Shabbat XXVII: 9.

45 *Tosafot*, B. Sabbath 34a and B. Pesahim 94a

46 This is also the conclusion of B. Berahot 2b.

47 Because the Gemara Pesahim is based on incorrect scientific bases, R. Moses Al Ashkar considered in his responsum 96 that this *Gemara* is refuted and that we don’t take it into consideration concerning the contradiction between it and B. Sabbath 34a. On the contrary, his elder colleague R. David ibn Zimra, in his responsum 1353 (or 282 according to another numbering) writes that the discussion between the sages of Israel and the nations was about the representation of the scheme of sunset but not about the length of twilight (*bein ha-shemashot*). In other words, the incorrectness of the cosmographical explanations does not affect the relevance of the passage.

48 We find also a good description of this system in the commentary *ad locum* of R. Eliazar of Metz, pupil of R. Tam.

cosmographical system, the sun turns from east to west during the day, and in the opposite direction above an opaque surface during the night. In order to explain the dawn and twilight, which have diminishing light while the sun has disappeared, the system imagines that the sun, for example at sunset, enters an opaque pipe and crosses the heaven from its day trajectory to its night trajectory. Light diminishes with the progression of the sun in the pipe, and finally, when the sun finishes crossing the thickness of heaven, it gets back to its window and begins its night trajectory. At this moment, which in modern terminology is the end of astronomical twilight, there is no more direct or indirect light coming from the sun, and all the stars, even the smallest, are now visible. According to this system, night happens only when the sun is behind the opaque vault and the four miles of dawn and the four miles of twilight belong to the day. Similarly, at daybreak, the sun enters a pipe and crosses the heaven until sunrise. Day begins four miles before sunrise, at daybreak, and ends four miles after sunset, at the end of astronomical twilight. It must also be observed that in many instances, in *Tosafot* and even in Rashi, it speaks of a dawn of five miles. In other words, not only has the incorrect distance of 15 miles from Modiim to Jerusalem been generally accepted, but the refuted opinion of Rava and Rabbah bar Bar Hannah (and Ulla) still survives, incomprehensively, in many passages of *Tosafot*,⁴⁹ Rashi,⁵⁰ and the German⁵¹ and Italian⁵² *rishonim*. This provokes some confusion, the mile there being estimated to be 22.5 m or 24 m. We also observe that both the former values of 22.5 or 24 m are 18 m if they are expressed in long temporary hours. This is misleading and increases the confusion.⁵³

According to column D of our table, which generally was considered to be the definitive solution, the long temporary hour on the day of the equinox is $40/32 = 1.25 \text{ h} = 1 \text{ h } 15 \text{ m}$ short temporary hours (equal to the equinoctial hours on the day of equinox) and sunrise occurs at $(4/40) \times 12 = 1.2 \text{ h} = 1 \text{ h } 12 \text{ m}$ long temporary hours. According to column B, which, despite the talmudic refutation, still remains the basis of some *Tosafot*, the long temporary hour is $(40/30) = 1.33 \text{ h} = 1 \text{ h } 20 \text{ m}$ short temporary hours, and sunrise occurs at $(5/40) \times 12 \text{ h} = 1.5 \text{ h}$ long temporary hours.

49 B. Berahot 2b, B. Pesachim 11b, B. Sanhedrin 41b, B. Avoda Zara 34a and B. Menahot 20b.

50 B. Berahot 2b.

51 B. Sabbath, Mordekhai 293; Rosh on B. Taanit I: 12; Sefer ha Yashar on Sabbath 34a.

52 *Tosafot* Rid: Rabbi Isayah Di Trani the Elder, southern Italy, 13th century.

53 The *Novellae* of Rashba on B. Berahot speak of a mile of 18 m even when Rashba considers 32 miles covered in 12 hours. The mile is then 22.5 m equinoctial and 18 temporary minutes.

As far as the problem of the discussion between Ulla and Rav Judah is concerned, *Tosafot* considers that the time of slaughtering lasts until the beginning of the night (end of astronomical twilight).⁵⁴ In B. Zevahim 56a and in B. Menahot 20a, to the contrary, *Tosafot* considers that the time of slaughtering ends with sunset and therefore it is at noon that we decide whether the person is in Modiim and is obliged to leave for Jerusalem, or whether he is beyond it and must report for the second Passover.

According to Rav Judah, things are more complex because the beginning of the festival is four⁵⁵ miles after sunset and *bein ha-shemashot* begins 3.25 miles after sunset. Furthermore, someone arriving at this moment at the beginning of the *tchum* is authorized to continue on his way to the town.⁵⁶ Therefore, logically, according to Rav Judah, the important moment in Modiim should be 4.25 miles after noon. There is no need to emphasize the simplicity and genuineness of Maimonides' interpretation, and the complexity of the solution of *Tosafot*.

C. The Correct Exegesis in the Frame of the Standard Analysis

In the time of the Mishnah, the situation was clear. Rabbi Akiva and Rabbi Judah were perfectly aware of the true distance of 20 miles between Modiim and Jerusalem, and they knew that this distance could barely be covered in six hours. They also knew the division of the day: four miles during dawn, 20 miles in the morning, 20 miles in the afternoon and four miles during twilight. Furthermore, the test moment for leaving Modiim is necessarily at 6 a.m. and the theoretical time of arrival is noon. This allows normal walkers to arrive at about 2 p.m.,⁵⁷ still in time for the slaughtering of the Paschal lamb. In the *Gemara*, all of these elements were forgotten. Nevertheless, as was already pointed out, it was possible to reach an exact solution of the problem without knowing, *a priori*, the distance between Modiim and Jerusalem. The correct interpretation⁵⁸ of the ratio 1/10 must lead to column C, implying that the distance between Modiim and Jerusalem is 20 miles and that one mile corresponds to a time of 18 minutes. When the Talmud refuted the opinion of Rava, it was because of the contradiction of the ratio of dawn to day

54 B. Pesahim 93b, first *Tosafot*.

55 *Tosafot* B. Menahot 20b mention the 15-mile distance between Modiim and Jerusalem and a length of dawn of four miles. *Tzon Kodashim* corrects this to five miles.

56 See Maimonides, *Hilkhot Shabbat* XXVII, 9.

57 See the end of this paragraph.

58 As far as the reading in B. Pesahim 94a is 1/6 according to Rava. There is a variant reading of 1/8, but it is marginal. All the classical commentators had the reading 1/6 in the ratio expressed according to Rava.

of 1 to 6 instead of 1 to 10 and, consequently, the faulty estimation of the length of the dawn as two hours instead of 1.2 hours. When the Talmud refuted Ulla's opinion, it was because, according to Rabbi Judah, the distance between Modiim and Jerusalem is actually 20 miles (3.33 miles/hour x 6 hours), and not 15 miles as he stated. As far as Rabbi Johanan is concerned, the classical exegesis assumed that he could not propose an independent position, but could only follow the position of Rabbi Judah as expressed in column C.⁵⁹ Therefore, the length of dawn at the equinox is 1.2 h. In Jerusalem, with a latitude of 31.8° from the equator, the depression of the sun is 15.25° at 19h 12m at the end of the astronomical twilight.

Since we know that the distance between Modiim and Jerusalem is 20 miles, we know the true meaning of the Mishnah, and we can see how the *Gemara* tried to uncover the true meaning of the Mishnah. Apparently, and this is our thesis, the *Gemara* discovered the true meaning of the Mishnah but the standard commentators did not. An important conclusion is that the speed of Rabbi Judah's traveler is a theoretical speed of about five km/h.⁶⁰ A normal man will need about eight hours to cover the distance.⁶¹ Therefore, there is no place for an afternoon traveler (Rashi), neither for a criterion depending on an arrival at the time of eating (Rav Judah), nor for a practical journey of 40 miles per day. This distance is the extrapolation of the maximum speed of Rabbi Judah's traveler, walking 12 h without any rest or any break for eating, at the speed of 1 mile in 18 m! This is a theoretical distance, not a practical one.

59 This is of course a difficulty for this reasoning. The Talmud says that Rabbi Johanan has not been rejected and therefore Rabbi Judah could not destroy his position (column E or F), and we want him to abandon his position and accept the position of Rabbi Judah.

60 1 mile in 18 m is 3.33 miles per hour or 4.938 km/h.

61 In a book still in manuscript, R. Raphael from Hanover mentions that the normal velocity of a traveler is one German league or *Deutsche Meile (parsah germanit)* in two hours. A German league is five Roman miles and, therefore, the normal time to cover 20 Roman miles is eight hours. On the other hand, I found in Weiss (1985), p. 363 n. 10 the following additional elements: R. Jacob Emden (*Sefer Mor u Ketzia, Kuntras yshuv Eretz Israel*) writes that a day's journey is five German leagues, one German league in two hours, during 10 hours corresponding to 25 Roman miles per day. He considered that the five German leagues are equal to 10 talmudic *parsah* and therefore his cubit was equal to 46.3 cm. The rate of one German league per hour appears also in the printed book of R. Joseph Delmedigo. R. Yair Bachrah, in *Sefer Hut ha Shani*, p. 97, writes also that the normal velocity of the walker is one German league in two hours, but the distance covered in a day is, according to him, six German leagues (44.45 km). He considers a man walking during 12 hours. He considers therefore that 6 German leagues = 30 Roman miles = 40 talmudic miles and therefore 1 cubit = .56 cm. In the book *Minhat Baruch*, R. Baruch Krinik also writes that the day's journey is about five German leagues (37.04 km).

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This can be demonstrated by the following consideration. According to the Mishnah Ma'aser Sheni, V: 2, Lod is at a day's distance from Jerusalem. The direct distance between the old town of Lod and Jerusalem is about 37 km,⁶² while the direct distance between Jerusalem and Modiim is 28 km. The corresponding road distances must then be about 40-41 and 30-31 km, or even more. It is clear that the time to reach Modiim cannot be six hours if we need a day to reach Lod,⁶³ which is about 10 km northwest of Modiim.

D. Back to the Exegesis of the Passage from B. Pesahim

It appears that Rabbi Johanan's position is different to that of Rabbi Judah. Rabbi Johanan's position corresponds to column E (eventually column F) and Rabbi Judah could not refute it. Therefore, the idea of identifying Rabbi Johanan with Rabbi Judah seems far-fetched. Rabbi Judah's traveler walks 20 miles in six hours, or one mile in 18 m, at the rate of about 4.9 km/h, without fatigue, during six or even twelve hours, without taking a break for eating or for relieving himself. On the other hand, Rabbi Johanan's traveler covers a distance of 15 miles in six hours, or one mile in 24 m, at the rate of 3.7 km/h. It is reported that Herodotus⁶⁴ asserted in the *Antiquity* that a normal walking rate is 20 *stadia* per hour and 200 *stadia* per day, because a man cannot maintain this rate for more than 10 hours. With eight *stadia* per mile, the covered distance of 20 *stadia* per hour is equal to 2.5 miles per hour or 15 miles in six hours, and the 200 *stadia* per day is equal to 25 Roman miles per day. It was also agreed in Germany that a normal walker covers a distance of 25 Roman miles per day.⁶⁵ The traveler of Ulla and Rabbi Johanan walks slightly faster than these historically average travelers, as he covers 30 miles in a day instead of 25 miles. So Rabbi Judah's traveler is a fast walker, while that of Rabbi Johanan seems to be an average walker. Now, in the text of the *Gemara*, Rabbi Judah's

62 See the encyclopedia for *Talmudic Geography* by Pinkhas Neeman.

63 R. Y.G. Weiss let me remark that Lod was the boundary of Jewish Palestine in the time of the Mishnah as we see in Mishna Gitin I: 1. Therefore, it was one of the boundaries for *Ma'aser Sheni*, although it was less than a day's walk. It was already pointed out by *Kaftor Vaferah* that the four distances given in the Mishna Ma'aser Sheni are not equal. In fact, Lod is about 40km from Jerusalem and I think that this corresponds to about one day's walk from Jerusalem. See remark 62 above.

64 See Herodotus, Book 4 Art. 101. This source is also quoted by Borenstein (who says that this data is based on a 10-hour walking day. He quotes no source for this reference). However, in Book 5 Art. 53, Herodotus says that the *parsah* is 30 *stadia* and a day's journey can be taken as 150 *stadia*. I thank R. Y.G. Weiss for this information.

65 See Remark 58.

walker is also called an average walker. We have therefore a good case for deleting the word “average” from Rabbi Judah’s *baraita*.⁶⁶ Deleting the word “average” from this *baraita* would mean that Rabbi Judah is dealing with quick walkers, while Rabbi Johanan is dealing with an average walker.

The *Gemara* rejected Rava’s opinion because his duration of dawn and twilight is two hours instead of 1.2 hours; the objection was raised only on the basis of the difference of the ratio of dawn to day. The *Gemara* rejected Ulla’s statement about the distance of 15 miles between Modiim and Jerusalem because it contradicts the distance implied by Rabbi Judah’s *baraita*, according to which the distance is $3.33 \text{ miles/hour} \times 6 \text{ hours} = 20 \text{ miles}$. Finally, the *Gemara* did not reject the opinion of Rabbi Johanan, because his division of the day is compatible with that of Rabbi Judah. Apparently the *Gemara* was aware of the difference in speed between the walkers, and saw no fundamental objection to the existence of two types of walkers – quick walkers and average walkers. It is probably because Rabbi Johanan considered the speed of Rabbi Judah’s walker exceptional that he reformulated the division of the day. Since Rabbi Johanan was not concerned with the distance between Modiim and Jerusalem and did not try to deduce it, he was not rejected.

What about the time necessary to cover a mile? We now have a time span of 18 m (or 22.5 m according to Rashi, *Tosafot* and R. Hananel), corresponding to a quick walker and a time span of 24 m corresponding to an average walker. Most of the rabbis followed the opinion of Rabbi Judah, the *tanna*, because they considered that, except possibly for the problem of the physical distance between Modiim and Jerusalem, Ulla and Rabbah bar Bar Hanna’s position was taken as a whole, and it was rejected.

We can also note that most of the measurements expressed in miles were expressed by Rabbi Judah. The repartition of the day is generally presented according to the *baraita* of Rabbi Judah, and the beginning of Sabbath is expressed

66 R. Y.G. Weiss proposed the following explanation: the word “average” could have been transferred there by a scribe who mistakenly deleted the term from the first quotation by Rabba bar Bar Hanna of Rabbi Johanan (p. 93b) and placed it in Rabbi Judah’s *baraita*. But the scribe did not delete the word “average” from the second quotation by Rabba bar Bar Hanna of Rabbi Johanan (p. 94a). This explanation is valid for the text of the printed edition (Vilna), but in the extant manuscripts, Vatican 134, Vatican 125 and Columbia X 893 – 141 T), there is no omission. R. Y.G. Weiss also justifies in this way the *Gemara* confronting Rabbi Hanina’s statement with the *baraita* of Rabbi Judah. It would be strange that the Talmud did not realize from the very start that Lot might have been walking at an extraordinary speed. But since Rabbi Judah is also dealing with a maximum speed, the question could be valid and the Talmud goes on to say that, with the prompting of the angels, this speed could have been increased even more.

in miles according to the opinion of Rabbi Judah. It is therefore normal that the mile is evaluated according to Rabbi Judah, at the rate of 1 mile in 18 m or 3.33 miles per hour, even if his walker's speed is quick, not average.

In conclusion, according to what seems to be the true exegesis of the talmudic passage, the mile as a unit of time is derived from the schedule of the eve of Passover. The Talmud has clearly decided in favor of Rabbi Judah, both for the distance between Modiim and Jerusalem, which is 20 Roman miles, and for the span of time corresponding to a mile, which is 18 m – even though this corresponds to a quick walker. The fact that Rabbi Johanan felt obliged to propose another schedule, based on an average walker, has aroused some confusion. It must be concluded and remembered that Rabbi Johanan's time schedule had no far-reaching consequences; the distance between Modiim and Jerusalem, and the length of the mile as a halakhic⁶⁷ unit of time are deduced from Rabbi Judah's schedule, and not Rabbi Johanan's.

II. THE METROLOGY OF MAIMONIDES

A. The Mile as a Unit of Time

The opinion of Maimonides has fascinated generations of scholars, probably because of the rationality of his argument. To whom more than him does the following dictum of Samuel apply: גיטין ס"ז: נמוקו עמו. אילמלי ראיתו, מaimonides believes that one mile corresponds to 24 m, that the distance between Modiim and Jerusalem is 15 miles, and that this distance is covered in six hours. At first glance, this completely contradicts the *Gemara*!

Furthermore, he writes in his commentary on Mishna Berakhot I: 1 that the length of dawn is 1.2 h. This last passage has been completely misunderstood by the standard commentators and by modern scholars, who could not reconcile this advice with the former data. The Gaon of Vilna was especially puzzled by the problem; in his commentary on *Shulhan Arukh*,⁶⁸ he could not explain why Maimonides rules that a mile is 24 m, contradicting the conclusion of B. Pesahim. He even contemplated the possibility of a different reading of Maimonides in the *Gemara*, according which Ulla would not have been rejected. But in his commentary on Berakhot,⁶⁹ *ad locum*, he wrote that in Berakhot also, Maimonides deals with

67 By halakhic mile, we mean the mile that emerges from the talmudic discussion and represents the definitive span of time to which the Talmud refers.

68 Orah Hayim 459.

69 R. Jacob Weiss has forwarded to me a scan of the introduction to the commentary of the *Gra* to Mishlei, edited by the *Gra*'s pupil R. Menahem Mendel of Hassalovitz in Shklov, 1798. I want

the situation in Israel⁷⁰ at the equinox, and that the 72 m correspond to four miles at the rate of 18 m per mile. He offers no satisfactory solution to explain Maimonides' different rulings. The only way to propose a solution allowing the following data: 1 mile = 24 m, and Modiim – Jerusalem = 15 miles is to connect the ruling of Maimonides with the opinion of Rabbi Johanan that we described above. We must admit that Maimonides has ruled according to Rabbi Johanan, who was not refuted. We then have the possibility of considering columns E or F of our table. We see immediately that column E offers a solution: 30 miles in 12 hours correspond to 24 m for one mile, and a length of three miles for dawn corresponds to 72 m, as is written in the commentary on Berakhot.⁷¹

B. The Thickness of the Atmosphere

In his commentary on Berakhot I: 1, Maimonides writes that the length of twilight is 72 m, and he adds, in anodyne precision, that the thickness of the atmosphere is

to express my gratitude to him. In this introduction, the editor expounds a teaching that he received from the *Gra*, which deals precisely with the commentary of Maimonides on Mishna Berakhot I: 1. According to this teaching, the 72m of twilight correspond to 4 miles of 18m and is based on the principle of 40 miles in 12 equinoctial hours and of a dawn and twilight of 4 miles or 72m. The *Gra*, however, does not explain the ruling of Maimonides in Hilkhot Korban Pessah, according to which the walker of the eve of Pessah walks 15 miles in 6 hours at the rate of 1 mile in 24m. The text of the introduction to the commentary of Mishlei and the text of the commentary to the Mishna Berakhot I: 1 in *Shenot Elishu* (edited in Lemberg in 1799) are very alike. It is unanimously accepted that the introduction of R. Menahem Mendel to Mishlei was transplanted into the commentary of *Shenot Eliyahu*. Moreover, the commentary *Shenot Eliyahu* is not constituted of marginal autographic notes by the *Gra*, but it is a compilation of what the disciples heard from him (introduction to *Shenot Eliyahu* by R. Hayim of Wolozin). Similarly, it is likely that the same introduction or, according to R. Abba Kleinerman, the text of *Shenot Elishu*, was then transplanted into the commentary of the *Gra* on Shulhan Arukh Orah Hayim 459.5 (*Sefer Meginei Eretz* [Shklov, 1803]) after the autographic margin notes of the *Gra*. We observe indeed that there is no unity in this text: there is a completely different explanation of Maimonides in the second passage than in the first. In the first passage, the *Gra* concludes that a mile is 22.5m while in the second passage the mile is rather 24m. See variant reading by R. Abba Kleinerman, p. 91 of the Vilna edition, just after הגהות יעב"ק. I thank R. Jacob Weill for this information.

70 R. Joseph Solomon Delmedigo, in *Sefer Elim*, understood that, in Mishna Berakhot I: 1, Maimonides deals with the situation at the equator and at the equinox. Similarly, R. David Hoffman (Melamed le-Hoïl I: p. 32 § 7) understood that Maimonides deals in his commentary on Mishna Berakhot I: 1 with the situation at the equator at the equinox. R. Hoffman considers that the end of twilight corresponds to a solar depression of 18° in accordance with the modern definition of astronomical twilight. Nevertheless, neither of them could reconcile the inconsistencies between the different rulings of Maimonides.

71 This solution was already proposed by R. Yehiel Schlesinger (1923). R. Y.G. Weiss wrote me

51 miles. In his commentary, *ad locum*, *Tosafot* Yom Tov mentions that R. Solomon Delmedigo, in his book *Elim*, corrects that figure to 52 miles and says that, according to his own data, the true value is 44 miles. The ancients thought that the upper surface of the atmosphere was a reflecting surface, and they explained the end of twilight as the moment when the last ray sent by the sun, after reflection on this reflecting surface, reached a given place on the earth. After this moment, the depression of the sun has reached such a value that no ray coming from the sun reaches any more, after reflection, the eyes of the observer standing on a given place of the earth. The darkness has reached its maximum, and this moment corresponds to the end of the astronomical twilight.

We established the following theory in order to check the values of Maimonides and Delmedigo. In the meantime, we have taken account of the English⁷² and Hebrew⁷³ translations of the manuscript of the *Book of Dawn*, which inspired Maimonides, and which was already known by Delmedigo in a Latin version. It appears that this book chooses a depression of 19° ⁷⁴ at daybreak and at the end of twilight and calculates a thickness of the atmosphere of 51.8 miles. Maimonides' value of 51 miles would then be a truncation of the exact number and the 52 miles of Delmedigo, a correct rounding off. If we examine the situation according to column E of our table, which we supposed was the opinion of Maimonides, we deduce from the formulas that, for a depression of 15.25° at equinox, the thickness of the atmosphere is 33.086 miles.⁷⁵ This solution is not acceptable, despite the good correspondence between three miles in Pesahim and 72 m in Berahot.

But if we consider column F, we will find a satisfactory solution. The 3.75 miles represent 1.5 h. At 7:30 p.m. in Jerusalem, 1.5 h after sunset, the solar depression is exactly 19° and the thickness of the atmosphere is then 51.808 miles. The data in Berakhot can no longer apply, therefore, to Israel; it concerns the equator, where the time at the end of twilight is 7 h 16 m p.m. All these elements allow us

that R. Jonah Landsofer (1678-1712) had already proposed this solution: כנפי יונה יר"ד ס' ט"ד ד"ה: נמצא מוכח. He champions this solution: Maimonides can argue, he says, that the ratios twilight/day considered in B. Pesahim 94a refer to the equator and not to Israel, as generally understood. However this seems farfetched because the ratio 1/6 of Rava refers certainly to Israel at the equinox (Lot).

72 Goldstein (1985).

73 Katz (1986) and Katz and Weiss (1997).

74 The book mentions the extant values of 18° and 19° , but it works with the value of 19° .

75 These miles are neither Roman miles nor talmudic miles. These miles are those used in Arabic geodesy. When Maimonides writes that the equator of the earth measures 24,000 miles, he uses the same miles. This mile is about 1.67 km.

to say with certitude that Maimonides, in his commentary to Mishna Berakhot I: 1, is dealing with the situation at the equator at the equinox.

The question is then: why did Maimonides speak about the duration of twilight as 72 m and not as 76 m? There is only one possible answer. Maimonides begins twilight at 18h 04 m, when the depression of sun is 1° ,⁷⁶ corresponding to apparent sunset, when the sun disappears completely at the horizon. This depression is slightly different from the modern, correct depression of 0.85° at apparent sunset.

In conclusion, we have shown how Maimonides could give a definitive ruling in Gemara Pesahim in accordance with the scientific achievements of his time. He surely attributed his interpretation of Pesahim to Rabbi Johanan. The concordance with the results of the *Book of Dawn* was, for Maimonides, the best proof of the correctness of his conclusions.⁷⁷ This conviction was further confirmed by the fact that Maimonides believes that night falls 20 m after apparent sunset. He could consider this moment as the beginning of the night of Rabbi Jose, following by two minutes⁷⁸ the beginning of the night of Rabbi Judah, which occurs $24 \times (3/4) = 18$ m after apparent sunset.

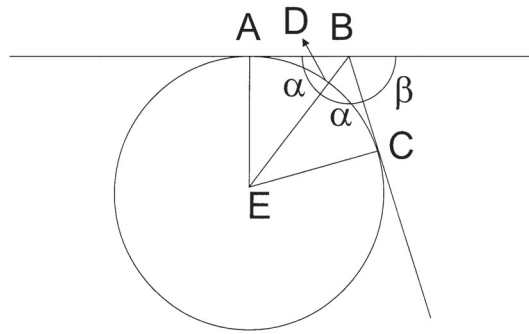
76 Eng. Tuvia Katz wrote to me that he was not completely sure of the correctness of this interpretation. I wondered if Maimonides was perhaps hesitating between the two values 18° and 19° . But now it appears that column F of our table satisfies the requirements of the Gemara Pesahim and must, without a doubt, represent the solution that Maimonides attributed to R. Johanan. It is now certain that Maimonides believed that the end of astronomical twilight corresponds to a solar depression of 19° . Therefore, it is now certain that Maimonides considered in Berakhot, at the equator, an astronomical twilight beginning at 18h 04m and ending at 19h 56m and lasting 72m. This important result allowed me to demonstrate that the epoch of Maimonides in Hilkhot Kiddush ha Hodesh is, at the equinoxes, 20 minutes after *apparent* sunset, when the solar depression is 1° , and that Maimonides demonstrates a remarkable coherence throughout his work, astronomical and not astronomical, in the definition of the beginning of the night, the beginning and the length of *bein ha-shemashot*. See "The Equation of Time in Ancient Jewish Astronomy," *B.D.D.* 16.

77 Of course, he was obliged to accept a mile of 24m in order to get an acceptable span of time for .75 mile, corresponding to *bein ha-shemashot*, the halakhic twilight. This obliges him to accept that the traveler of the eve of Passover walks very slowly. While, in his commentary on Mishna Pesahim IX: 2, he writes that a man can walk the distance of 15 miles between Modiim and Jerusalem at a medium speed between 6 a.m. and noon, in Hilkhot Korban Pessah V: 9 he writes that the man can walk this distance *slowly*. In Hilkhot Evel VII: 4, he agrees that it is possible to walk 40 miles in one day (if one walks faster). Maimonides' mile is the halakhic mile of 2,000 cubits.

78 About two minutes corresponding to $2m = 20m - 18m$ the difference between 20m and .75 mile, i.e. 18m.

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Figure 1
Representation of the Situation at the End of the Astronomical Twilight,
when the Sun is at the Infinite



E is the center of the earth.

A is the position of the observer on earth.

CB is the last ray emanating from the sun. After reflection on the dioptric surface in B, it gives the ray BA, the last ray reaching the observer.

β is the depression of the sun, r is the radius of the earth and is worth $\frac{24000}{2\pi} = 3,819.7186$ miles, h is the thickness of the atmosphere.

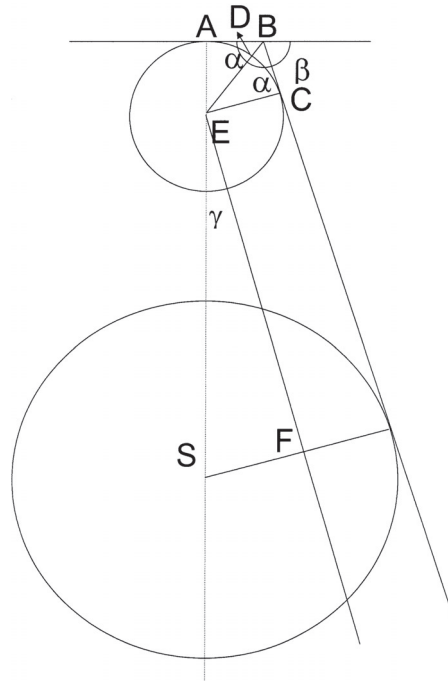
$$\sin \alpha = \cos \frac{\beta}{2} = \frac{r}{r+h}$$

$$h = r \left(\frac{1}{\cos \frac{\beta}{2}} - 1 \right)$$

$$r = EA = EC$$

$h = DB$ is the thickness of the atmosphere.

Figure 2
Representation of the Situation at the End of Astronomical Twilight -
The Sun is at a Finite Distance



R is the radius of the sun, $d=ES$ is the distance between the sun and the earth.
 δ is the depression of the sun.
In ancient astronomy, $r=1$, $R=5.5$ and $d=1110$. γ is a measure of the distance of the sun.
 E is the center of the earth, A is the position of the observer and S is the center of the sun.

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$$\sin \alpha = \cos \frac{\beta}{2} = \frac{r}{r+h}$$

$$\sin \gamma = \frac{R-r}{d}$$

$$\delta = \beta + \gamma$$

$$h = r \left(\frac{1}{\cos \left(\frac{\delta - \gamma}{2} \right)} - 1 \right)$$

$$\sin \gamma = \frac{5.5 - 1}{1110}$$

$$\gamma = .2323^\circ = 0^\circ 13' 56''$$

If $\delta = 19^\circ$, $h=51.808$ miles.

If $\delta = 15.25^\circ$, $h=33.0386$ miles.

We also see that four and five centuries before Delmedigo and Hanover, Maimonides was able to transpose a phenomenon from one place on the earth to another, or from one season to another by conservation of the solar depression. Similarly, we have shown in another paper⁷⁹ that the beginning of Maimonides' night (apparition of three stars, theoretical end of Sabbath) in Jerusalem at the equinox is at 6 h 24 m true time, twenty minutes after apparent sunset, when the solar depression is 5.1° . It is interesting to note that Maimonides divides the religious day (time for prayers⁸⁰ or time for eating leaven on the eve of Passover)⁸¹ on the basis of short temporary hours, but for moments connected to an astronomical phenomenon, on the basis of a solar depression. In so doing, he was an exceptional precursor. He was actually so unassuming, that it was never recognized by earlier scholars, so that Delmedigo and Hanover appeared to be the precursors.

79 *The Equation of Time in Ancient Jewish Astronomy*; B.D.D. 16 (Tamuz 5765), Bar-Ilan University.

80 Hilkhot Tefila III, Hilkhot Shema I: 11.

81 Hilkhot Hametz u Matzah I: 8 and 9.

3. The Exegesis of the Passage of B. Pesahim According to Maimonides

Maimonides ruled that a mile represents a time span of 24 m,⁸² that the distance from Jerusalem is 15 miles⁸³ and that a man can possibly cover a distance of 40 miles in a day.⁸⁴ In his silence, we may assume that Rabbi Abraham ben David (Rabad) agrees with these rulings. In order to justify the two first rulings of Maimonides, the *Gra* writes that Maimonides probably had another reading of B. Pesahim.

We can assume that Maimonides did not have the word “average” in the *baraita* of Rabbi Judah. It should be noted, according to the exegesis of Maimonides, that the type of walker involved is completely irrelevant to Rabbi Judah’s argument, based on the proportion of dawn to day and, consequently, on setting the duration of dawn and twilight at 72 m.⁸⁵ Indeed, the objection raised against Rava and Ulla by the introduction of Rabbi Judah’s *baraita* was only against his length of twilight of two hours.⁸⁶ It is normal that only the part of Rabbah bar Bar Hanna’s statement, that an average person walks five miles during twilight, conflicted with Rabbi Judah’s statement, that even a quick walker does not walk more than four miles during twilight. On the other hand, the *Gemara* was aware of the difference of speed of the walkers, and saw no contradiction between the 20 miles in half a day of Rabbi Judah and the 15 miles of Ulla. Therefore, the objection was raised only against the difference of the ratio of twilight to day between Ulla and Rabbah bar Bar Hanna and Rabbi Judah.

Under these conditions, it is not more certain at all, according to Maimonides, that the *Gemara* took a position on the distance between Modiim and Jerusalem. The objection raised against Ulla, therefore, was only about the length of twilight. The Talmud was aware that Rabbi Judah’s walker is a quick walker and that of Ulla, a slow walker. Maimonides ruled according to Rabbi Johanan, because he was not rejected, and, consequently, he accepted Ulla’s statement, which he considered a corollary of the statement of Rabbi Johanan, i.e. that an average walker covers 15 miles in six hours.⁸⁷ This position was only possible because Maimonides

82 See his Commentary on the Mishna Pesahim, III: 2 and IX: 2. See his *hibur*, Hilkhot Hametz u Matzah V: 13, where he mentions the time necessary to walk a mile without more precision.

83 See *Hibbur*, Hilkhot Korban Pessah V: 13.

84 See *Hibbur*, Hilkhot Evel VII: 4.

85 $(1/10) \times 12h = 1.2 h = 72 m$.

86 $(1/6) \times 12h = 2 h$.

87 Maimonides has necessarily understood תיובתא דעולא as the rejection of the common opinion of Ulla and Rabbah bar Bar Hanna about the length of dawn and twilight of two hours (1/6 of 12

ignored the true distance between Modiim and Jerusalem,⁸⁸ and the true length of a Roman mile. Now, in a case of emergency, when we evidently are dealing with a quick walker, he ruled according to Rabbi Judah and adopted a rate of 40 miles per day.

As we have seen above, Maimonides understood Rabbi Johanan according to column F of our table and, therefore, he must have understood Rabbi Judah according to column D. This means that, contrary to the assumption of *Kaftor Vaferah*, Maimonides' mourner covers the 40 miles in 15 hours, not in 12 hours, at a rate of 1 mile in 22.5 m, instead of 30 miles in 12 hours at a rate of 1 mile in 24 m on the eve of Passover.

There remains, however, one difficulty: why does Maimonides characterize the walk of his traveler on the eve of Passover, in *Hilkhot Korban Pessah*, as a slow walk and not an average walk, as he did in his commentary to *Pesahim*? He was probably aware that his average walker was, indeed, very slow.⁸⁹ Therefore, it is not impossible that the 40 miles in a day of his mourner were nevertheless covered in 12 hours, because with the mile of Maimonides, this remains an acceptable speed. It is also possible, even likely, that Maimonides changed his mind with respect to the characterization of the traveler of the eve of Passover, which he had considered average in his commentary of the *Mishna Pesahim*. He could probably verify that 40 miles of about 900 m per day correspond to 36 km per day and are appropriate to an average walker, while the 30 miles per day of Rabbi Johanan correspond to a slow walker. It is likely that Maimonides ruled according to Rabbi Johanan because the speed of one mile in 24 m fits perfectly his theories of the duration of the astronomical twilight (see above) and of the apparition of the three first middle stars marking the beginning of the night, as well as the talmudic exposition of *bein ha shemashot*.⁹⁰ He considered these three middle stars, which become visible at the equinox, 20 m after apparent sunset, as the night of Rabbi

hours or 5 miles x 24 m) according to the proposed answer of Rabbi Johanan, but without taking a definitive position on the distance between Modiim and Jerusalem.

88 In ruling on the contradiction about the distance between Modiim and Jerusalem according to Rabbi Johanan and Ulla, he arbitrated in favor of Ulla.

89 If we consider that the mile of Maimonides is equal to 900m, then a rate of 1 mile in 24 m corresponds to the very slow rate of 2.25 km/h. Even with a mile of 1,100m (according to R. Y.G. Weiss) this is not more than 2.75 km/h. Note that the quick speed, according to Rabbi Judah, would be only 3 km/h.

90 See B. Sabbath 34a. Of course there is a difficulty at this level, as the $\frac{3}{4}$ mile of *bein ha-shemashot* was defined by Rabbi Judah and should be considered according to Rabbi Judah's advice.

Jose, which begins 2 m after the night of Rabbi Judah. The latter begins $\frac{3}{4}$ mile or 18 m after apparent sunset and this confirms the choice of 1 mile in 24 m.

We could even consider explaining the rulings of Maimonides with our present text, without any change, with the word “average” in the statement of Rabbi Judah. The simple fact that Rabbi Johanan was not contradicted by the *baraita* of Rabbi Judah implies that the Talmud considers the possibility of travelers walking at different speeds, and even a contradiction between rabbis about average speed. Maimonides ruled according to Rabbi Johanan for the general cases, but he adopted the quicker speed of Rabbi Judah’s traveler in the case of the mourner in a hurry.

In conclusion, Maimonides ruled according to Rabbi Johanan, who was not rejected by the *baraita* of Rabbi Judah, and he accepted a halakhic mile of 24 m, even though it corresponds to a slow walker. He was perfectly aware of this fact, and clearly expressed it in Hilkhhot Korban Pessah. In Hilkhhot Evel, he considered an average walker at the speed of 40 miles per day.⁹¹

91 It seems that these 40 miles in a day must be understood in a day of 12 hours and not 15 hours. Indeed, with a mile of 900 m, 40 miles per day represents 36 km per day, practically the distance of 37 km covered by an average walker. But in so doing, he interprets the fraction dawn/day of $\frac{1}{10}$ according to Rabbi Judah, differently to the same fraction for Rabbi Johanan: $\frac{3.75}{(3.75+30+3.75)}$. *Kaftor Vaferah* seems to have understood Maimonides in the same way. The traveler on the eve of Passover covers the 15 miles between Modiim and Jerusalem in six hours at a slow speed, but he says that an average walker covers 40 miles in a day and walks the distance between Jerusalem and the rock of Azazel in three hours. Necessarily, he considers a distance of 10 miles according to Rabbi Judah in B. Yoma 67a, and a span of time of 18 m for a mile. R. Joseph Schwartz has followed this interpretation of *Kaftor Vaferah* because the 40 miles per day corresponds very well with 37 km per day, which he considered the accepted daily walk of an average walker (five German leagues per day). Therefore, he considers that the distance between Modiim and Jerusalem of 15 miles, or about 14 km, is covered by an average walker in 4.5 hours. The Hatam Sofer ruled in Orah Hayyim 89 for a mile of 22.5 m. Nevertheless, at the end of his statement, he finally accepts the value of 18 m for one mile on the basis of the statement of *Kaftor Vaferah*, which he considered experimental testimony. He actually made two mistakes: first, *Kaftor Vaferah* does not confirm the location, but at the rate of one mile in 18m, he says that it must take three hours to cover this distance of 10 miles at an average speed; second, the halakhic mile is not deduced from an average and practical walk, but from the walk of the eve of Passover. Therefore, the halakhic mile must be fixed according to his first speculations and correspond to 22.5 m as stated at the beginning of his explanation.

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III. ASTRONOMICAL EVIDENCE ABOUT THE DURATION OF THE MILE

B. Rosh Hashanah 25a writes about the last sighting of the old crescent of the moon on the morning of the 29th day of Elul,

ר' חייא חזיא לסיהרא דהווי קאי בצפרא דעשרים ותשעה, שקל קלא, פתק ביה, אמר לאורתא בעינן לקידושין ואת קיימת הכא, זיל איכסי, אזיל ואיכסי

Apparently Rabbi sent Rabbi Hiya to sanctify the new moon on the evening following the 29th day, so that the former month would be defective⁹² and the new month would begin on the 30th day, even though they still saw the old crescent of the moon at the end of the night of the 29th day.

Y. Rosh Hashanah II: 5,58a writes concurrently:

ר' חייא הילך לאורו של ישן ארבעת מיל. ר' אבין משרי עליה צריין ואמר לה לא תבהית בני מריך ברמשא אנן בעינן תיתחמי מיכא ואת מיתחמי מיכא, מיד איתבלא מן קומיה

The second sentence is related to another period, probably in the time of R. Johanan. The first sentence is relative to R. Hiya and it probably refers to the case considered in B. Rosh Hashanah 25a, although this is not certain. It can also refer (especially if the reading of four miles is correct) to another case when R. Hiya found, at the last sighting of the old moon, that he could walk four miles, or 72m, during its light. It was too far from conjunction⁹³ and he probably did not sanctify the new moon on the 30th of Elul but on the following day, the 31st of Elul. In Midrash Tanhuma (Buber edition) Parashat Bo n°8, both events – the latter and this of B. Rosh Hashanah – are connected:

מעשה בר' חייא הגדול שעלה הירח ערב ראש השנה והלכו הבהמין לאורו מהלך ג' מילין, ראה אותו ר' חייא נטל צרורות ועפר והיה זורק בו, אמר למחר אנו מבקשים לחדשך ועלית לך עכשיו, מיד נבלע במקומו...

In Yalkut Shimoni, chap. 191 (Bo) the reading is slightly different:

מעשה ברבי חייא הגדול שעלה הירח ערב ראש השנה והלכו הספנין לאורו מהלך ג' מילין. ראה אותו רבי חייא, נטל צרורות ועפר והיה זורק בה, א"ל למחר אנו מבקשין לקדשך ועלית לך עכשיו, מיד נבלע במקומו

92 A Jewish month has either 29 days (defective month) or 30 days (full month).

93 The moment when the sun and the moon have the same longitude and the sun occults the moon is the new moon.

Rabbi Hiya and principally Rabbi decided to proclaim the 30th day of Elul to be the first day of Rosh Hashanah. It was indeed an empirical rule to have Elul and Adar (before Nissan) defective in order not to confuse the Diaspora⁹⁴ and to help them fix the holidays with confidence. Therefore, they had to manipulate the length of the summer months and introduce enough full months to ensure that Elul would be defective and to avoid the visibility of the old lunar crescent on the morning of the 29th of Elul.

Of course, the visibility of the old crescent on the morning of the eve of Rosh Hashanah would be a rather unsatisfactory situation.⁹⁵ It was the result of the lack of one, or even two, supplementary full months in the summer.

In Tishri, the time span between the last visibility of the old moon and the true conjunction, and between the true conjunction and the first visibility of the new moon is a minimum of about 19 hours and a maximum of about 77.5 hours.⁹⁶ The span of time between the last visibility of the old crescent and the first visibility of the new crescent is at least 38 hours and at most 155 hours. Therefore, in the case of the visibility of the old moon on the morning of the eve of Rosh Hashanah,⁹⁷ we are sure that the new moon will not be visible at the beginning of the evening of the 2nd of Tishri and it will be visible, at the earliest, at the beginning of the evening of the 3rd of Tishri. Normally, the Talmud accepts a first visibility of the new moon on the day following the Neomenia.⁹⁸

We can now show that using a mile of 24 m (or 22.5 m) in place of a mile of 18 m seriously worsens the situation in which the calendar committee of the Sanhedrin had placed itself. If we consider a mile of 18 m, the situation on the morning of the 29th of Elul was the following: the old crescent was seen during 54 m. If we assume that the old moon became invisible at sunrise, we can deduce that the moon rose at about 54 m before sunrise and the elongation between moon and sun was about 13.5°. Therefore, the true conjunction of Tishri occurred about 27 hours later,⁹⁹

94 See B. Rosh Hashanah 19b and Y. Sanhedrin I: 2. See also Ajdler (1966), p. 673 n. 2.

95 The true lunar months are shorter in the summer than in the winter. In the summer, especially in June and July, the sun is near its apogee, so its velocity is minimal and the moon catches up with the sun faster. Therefore, there are more defective months in summer, see Ajdler (1966), p. 701. In this case, they had foreseen too many defective months and therefore the old moon was seen too late in Elul.

96 See Ajdler (1966), pp. 206-208.

97 Even in our calculated calendar, it is not completely impossible to see the old moon on the morning of the 29th of Elul. See Ajdler (1966), p. 668 n. 4.

98 See note 100.

99 The rate of variation of the elongation is about .5° per hour.

during the morning of the 1st of Tishri, and the first visibility of the new moon of Tishri was at least 46 hours later than the last visibility i.e., at the earliest, at the beginning of the evening of the 3rd of Tishri.

If we consider now a mile of 24 m, the old crescent was seen during 72 m, and the elongation between the moon and the sun on the morning of the 29th of Elul was still 18°! The true conjunction occurred about 36 hours later, at the end of the day of the 1st of Tishri. Therefore, a mile of 24 m instead of a mile of 18m worsens the situation and moves the conjunction back by nine hours. With a mile of 22.5 m, the worsening would be slightly less important. Therefore, the most likely span of time represented by a mile is 18 m. Similarly, in the Gemara Y. Rosh Hashanah II: 5 mentioned above, we must consider whether the reading of four miles should be corrected to three miles or to assign this passage to another case where Rabbi Hiya resolved to fix Rosh Hashanah on the 30th of Elul but was forced to postpone its sanctification to the 31st of Elul.¹⁰⁰

IV. THE POSITION OF R. ISRAEL ISSERLEIN

R. Israel Isserlein (1390-1460) was a pupil of Maharil. He is considered the *primus inter pares* among his colleagues R. Jacob Weill and R. Joseph Colon, and is celebrated for his *Responsa Terumat ha-Deshen*. In his responsum I: 167, he writes that a mile represents 18 m.¹⁰¹ R. Joseph Karo adopted this ruling in *Orah Hayim* 459: 2,¹⁰² but the *Gra* and R. Jacob Reicher sharply challenged this position. According to them, R. Isserlein counts his temporary hours from daybreak to night.¹⁰³ He then uses long temporary hours (the *Gra* considers that counting long temporary hours from daybreak until night is a big mistake, contrary to astronomy)¹⁰⁴ and, therefore, the distance covered in 12 equinoctial hours is 32 miles, and the time

100 See B. Erahim 9a: it was accepted that the new moon became visible one day after the Neomenia, but not more. See Ajdler (1996), pp. 221-24.

101 “as we proved it from the 40 miles walk of an average man during an average day representing 12 hours.”

102 He refers explicitly to this ruling of *Terumat ha-Deshen* in Beit Yossef Orah Hayim 459.

103 In his responsum I: 1, he writes that *pelag ha minha* is 1.25 h before the appearance of the stars. In his responsum I: 123, in the note, it states that the day’s journey is 10 *parsah* in a day of 12 hours. His pupil, R. Joseph from Muenster, in *Leket Yosher* specifies that these 10 *parsah* are covered in the middle of a day, from daybreak until night, which represents 12 hours.

104 In other words, the *Gra* considers also a mile of 22.5m and a walk of 32 miles in 12 equinoctial hours, but he does not accept the principle of long temporary hours, even though this principle was accepted by *Tosafot* (ר"ה אהר אומר, in B; Pesahim 11b and in B; Sanhedrin 41b). According to *Gra*, the temporary hours must coincide with the equinoctial hours at the equinox.

corresponding to one mile is 22.5 m. The 18 m mentioned by R. Isserlein are actually expressed in long temporary time; they represent $(40/32) \times 18 = 22.5$ m equinoctial time. We find that R. Jacob Weil has a very similar position. In his responsum 193, devoted to the eve of Passover, he writes that a mile is 18 m.¹⁰⁵

Actually, R. Joseph Karo would then have misunderstood the ruling of R. Isserlein. Nowadays, such a misunderstanding can still be found in the book *Jewish Chronology* by Leo Levi, pp. 17-18 (Hebrew text). Let us examine the position of R. Isserlein in detail. If we combine several of his responsa, he gives enough information to solve the problem. In responsum I: 1, we learn that he was not accustomed to temporary hours and he apparently believed that all the hours in the Talmud are equinoctial hours. He remembers that in his youth, when learning a *Tosafot* in Berakhot,¹⁰⁶ he discovered temporary hours. In his responsum 121, dealing with the schedule of the eve of Passover, he considers the case when Passover occurs very late (nowadays Passover can fall as late as April 25) and he mentions that the end of the 4th hour is still three hours before noon. In Vienna (near his town of Neustadt), latitude 48°, we observe that, on the eve of this late Passover, sunrise is at 4 h 58 m, noon is at 11 h 59 m and sunset is at 18 h 59 m. The duration of the morning is indeed 7h 01 m. At the end of the fourth hour, we are at 9 a.m., three hours before noon.¹⁰⁷ It appears here that he counts the hours from sunrise. In his responsum 109, dealing with the early reading of the *megila* on the eve of Purim, he considers the case when Purim occurs very late (nowadays Purim can

105 “as we can deduce it from *Tosafot* B. Pesachim 11b, ד”ה אהרן אומר, and from B. Pesachim 94a where we have seen that an average man walks 40 miles in a day corresponding to 12 hours.” Indisputably, R. Jacob Weil considers long temporary hours and the 18m mentioned by R. Jacob Weil are in fact 22.5 equinoctial minutes. We see also that although the rulings of R. Isserlein and Weil are very similar in their expression and both reach the conclusion of a mile of 18 m, it appears that they differ: the mile of R. Isserlein is 18 equinoctial minutes while the mile of R. Jacob Weil is 22.5 m.

106 The editor could not give a reference. There are actually many other *Tosafot* that cannot be understood without the use of the concept of temporary hours.

107 R. Isserlein is thus very lenient and accepts eating bread until the beginning of two equinoctial hours before noon. Today, this leniency is not accepted. Today there are two ways of calculating the schedule of the eve of Passover:

1. According to the principle of short temporary hours (Maimonides, *Gra*, Levush).
2. According to the principle of the long temporary hours (*Tosafot*, German and Spanish *rishonim*). It is, nevertheless, incorrect to ascribe this system to R. Isserlein and even to Magen Avraham, as people are accustomed to do. Indeed, the latter does not take a position on this issue, except in O.H 58 where he uses the long temporary hours for the calculation of the limit of the reading of *Shema*.

fall until March 26). On the eve of this late Purim, sunrise is at 5 h 51 m, noon is at 12 h 06 m and sunset is at 18 h 20 m. The duration of the afternoon is 6 h 14 m and *pelag ha-minha* is then 4 h 59 m after noon, i.e. 4h 59 m true time. The repetition of this responsum by his pupil in *Leket Yosher* mentions that this moment is just before the clock of Neustadt rings 5 p.m. It is then evident that R. Isserlein uses equinoctial hours and counts the hours of the day from sunset. Most likely, he did not follow R. Tam about the times of Sabbath and considered the beginning of the night 0.75 miles after sunset, and therefore he probably called sunrise *alot ha-shahar* and sunset *tzeit ha-kohavim*. The earlier rabbis did not correctly understand R. Isserlein (he was indeed not very clear) and did not check the times indicated in these two responsa.

The question now is whether R. Joseph Karo adopted the duration of 18m for a mile with full knowledge of the facts.¹⁰⁸ It is likely that he was not aware of the former results, and that he understood *alot ha-shahar* and *tzeit ha-kohavim* according to the standard understanding of the Talmud B. Pesahim 94a. But, while all the other rabbis understood *Terumat ha-Deshen* according to column D of our table, the 18 m being 18 long minutes or 22.5 equinoctial minutes, in accordance with their own comprehension of Pesahim, R. Karo (followed by Rema and Levush) understood *Terumat ha-Deshen* according to column C, the 18m being 18m equinoctial. In any case, there is enough evidence in *Terumat ha-Deshen* that all his hours (even on the eve of Passover, when according to the plain explanation of the Mishna Pesahim I: 1 the hours are temporary hours) are equinoctial hours, that he is not accustomed to temporary hours, and that the mile is 18 equinoctial minutes.

V. CONCLUSION

According to what was considered the definitive exegesis of the talmudic passage of B. Pesahim, the halakhic mile represents a span of time of 18 m, which corresponds to the time taken by a quick walker to cover that distance. According to the definitive exegesis of the interpretation of the passage by Maimonides, the halakhic mile represents a time span of 24 m; this corresponds to the time taken by a slow walker to cover the distance. In both exegeses, the halakhic mile (unit of time) does not correspond to an average walk.

108 See Kosover (1989), p. 19 and Benish (1996), t. I, p. 113.

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