Zemanim In *Halacha*

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Introduction

The *halachic* Jew's life is centered around performing *mitzvot.* Many of these *mitzvot* are based on time. To properly perform these time-bound *mitzvot,* one has to be aware of the *halachic zeman* (time) of when to do them. This paper will discuss the *halachic zemanim* that we encounter every day: *Bein HaShmashot, Tzeit HaKochavim, Alot HaShachar, Misheyakir, HaNeitz HaChama, Chatzot, and Shkiat HaChama.* It will explain how to understand the different *zemanim* being used today. By delving into the *sugyot* of the Gemara, and analyzing the positions of the *Rishonim* and *Poskim,* the paper gives a strong overview of the different *zemanim* relied upon nowadays.

If one wishes to delve more into the topic, he or she should study the *sefer* Dvar Yom by Rabbi Dovid Braunfeld. This *sefer* provides cogent explanations and delineates the topics discussed in this paper. It has been a tremendous guide to the author, who has included some pictures from his *sefer* to further clarify technical details.

Bein HaShmashot

At the end of the previous *halachic* day, after *Shkiah* (sunset) it is unclear when the next *halachic* day begins. The next day begins with *Tzeit HaKochavim* (the emergence of three stars), but the transition from *Shkiah* to *Tzeit* is not evident,[1] and therefore this time period between *Shkiah* and *Tzeit*, known as *Bein HaShmashot* is subject to a *machloket*. It is important to identify when this time period takes place since it has *halachic* ramifications. During this time period before the onset of *Shabbat*, one is still allowed to tithe *demai*,[2] insulate hot food, and establish

[1] The explanations of *Shkiah* and *Tzeit* will be further discussed later.
[2] *Demai* is produce which is questionable whether it has been tithed or not. As a precautionary measure, the Sages require tithe to be separated from it.

an *eruv* in a courtyard.[3] Additionally, there is a mitzvah of *tosefet Shabbat*, adding on to *Shabbat* from the weekday.[4] It is important to identify when *Bein HaShmashot* is to ensure that one is doing *tosefet Shabbat* properly on the eve of Shabbat (*erev Shabbat*) and after Shabbat is over (*motzei Shabbat*).

The Gemara in *Shabbat*[5] explains how the time period of *Bein HaShmashot* is a time of uncertainty; it is unclear whether it is day, night, or both, and therefore it is given the stringencies of both days. The Sages go on to discuss when exactly *Bein HaShmashot* takes place. This is subject to a dispute among the Sages. Rabbah in the name of Rav Yehudah understands *Bein HaShmashot* to begin after the sun sets (משתשקע החמה) until the upper sky is as dark as the bottom sky. While the eastern sky is reddening and the upper sky is not yet as dark as the bottom sky, he still understands it to be *Bein HaShmashot*. Rabbah says this length of *Bein HaShmasho*t is the time it takes an average person to walk the distance of ¾ *mil*.[6] Rav Yosef in the name of Rav Yehudah has a different opinion. He holds that it is still considered the day when the eastern sky is reddening. When the bottom sky darkens, and the upper sky is still light, this is *Bein HaShmashot*. When the upper sky darkens, it is then considered nighttime. He understands *Bein HaShmashot* to be how long it takes for an average person to walk the distance of ⅔ *mil*.[7] Rav Nechemya holds that *Bein HaShmashot* is slightly shorter. He thinks it begins after the sun has set and lasts the time period it takes an average person to walk the distance of ½ *mil*. Rav Yose, the last opinion, holds that *Bein HaShmashot* occurs in the blink of an eye, *k'heref ayin.* The night enters and the day leaves, and thus it is impossible to calculate the exact duration of *Bein HaShmashot*.

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[3] Shulchan Aruch, Orach Chayim 261:1
[4] Ibid., 261:2
[5] Shabbat 34b
[6] This is 1500 *amot* (Shulchan Aruch, Orach Chayim 261:2).
[7] This is 1/12 *millin* less than Rabbah.

According to Rabbah and Rav Yosef who are both quoting Rav Yehudah, *Bein HaShmashot* ends, and it is deemed nighttime, when the upper sky is just as dark as the lower sky. The Gemara clarifies that Rav Yose's *zeman* of *Bein HaShmashot* occurs after Rav Yehudah's *Bein HaShmashot* concludes.[8] Rabbah bar bar Channah therefore establishes that we are strict for both Rav Yehudah and Rav Yose. The *halacha* is like Rav Yehudah in matters regarding *Shabbat*, and it follows Rav Yose in regard to *terumah*.[9] The Kohanim who were previously impure and immersed themselves in the *mikveh* before *Bein HaShmashot* cannot eat *terumah* until after Rav Yose's *Bein HaShmashot* ends. The Rashba[10] and the Ran[11] both understand that we only follow Rav Yehudah in regard to starting *Shabbat* since his opinion is only stricter then. Thus, we can no longer perform *melacha* (forbidden work) when Rav Yehudah's *Bein HaShmashot* begins. Regarding Shabbat ending, *motzei Shabbat*, however, since Rav Yose's *Bein HaShmashot* is after Rav Yehudah's, it is the more stringent opinion and we thus wait to do *melacha* until after Rav Yose's *Bein HaShmashot* ends.

The Gemara established that we follow Rav Yehudah in regard to the onset of *Shabbat*. There is a *machloket,* however, how Rav Yehudah holds,[12] and the Gemara did not elaborate which opinion we follow. The Rif[13] says we *paskin* (hold) like Rabbah that *Bein HaShmashot* is ¾ *mil*[14] since this is the more stringent opinion and whenever Rabbah and Rav Yosef disagree the

[8] Shabbat 35a
Tosafot (Shabbat 35b "Elah") determines that Rav Yose's *Bein HaShmashot* must occur a bit after Rav Yehudah's *Bein HaShmashot* ends or else there wouldn't be a difference between them in regard to when *Bein HaShmashot* ends.
[9] Ibid.
[10] Chiddushei Rashba on Shabbat 35a
[11] Rabbeinu Nissim on the Rif Shabbat 35a
[12] Whether he holds *Bein HaShmashot* is ¾ *mil* like Rabbah quotes him as saying or he holds it is ⅔ *mil* like Rav Yosef quotes Rav Yehudah as saying.
[13] Shabbat 15a
[14] This is the time it takes the average person to walk that distance. For brevity, throughout the paper, this measure of time will be referred to as a *mil*, even though a *mil* is only a measure of distance.

halacha is like Rabbah, except for in three cases mentioned in *Bava Batra*.[15] Tosafot also says that we only follow Rav Yosef in these three cases; in all other cases, presumably including ours, the *halacha* should follow Rabbah.[16] Rashba quotes his Rebbe[17] who disagrees and believes we actually hold like Rav Yosef who holds *Bein HaShmashot* is ⅔ *mil*.[18] The Shulchan Aruch *paskins* like Rabbah and says *Bein HaShmashot* is ¾ *mil*.[19]

Even though we have identified the length of *Bein HaShmashot*, there is a *machloket* when this *zeman* takes place. Even though according to Rabbah *Bein HaShmashot* begins after sunset (משתשקע החמה), we will see how this language of משתשקע החמה is actually understood. This will be discussed later when we identify what is considered *Tzeit HaKochavim.*

Now that it is clear what length of *Bein HaShmashot* is in terms of *millin*, it is important to identify how many minutes it is. The Gemara in *Pesachim* teaches that an average person walks 10 *parsaot* (40 *millin*) on an average day.[20] There is a debate, however, how to divide up the 40 *millin*. Ullah holds that a person walks 5 *millin* from *Alot* to *HaHaNeitz* and from *Shkiah* to *Tzeit*, and 30 *millin* from *HaHaNeitz* to *Shkiah*.[21] Rav Yehudah holds that a person only walks 4 *millin* from *Alot* to *HaNeitz* and from *Shkiah* to *Tzeit*, and 32 *millin* from *HaHaNeitz* to *Shkiah*.[22] Rashi[23] states that this is referring to an average day, where the time of night and day are equal, 12 hours each. There is a disagreement, however, about what is considered *halachically* day. Some hold that the day is from *HaNeitz* until *Shkiah*, so there are 12 hours

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[15] Bava Batra 114a-114b mentions how we follow Rav Yosef in three cases: the dispute between two brothers regarding their father's field, the case of until when can one renege on a transaction, and when a husband tells his wife that she and her children can have half of his property (בְּשָׂדֶה עִנְיָן וּמֻחֲצָה).
[16] Tosafot Bava Batra 114b "V'Hilchata"
[17] He does not specify who this is. It is presumably the Ramban or Rabbeinu Yonah.
[18] Chiddushei Rashba on Shabbat 35a
[19] Shulchan Aruch, Orach Chayim 261:2
[20] Pesachim 93b
[21] 5 *millin* from *Alot* to *HaNeitz* + 30 *millin* from *HaNeitz* to *Shkiah* + 5 *millin* from *Shkiah* to *Tzeit* = 40 *millin*
[22] Pesachim 94a
4 *millin* from *Alot* to *HaNeitz* + 32 *millin* from *HaNeitz* to *Shkiah* + 4 *millin* from *Shkiah* to *Tzeit* = 40 *millin*
[23] Rashi on Pesachim 93b - "Kama"

during that daytime period.[24] According to this opinion, Ullah holds that an average person can walk 30 *millin* in 12 hours. A *mil* is therefore the equivalent of 24 minutes.[25] According to Rav Yehudah, an average person can walk 32 *millin* in 12 hours; thus, a *mil* is equal to 22.5 minutes.[26] Others have a different understanding of when the 12 daytime hours are.[27] Instead, they hold that the 12 hours begin with *Alot HaShachar* and end with *Tzeit HaKochavim*. Therefore an average person walks 40 *millin* in 12 hours; thus, a *mil* is equivalent to 18 minutes.[28] This is what the Shulchan Aruch holds.[29]

We see that there are 3 options for the length of a mil: 18 minutes, 22.5 minutes, and 24 minutes. The length of *Bein HaShmashot* therefore also has 3 possibilities based on the different calculations of a mil. If a *mil* is 18 minutes, ¾ *mil* will be 13.5 minutes. If a *mil* is 22.5 minutes, ¾ *mil* is 16.75 minutes. And if a *mil* is 24 minutes, ¾ *mil* will be 18 minutes.

Another factor that may affect the length of *Bein HaShmashot* is *shaot zmaniot*. This means that the daytime, which is subject to a *machloket,* is divided into 12 parts with each part being considered a *halachic* hour. We mentioned before how the Gemara is discussing a day where there are 12 hours. This is not usually the case, however. Since we divide the daytime into 12 parts, when the day is 12 hours, each *halachic* hour would equal a regular hour of 60 minutes. When the daytime is 9 hours, each *halachic* hour will only be 45 minutes.[30] When the daytime is longer, perhaps 14 hours, each *halachic* hour will be 70 minutes.[31] Therefore, the length of *Bein*

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[24] Biur HaGra on Shulchan Aruch, Orach Chayim 459:2
[25] 720 minutes (equivalent of 12 hours) / 30 *millin* = 24 minutes
[26] 720 minutes (equivalent of 12 hours) / 32 *millin* = 22.5 minutes
[27] Magen Avraham 58:1
[28] 720 minutes (equivalent of 12 hours) / 40 *millin* = 18 minutes
Even though the Gra does not hold that the day is from *Alot* to *Tzeit*, he (Orach Chayim 459:2) understands the Gemara to be that there are actually 40 *millin* between *HaNeitz* and *Shkiah*, so this time works for him as well.
[29] Shulchan Aruch, Orach Chayim 459:2
[30] (9*60 = 540) / 12 = 45 minutes.
[31] (14*60 = 840) / 12 = 70 minutes.

HaShmashot may not be a fixed amount of minutes; rather, it could vary from day to day based on how long the daytime is which would affect the length of the *halachic* hour.

Since *Bein HaShmashot* is a time where it is neither daytime nor nighttime, it is unclear whether it should follow the *shaot zmaniot* of the day or night. If the daytime and nighttime are both 12 hours, this would not make a difference. If, however, it is a day in *Tammuz* where the daytime is a lot longer than the nighttime, the *halachic* hour of the day will be longer than the *halachic* hour of the night. Therefore, if we calculate *Bein HaShmashot* based on *shaot zmaniot,* the length of it will depend on whether we consider this time to take place during the daytime or nighttime. Those who hold that the daytime lasts until *Tzeit* would calculate *Bein HaShmashot* using the *halachic* hour of the daytime. If, however, the daytime only lasts until *Shkiah*, the *halachic* hour of nighttime should ostensibly be used when calculating *Bein HaShmashot*.[32] This would mean that *Bein HaShmashot* will actually be longer in the winter months, when the nighttime is longer, and shorter during the summer months, when the nighttime is shorter.[33]

The exact *zemanim* that we use today to determine *Bein HaShmashot* will be discussed when determining the proper *zeman* for *Tzeit*, since *Bein HaShmashot* is dependent on when it is *halachically* deemed nighttime.

Tzeit HaKochavim

The day *halachically* begins at night; this is known from the time of creation. When Hashem created the world, after each day was finished the pasuk says "It was evening, it was morning."[34] Since evening is mentioned first, it is evident that the *halachic* day begins with the

[32] This is all a theoretical discussion if we were to hold that there is *shaot zmaniot*. We will see, however, whether we even hold that way.
[33] I have not seen this idea in any *Poskim*, but I thought it is something interesting to think about.
[34] Bereishit 1:5

nighttime. The first distinct *halachic* time of the new day is *Tzeit HaKochavim*, the appearance of three medium sized stars in the sky.[35] This time is important because it marks the beginning of the new calendar day, and it is at this time, the emergence of nighttime, when certain mitzvot such as *kriat shema shel Arvit* can now be performed.[36]

We already discussed how the Gemara in *Shabbat* says it is considered nighttime when the upper sky has darkened. This time of ¾ *mil* according to Rav Yehudah seemingly occurs after *Shkiah* and before *Tzeit*. In the Gemara in *Pesachim*,[37] however, there are two different opinions for the time between *Shkiah* (שְׁקִיעַת הַחַמָּה) and *Tzeit*, as was briefly mentioned.[38] Rav Yehudah states that from *Alot HaShachar* until *HaHaNeitz,* which is the same *halachic* time period as from *Shkiah* until *Tzeit*, the average person walks 4 *millin*.[39] Ullah holds that during this time period the average person walks 5 *millin.*[40] During these 4 or 5 *millin,* it must be that at some points it is either definitely daytime (*vadai yom)* or definitely nighttime (*vadai layla),* since the time of *Bein HaShmashot*, when it is uncertain whether it is daytime or nighttime, is only ¾ *mil*.

Rabbeinu Tam holds that there are two different sunsets and makes a distinction between the language of the words used for sunset in *Shabbat* and *Pesachim.* משתשקע החמה is the *lashon* (language) used in *Shabbat.*[41] Normally, Rabbeinu Tam explains, this refers to the end of *Shkiah*, when the sun has completely set, and it is *vadai layla*. In this case, however, in *Shabbat* משתשקע החמה means the beginning of *Bein HaShmashot*, when the sun has already entered the thickness of the firmament (*rakiya)*. The *lashon* of שקיעת החמה is used in *Pesachim*, however, and it means the beginning of sunset, when the sun begins to enter the firmament. At this point, and for the

[35] Shabbat 35b
[36] Shulchan Arukh, Orach Chayim 235:1 (Kriyat Shema) and Shulchan Arukh, Orach Chayim 293:2
[37] Pesachim 93b-94a
[38] It does not use the language of *Bein HaShmashot;* it discusses the time period between *Shkiah* and *Tzeit.*
[39] Pesachim 94a
[40] Ibid., 93b
[41] Tosafot Shabbat 35a- "Trei Tiltei Mil" and Sefer HaYashar L'Rabbeinu Tam 221

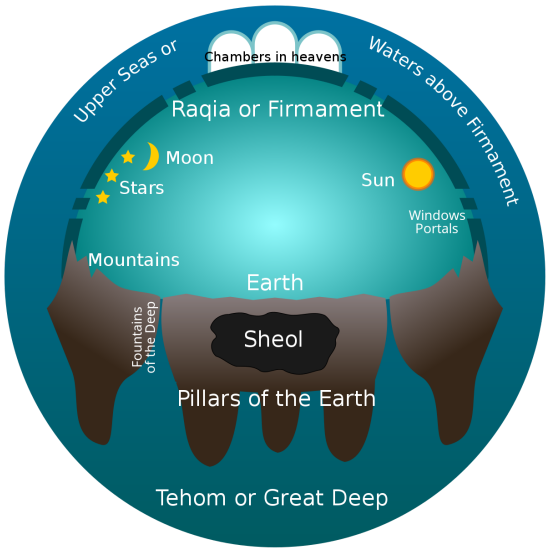
next 3 ¼ *millin,* it is considered *vadai yom.*[42] After that, it is *Bein HaShmashot* for the next ¾ *millin* until it is *Tzeit* and *vadai layla.* Rabbeinu Tam understands all these 4 *millin* of Rav Yehudah to be the time when the sun is traveling within the *rakiya.* This *rakiya* that Rabbeinu Tam and the Gemara discuss is a dome-like covering that was believed to be on top of Earth. At the end of the day, the sun was said to travel through the thickness of this *rakiya* and go on top of it, leaving humans without sunlight. Throughout the night, the Sages believed that the sun traveled on top of the *rakiya* back around to the east before entering the *rakiya* again and shining on earth for the next daytime.[43]

The Maharam El Ashkar[44] points out a difficulty with the view of Rabbeinu Tam. Rabbeinu Tam's view is based on the premise that the sun travels through the *rakiya* and goes above it throughout the night. The Gemara in *Pesachim* gives an alternate view, the view of the Gentiles, that the sun is below the *rakiya* during the day and goes below the ground at night. Rebbe says that the view of the Gentiles seems more correct.[45] The Rambam and the Gaonim also believe that the Jewish sages abandoned their astronomical views for the views of the Gentiles.[46]

In the Gemara in *Pesachim* it is unclear whether the Gentiles believed the sun still goes through the *rakiya* and just travels below the ground, or if they held it never goes through the *rakyia*; rather, the sun goes straight below the ground at night. The Maharam El Ashkar must be understanding their view to be that just the sun goes below the ground and never travels through the *rakiya* or else it would not be a difficulty in understanding Rabbeinu Tam. If the sun goes

[42] This is based on the understanding that Rabbeinu Tam holds like Rav Yehudah that there are 4 *millin* from *Shkiah* to *Tzeit*. It is unclear what he holds but we will usually write as though he holds 4 *millin.*
[43] Pesachim 94b
[44] Siman 96
[45] Pesachim 94b
[46] Moreh Nevuchim II:8

straight below the ground without ever traveling within the *rakiya,* it is clear that Rabbeinu Tam's position is based on science that we do not hold like and thus is faulty.



The Gra along with many others understand the Gemaras differently.[47] The Gra points out that there is no distinction between the *lashon* of שקיעת החמה and משתשקע החמה. They are both referring to one *Shkiah*: when the sun sinks below the horizon. Instead, there is a difference between the *Tzeit* mentioned in *Pesachim* and *Shabbat.* The *Tzeit* mentioned in *Pesachim* that occurs 4 *millin* after sunset, is when all the stars have come out, including the small ones. The *Tzeit* in *Shabbat* of three medium-sized stars occurs ¾ *mil* after *Shkiah*, and for the next 3 ¼ *millin* after that, it is considered *vadai layla* even though all the stars have not yet appeared in the sky. According to the Gra, the *Tzeit* mentioned in *Pesachim* which is 4 *millin* after *Shkiah* and all the stars come out does not have any *halachic* significance.

There is a third opinion for when the time of *Tzeit* occurs. The Sefer Yeraim,[48] a student of Rabbeinu Tam,[49] understands the *lashon* of משתשקע החמה to be a time before שקיעת החמה. He

[47] Biur HaGra on Shulchan Aruch, Orach Chayim 261:2
In Biur Halacha 261:2 "Ub'emet," he says the Gaonim, the Maharam, and others hold this way as well.
[48] Sefer Yeraim 274 last paragraph
[49] Rav Shlomo Sternberg (http://people.math.harvard.edu/~shlomo/docs/beinhashemashot.pdf) points out that since the Sefer Yeraim was a prime student of Rabbeinu Tam, they must have spent Shabbat together and it is crazy to assume they started *kabbalat Shabbat* at different times. Rather, Rabbeinu Tam and his community all accepted Shabbat before the first *Shkiah* like we do nowadays. According to him,

holds that שקיעת החמה occurs 5 *millin* before *Tzeit* as it says in *Pesachim* according to Ullah. משתשקע החמה which is mentioned in *Shabbat* as the beginning of *Bein HaShmashot,* occurs ¾ *mil* before שקיעת החמה. He understands שקיעת החמה to be the same as Rabbeinu Tam: when the sun begins to set and enter into the *rakiya*. The Sefer Yeraim holds that *Bein HaShmashot* takes place ¾ *mil* before *Shkiah* until the *zeman* of *Shkiah.* According to him, right after *Shkiah*, which is the end of *Bein HaShmashot*, it is considered *vadai layla*.[50]

We can now calculate how many minutes after *Shkiah* is the time of *Tzeit* for both Rabbeinu Tam and the Gra.[51] We mentioned previously that there are 3 options for the length of a *mil*: 18 minutes, 22.5 minutes, and 24 minutes. Thus, according to Rabbeinu Tam, *Tzeit* can be 72 minutes,[52] 90 minutes,[53] or 120 minutes after *Shkiah*.[54] According to the Gra, where *Tzeit* is ¾ *mil* after *Shkiah*, the three different times for *Tzeit* are: 13.5 minutes after *Shkiah*,[55] 16 ⅞ minutes after *Shkiah*,[56] and 18 minutes after *Shkiah*.[57]

After choosing which of the *zemanim* as the *halacha* to follow, it should be simple to calculate the times of *Tzeit* throughout the year. There are many more factors to consider,

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Rabbeinu Tam's definition of *Bein HaShmashot* must have been theoretical and he did not actually practice that way.

[50] Some explain the reason why in many communities it is customary to light candles 18 minutes before *Shkiah* is in deference to the view of the Sefer Yeraim. The Biur Halacha (Orach Chayim 261:2) says it is good to be stringent for this view and light candles before his *zeman.* The longest time for a *mil* is 24 minutes as we mentioned, and thus ¾ of 24 is 18 minutes. If we actually want to keep his view, however, we should really accept Shabbat a little (perhaps even a second) before the 18 minutes to make sure we have time for *tosefet Shabbat* before.

[51] For the Sefer Yeraim, *Tzeit* occurs right after *Shkiah*.

[52] He holds like Rabbi Yehudah that *Tzeit* is 4 *millin* after *Shkiah* and we are maintaining that a *millin* is 18 minutes long, so 4*18 = 72 minutes.

[53] He holds like Rabbi Yehudah that *Tzeit* is 4 *millin* after *Shkiah* and we are maintaining that a *millin* is 22.5 minutes long, so 4*22.5 = 96 minutes.

[54] A mil is 24 minutes long. This opinion works in accordance with Ullah who holds that there is 5 *millin* between *Shkiah* and *Tzeit*. Thus, 5*24 = 120 minutes.
This opinion goes according to the opinion that Rabbeinu Tam actually holds like Ullah that there are 5 *millin* between *Shkiah* and *Tzeit*.

[55] A *mil* is 18 minutes and *Tzeit* occurs ¾ mil after *Shkiah*. (¾)*18 = 13.5 minutes.

[56] A *mil* is 22.5 minutes and *Tzeit* occurs ¾ mil after *Shkiah*. (¾)*22.5 = 16.875 minutes.

[57] A *mil* is 24 minutes and *Tzeit* occurs ¾ mil after *Shkiah*. (¾)*24 = 18 minutes.
This does not actually work according to the Gra since he holds there are 4 *millin* from *Shkiah* to *Tzeit*, and the 24-minute *mil* is based on Ullah's opinion that there are 5 *millin* between *Shkiah* and *Tzeit*.

however, which make it difficult to calculate the precise *zeman* of *Tzeit.* We have mentioned how *shaot zmaniot* could be a factor since this is how *zemanim* are usually calculated throughout the day. This case, however, may be logically different. The minutes which we derived are based on *millin*; the Gemara does not say that *Tzeit* occurs at a certain *halachic* hour. One can therefore conclude that *shaot zmaniot* should not apply in this case.[58] The Biur Halacha understands that if one holds this way (that *shaot zmaniot* does not apply here) then throughout every time of the year, it is a fixed number of minutes after *Shkiah.* This is confusing, however, since one can hold that the length of *Bein HaShmashot* is not dependent on the length of the day (as in, there are no *shaot zmaniot)*, yet still believe that it does change based on the time of year[59] as will be explained below.

The Gra points out that the time between *Shkiah* and *Tzeit* does change throughout the year and based on location.[60] He says that the Gemara is talking about the months of *Nissan* and *Tishrei* and the locations of Israel and Bavel; thus, in locations further north and during other times of year, the time between *Shkiah* and *Tzeit* will be different. Nowadays, since we have access to scientific tools, we are able to calculate the arrival of *Tzeit* and other *zemanim* more precisely. Therefore, this paper will now discuss how we use modern science to properly determine the different *zemanim* for *Tzeit.* Since the Gra explains that the *zeman* of the Gemara is not fixed, we want to be able to correctly calculate the *zeman* of *Tzeit* for any time and any place.

All the *halachic zemanim* are dependent on the position of the sun. Since the amount of light in the sky and the ability to see the stars are related to the position of the sun, the *halachic zemanim* throughout the day can be calculated based on the sun's position relative to the horizon.

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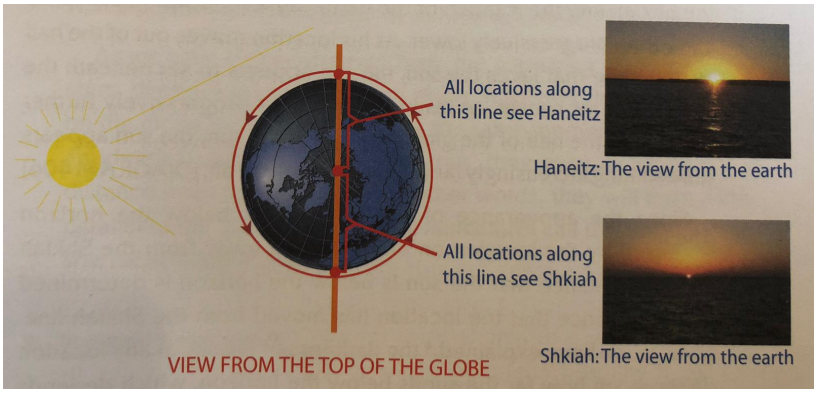
[58] The Biur Halacha (Orach Chayim 261:2) quotes the Pri Megadim as holding that the 4 *millin* are *shaot shavot* (regular hours) not *shaot zmaniot*.
[59] For example, when it is *Tammuz* versus *Nissan*, the length of *Bein HaShmashot* can be different, but it is not directly correlated to the length of how long the day is. This will be further clarified below.
[60] Biur HaGra on Shulchan Aruch, Orach Chayim 261:2

Although we define *Tzeit* as the coming out of the stars, the stars never actually come out; they are always in the sky. We are unable to see the stars throughout the day, however, since the sun outshines the light of the stars. Once the light of the sun goes below the horizon, the sky gets darker, and we are able to see the stars. Therefore, *Tzeit* is directly related to the position of the sun. To understand the arrival of *Tzeit*, we have to understand the movement of the sun and earth throughout the time period between *Shkiah* and *Tzeit*.

The earth rotates on its axis, appearing to spin in a counterclockwise rotation from the North Pole's vantage point. At any time throughout the day, half of earth is facing toward the sun and the other half is facing away from the sun. On an imaginary line dividing up the two halves,[61] the people are seeing the sun on the horizon. Half of those people are seeing the sun setting, *Shkiah*, while the other half are seeing the sun rising, *HaNeitz*. This location where people are seeing the sun setting will be referred to as the *Shkiah* line.[62]

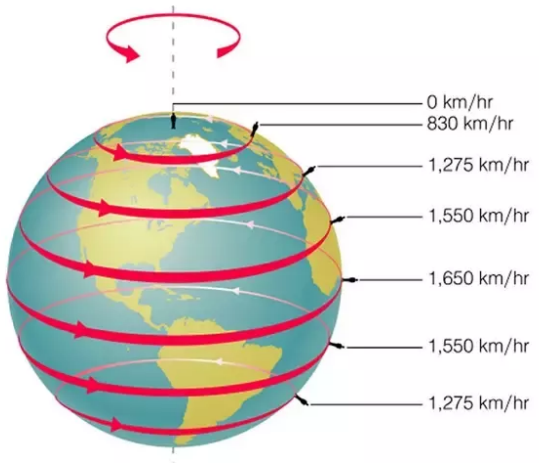


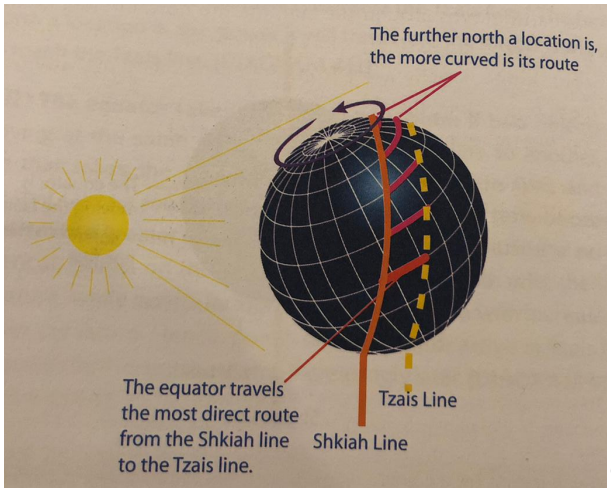
[63]

When people see the sun setting below the horizon it is due to the earth moving away from the bottom half of this imaginary line. However far the earth has rotated counterclockwise from this line will determine how dark the sky is and therefore how many stars appear in the sky. All locations equally east of this line will be experiencing the same level of darkness, and

[61] This is from the view of the North Pole, the top of the globe.
[62] This is what Rabbi Braunfeld calls it in his sefer, Dvar Yom.
[63] Dvar Yom By Rabbi Braunfeld, page 59

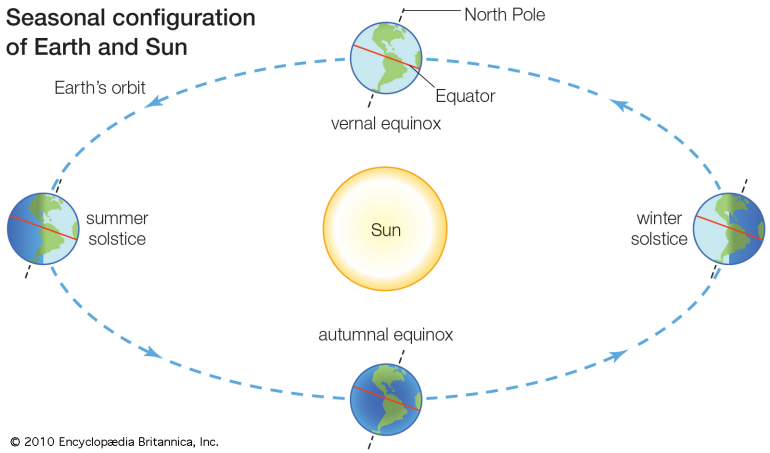
therefore *Tzeit* will occur at the same time in all of these locations. If a line is drawn parallel to the *Shkiah* line that represents the time *Tzeit* should hypothetically occur based on the darkness in the sky, all locations along that line will also be experiencing the same level of darkness in the sky. This imaginary line where every location is experiencing *Tzeit* will be referred to as the *Tzeit* line. Since the earth rotates on its axis, however, not all of the locations that experience *Shkiah* at the same time will experience *Tzeit* at the same time. In the Northern Hemisphere, locations closest to the equator will have the shortest time interval between *Shkiah* and *Tzeit*. This is because the equator travels the straightest path since it is in the middle of the globe. The further north the location on the globe is, the more circular its path, and thus it will take longer for that location to reach the time of *Tzeit*. Additionally, the center of the globe, the location at the equator, is moving the fastest. Since every point on the globe makes one revolution in the same amount of time, and the center has the longest route, the center must travel the fastest to complete the large circuit in the same amount of time. The equator is therefore moving fastest, and locations closer to the equator will reach *Tzeit* at a faster time than locations closer to the North Pole. It is clear from here that the Gra is right; locations further north will experience *Tzeit* later.





[64]

The Gra also mentions that time of the year affects the time between *Shkiah* and *Tzeit.* Since the earth is orbiting the sun, the tilt of the earth's axis is constantly changing in relation to the sun. When the Northern Hemisphere is tilted toward the sun, it is the longest day of the year; this is referred to as the summer solstice. This is most likely the time the *Rishonim* refer to as *Tammuz.* The winter solstice, the shortest day of the year, is when most of the Northern Hemisphere's orbit is tilted away from the sun. The equinox occurs when there is an equal amount of daytime and nighttime around the globe and the axis is exactly in between. The equinox occurs twice throughout the year and this is the day the Gemara is referring to when it is discussing the 4 or 5 *millin.* The *Rishonim* understand these days to be in *Nissan* and *Tishrei.*



[64] Dvar Yom By Rabbi Braunfeld, page 68

Since the tilt of the axis changes in relation to the sun throughout the year, the path for a location to travel from the *Shkiah* line to the *Tzeit* line varies from more straight to more curved. During the days of the equinox, the path of travel is the straightest; and on the summer solstice, the path of travel is the most curved. In the winter solstice, the path is in between that of the equinox and winter solstice. Therefore, the time between *Shkiah* and *Tzeit* is longest in the summer solstice and shortest in the equinox. It is clear from here that the interval of time between *Shkiah* and *Tzeit* is not dependent on *shaot zmaniot*.[65] Therefore, it makes sense to understand that the interval between *Shkiah* and *Tzeit* varies based on time and location and still not hold that it is based on *shaot zmaniot.*

According to the Gra, the arrival of *Tzeit* changes based on one's location and the time of year; and the Gemara is referring to the shortest interval of time: on an average day in *Nissan* or *Tishrei.* Additionally, the Gemara is discussing the *millin* for Israel or Bavel, so any place further north experiences *Tzeit* later.

Since we know how long it takes for *Tzeit* to arrive in Israel or Bavel on the average day, we can calculate how far the sun has gone below the horizon on that day, then use that angle to calculate how long it will take for the sun to reach that same level below the horizon in any place at any time. At 13.5 minutes, the sun is approximately 3.7 degrees below the horizon. At 16 ⅞ minutes, the number of degrees is roughly 4.4 degrees beneath the horizon. And at 18 minutes, the sun is about 4.7 degrees below the horizon. For Rabbeinu Tam, at 72 minutes, the sun is around 16.1 degrees beneath the horizon. At 90 minutes, the sun is about 19.75 degrees below the horizon. Lastly, at 120 minutes, the sun is roughly 25.9 degrees below the horizon.[66]

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[65] Even though the days are the shortest in the winter, the time between *Shkiah* and *Tzeit* is not the shortest.

[66] Dvar Yom, page 105
All these degrees were calculated in Yerushalayim on the average day. At each of these minutes, the degrees the sun was below the horizon were calculated.

If we understand Rabbeinu Tam's ruling to not be fixed, rather to only be referring to Israel and Bavel on the average day, then in Israel, *Tzeit* will be later than 72 minutes after *Shkiah* every day except the two days in *Nissan* and *Tishrei* (the equinox). This is because this day mentioned in the Gemara is the average day where the time between *Shkiah* and *Tzeit* is shortest, as we have discussed. In all other countries to the north of Israel, *Tzeit* will always be later than 72 minutes after *Shkiah*.

If we choose to understand both the Gra and Rabbeinu Tam this way, then these *zemanim* do not really coincide with the emergence of three medium-sized stars. In Israel on the equinox, three medium-sized stars appear around 30 minutes after *Shkiah*.[67] Even in areas north of Israel, such as New York, stars appear 50 minutes past *Shkiah*.[68] This does not correspond to Rabbeinu Tam's opinion that *Tzeit* arrives after 72 minutes. The Gra's opinion also does not work well with these observations. His *shiur* (measurement) for the arrival of *Tzeit* is no later than 18 minutes after *Shkiah*,[69] and it is evident that three stars are not visible yet at this time. Therefore, there appears to be a contradiction between the two *shiurim* in *millin* given by the Gemara and the statement that *Tzeit* occurs based on the stars. The coming out of three medium-sized stars does not seem to correspond with the time of ¾ *mil* or 4 or 5 *millin*.

Many calendars today are therefore based solely on the appearance of the stars. This opinion seems to make sense with the Gemara in *Shabbat* since it first explains the time period of *Bein HaShmashot* based on what is occurring in the sky. It does bring in the *millin*, but as a way to quantify the opinions of Rabbah and Rav Yehudah.

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[67] Shivilei Dovid, Orach Chayim, 261 (page 55) says that *Tzeit* is not 4 *millin* after *Shkiah*, it is a little more than 30 minutes after *Shkiah*.
Bein Hashmashot, page 59 says that three medium stars appear 22 minutes after *Shkiah* and he quotes the Divrei Yosef who says the stars appear 28 minutes after *Shkiah*.

[68] Iggerot Moshe, Chelek 4, Siman 62, "Aval"
It seems like Rav Moshe thinks this is the latest time three stars will appear, as opposed to where he lived in Europe where it was 72 minutes.

[69] This is when a *mil* is 24 minutes.

In previous generations, *Tzeit* was probably determined by people looking at the sky since they did not have all the technological advances we have today.[70] The Minchat Kohein writes that one can rely solely on the appearance of three stars in the sky since this is when it is *halachically* night.[71] Even if in one's location three medium stars appear before 72 minutes, one can assume it is *halachically* nighttime.[72] The Biur Halacha explains that since in Gemara *Shabbat* it quantifies *layla* as when the upper sky is as dark as the lower sky, and stars will not appear until after this time, we can rely on the stars to be indicators of *Tzeit*.[73]

Nowadays, since we have the tools to precisely calculate the degrees of the sun during *Tzeit,* and modern lighting and pollution make looking for stars more impractical, many calendars calculate the arrival of three stars based on the sun's degrees below the horizon. According to the Ben Ish Chai, stars appear when the sun has dipped 5.7 degrees below the horizon.[74] For the Minchat Kohein, this time period is at 8.1 degrees.[75] It is clear that *Acharonim* determined *Tzeit* on the emergence of three stars and calculated the degrees at these moments to apply them to all places and all times of the year.

Many calendars today use the *shiur* of Rav Tukachinsky to calculate *Tzeit*. This is when the sun is 8.5 degrees below the horizon.[76] In New York and New Jersey, *Tzeit* therefore ranges

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[70] My mother told me that as a child in Iran, she would go outside and search for stars to determine when Shabbat ended.
[71] Minchat Kohein by Rav Avraham Cohen Pimental, Maamar Sheni, Perek Chamishi, "V'Nireh Li"
[72] Or if one is not an expert astronomer in medium stars, he needs to wait for three small stars.
[73] Biur Halacha 293:2- "Ad"
[74] In the Ben Ish Chai, Shana Aleph Parshat Vayakhel 8, he writes that *Tzeit* is 20 minutes after reading the Maghrib Prayer on a 12 hour (average) day. In his Shaylot v'Teshuvot, Rav Pealim Orach Chayim Chelek Bet Sheilah 19, writes that as far as he remembers the Maghrib Prayer is said 7 minutes after *Shkiah*. Thus, he holds that the *Tzeit* occurs 27 minutes after *Shkiah*. This is when the sun is approximately 5.7 degrees below the horizon.
[75] Minchat Kohein by Rav Avraham Cohen Pimental, Maamar Sheni, Perek Chamishi, "V'Hinei Acher" He writes that in *Nissan* and *Tishrei*, at the equinox, stars appear after 48 minutes. He lived in Amsterdam, so the sun is about 8.1 degrees below the horizon then.
[76] He holds that the sun is 8.5 degrees beneath the horizon on the equinox in Yerushalayim when three stars come out. Thus, he holds that we can apply this angle of the sun for every location and every time of year to be the indicator of *Tzeit.*

from 41 minutes after *Shkiah* during the equinox to 51 minutes during the summer solstice.[77] Using this *shiur*, the level of darkness at *Tzeit* fulfills the opinions that *Tzeit* is based on the emergence of three small-sized stars, and it includes extra time for *tosefet Shabbat*.

Many are still *machmir* for the 4 *millin* of Rabbeinu Tam. Since the Shulchan Aruch holds this way many choose to be stringent.[78] When people are *machmir* they usually hold a fixed 72 minutes after *Shkiah*, regardless of the time of year and place. It makes sense to follow the 72-minute *shiur* since it is based on an 18-minute *mil* and the Shulchan Aruch says that is the proper length of a *mil*.[79] Rav Moshe Feinstein also recommended waiting 72 minutes before ending Shabbat.[80]

Alot HaShachar

After *Tzeit HaKochavim*, the next *halachic zeman* is *Alot HaShachar* or *Amud HaShachar*. This is the first time in the day where light begins to fill up the sky and it is no longer complete darkness.[81] When *Alot* begins it is *halachically* considered the daytime.[82] It marks the beginning of the *halachic* day when *b'dieved* one is able to perform daytime *mitzvot* such as the *Shacharit tefillah*,[83] *megillah* reading on the morning of Purim,[84] and *shofar* blowing.[85]

As was mentioned, in *Pesachim* it states that the time between *Alot HaShachar* and *HaNeitz HaChama* is the same as the time between *Shkiah* and *Tzeit*. It is 4 *millin* according to

[77] https://www.myzmanim.com/read/sources.aspx
[78] Shulchan Aruch, Orach Chayim 261:2
[79] Shulchan Aruch, Orach Chayim 259:2
[80] Iggerot Moshe, Chelek 4, Siman 62, "V'lifi Zeh"
[81] Chizkuni and Seforno on Bereishit 32:25
[82] Megillah 20a-b
[83] Shulchan Aruch, Orach Chayim 89:1
[84] Shulchan Aruch, Orach Chayim 687:1
[85] Shulchan Aruch, Orach Chayim 588:1

Rav Yehudah and 5 *millin* according to Ullah.[86] Although there is a disagreement between Rabbeinu Tam and the Gra in regard to the time of *Tzeit*, they both agree regarding the time for *Alot*. The Gra understands there to be 4 *millin* from *Alot* to *HaNeitz*,[87] and Rabbeinu Tam holds it is either 4 or 5 *millin,* depending on how one understands him in regard to *Tzeit*. For Rabbeinu Tam, the distance between *Alot* and *HaNeitz* and S*hkiah* and *Tzeit* must be parallel because it is during this time that the sun is traveling within the *rakiya.* Since the thickness of the *rakiya* is the same on the eastern and western sides, the two *zemanim* must also parallel each other.

The three options for the interval of time between *Shkiah* and *Tzeit* for Rabbeinu Tam are identical here in the interval between *Alot* and *HaNeitz*. *Alot* can either be 72 minutes, 90 minutes, or 120 minutes before *HaNeitz*. These times as well are based on the average day, in *Nissan* and *Tishrei*, in Israel and Bavel.

Just as the time between *Shkiah* and *Tzeit* can be understood as varying based on one's location and time of year, so too the time between *Alot* and *HaNeitz* can be dependent on one's location and the time of year. Since it is dependent on the sun's location beneath the horizon, we can determine *Alot* the same way we did with *Tzeit*. All locations on the imaginary line that we can refer to as the *HaNeitz* line experience *HaNeitz* at the same time. At some time before *HaNeitz*, all locations the same distance from the *HaNeitz* line are experiencing *Alot* at the same time. We can call this the *Alot* line. The amount of time between *Alot* and *HaNeitz* is how long it takes to travel from a specific location on the *Alot* line to the *HaNeitz* lane.

The further a location is from the equator the longer it takes to travel from the *Alot* line to the *HaNeitz* line; thus, the interval of time between *Alot* and *HaNeitz* is longer. This is because, as we have previously mentioned, the earth moves fastest at the equator, and since the earth is a

[86] Pesachim 94a
[87] Biur HaGra on Shulchan Aruch, Orach Chayim 261:2

sphere, the route from the *Alot* line to the *HaNeitz* lane becomes curvier further away from the equator line. The time of year also affects how long is the interval between *Alot* and *HaNeitz*. This is because the tilt of the earth changes in relation to the sun throughout the year. In *Tammuz,* on the longest day of the year, *Alot* will occur the earliest, so the time from *Alot* to *HaNeitz* will be longest. On the equinox, the interval of time between *Alot* to *HaNeitz* will be the shortest. And on the winter solstice, the shortest day of the year, this interval of time will be in between that of the summer solstice and the equinox.

As we did for *Tzeit*, when we determine how far below the horizon the sun is at all these times, we can calculate how long before *HaNeitz* the sun reaches this angle in all locations and times of year. When the sun is at a certain position beneath the horizon, the sky is the same level of darkness, regardless of the time of year and location. At 72 minutes before *HaNeitz*, the sun is roughly 16.1 degrees below the horizon. At 90 minutes, it is approximately 19.75 degrees beneath the horizon. Lastly, at 120 minutes before the arrival of *HaNeitz*, the sun is about 25.9 degrees below the horizon. The two earlier *shiurim* for *Alot*, 19.75 degrees and 25.9 degrees, are difficult, since scientifically the sun is said to be dark until it is 18 degrees below the horizon.[88] This *shiur* of 18 degrees, the astronomical dawn, is the opinion of Rav Moshe Feinstein.[89]

While some hold that *Alot* is determined based on how many degrees the sun is below the horizon, others believe it is based on *shaot zmaniot.*[90] Therefore, *Alot* can be 72, 90, or 120 *zmaniot* minutes before *HaNeitz.* When the *halachic* day is longer, the time period between *Alot* and *HaNeitz* will also be longer.[91] The Rambam seems to hold that *Alot* is 72 *zmaniot* minutes

[88] https://www.timeanddate.com/astronomy/different-types-twilight.html
[89] This is what the MyZmanim App says under the explanations for the different *zemanim.* It does not provide a source, however, and I have not seen the source myself.
[90] Kaf HaChaim 18:18
[91] Recall how I mentioned that this should only work if one holds the *halachic* day is from *Alot* to *Tzeit.* If one holds the *halachic* day is from *HaNeitz* to *Shkiah* then seemingly the time between *Alot* and *HaNeitz* should be shorter on longer days.

before *HaNeitz*.[92] If *Alot* is 72 *zmaniot* minutes before *HaNeitz* then it will vary throughout the year from about 59 to 83 minutes before *HaNeitz.*

Others also hold that *Alot* is a fixed amount of time before *HaNeitz.* Therefore, *Alot* would be a fixed 72, 90, or 120 minutes before *HaNeitz* everyday regardless of the length of the day, the time of year, or one's location. Many *Poskim* hold that 4 *millin* is 72 minutes, and thus *Alot* is considered to be 72 minutes before *HaNeitz* every day.[93]

In Israel the minhag is to consider *Alot* as 19.75 degrees below the horizon, and in America, when calculating *Alot* according to degrees, it is usually when the sun is 16.1 degrees beneath the horizon.[94] In New York, this ranges from about 81 to 109 minutes before *HaNeitz*.

Misheyakir

In the Gemara in *Berachot*,[95] the Mishnah says the earliest time one can say *kriat shema shel Shacharit* is when one can distinguish between blue and white. The Gemara explains this to mean when one can distinguish between the blue and white wool strands on one's tzitzit. The Gemara then cites a *baraita* that gives three other possibilities for the earliest time of *kriat shema shel Shacharit.* Rabbi Meir says it is when one can distinguish between a wolf and a dog. Rabbi Akiva says it is when one can distinguish between a donkey and a wild donkey.[96] The Acheirim say it is when one can recognize his friend from four *amot* away. Rav Huna says we hold like the

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[92] Rambam on Mishnah Berachot 1:1
Rabbi Yehudah Levi in Zmanim K'Halacha page 42 explains that Rambam uses a unique Arabic word and it is incorrect to translate it as *zmaniot*. Rather, it means that it is referring to the average day, and thus *Alot* should be calculated based on the sun's position below the horizon.

[93] באר היטב אורח חיים סימן פט,
בן איש חי שנה ראשונה פרשת משפטים סימן ב,
שו"ת יחוה דעת חלק ב סימן ח

[94] https://he.wikipedia.org/wiki/%D7%A2%D7%9C%D7%95%D7%AA_%D7%94%D7%A9%D7%97%D7%A8

[95] Brachot 9b

[96] The language of the Gemara is "Arod" which Rashi explains to mean a wild donkey.

Acheirim, but Abaye adds that this is only regarding the earliest time to put *tefillin* on, for *kriat shema shel Shacharit,* however, one should wait to conclude it at *HaNeitz*.

The Shulchan Aruch understands there to be different definitions of *Misheyakir*, depending on which mitzvah one is performing. The earliest time one can don tzitzit is when he can distinguish between the blue and white strands.[97] The earliest time one can say *kriat shema shel Shacharit* is when one can recognize his friend 4 *amot* away.[98] In the Beit Yosef, however, the Shulchan Aruch explains that these two times, when one can distinguish between blue and white and when one can recognize his friend 4 *amot* away, are not different definitions of *Misheyakir*. Rather, they are referring to the same *shiur* and are identical.[99]

It is unclear whether *Misheyakir* is when one can actually differentiate between blue and white, or whether it is when there is technically enough sunlight for one to be able to distinguish between blue and white, even if clouds or other factors are hiding the sunlight, or magnifying it. On cloudy or rainy days, the sun is less visible in the sky, so it would be later until one can distinguish between the blue and white colors. If it is snowing, the sunlight is enhanced, and one can differentiate the colors earlier. The Kaf HaChaim mentions how on cloudy days in the winter *Misheyakir* would occur later. He says that *lechatchila* we should be waiting until the actual *zeman* where one can distinguish between blue and white.[100]

There is no specific calculation for the time of *Misheyakir* in the Gemara, *Rishonim*, or the Shulchan Aruch. The minhag in Yerushalayim considers *Misheyakir* to be 52 or 60 minutes before *HaNeitz*.[101] At this time on the average day, the sun is about 13.5 degrees below the

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[97] Shulchan Aruch, Orach Chayim 18:3
[98] Shulchan Aruch, Orach Chayim 58:1
[99] Beit Yosef, Orach Chayim 58:4
[100] Kaf HaChaim 18:19-20
He also mentions that in regard to *tefilin* it is fine to not be strict since the nighttime is the actual time for *tefillin,* and it is only an *issur derabanan* to wear them at night so we can be lenient.
[101] Rav Tukatzinski in Eretz Yisrael 1:4 (pg 18) says the minhag of the earlier *Sefardim Gaonim* is to consider *Misheyakir* as 60 minutes before *HaNeitz*

horizon. Most present day *zemanim* use a measurement for *Misheyakir* of 10-11.5 degrees below the horizon.[102] In New York, the 11-degree *shiur* ranges from 53 to 68 minutes for *HaNeitz*. Rav Moshe Feinstein states that according to his observations *Misheyakir* is about 35 to 40 minutes before *HaNeitz*.[103]

HaNeitz HaChama

HaNeitz HaChama, sunrise, marks the time where one can perform daytime mitzvot such as *megillah* and *millah.*[104] It is also the ideal time where *Shemoneh Esrei shel Shacharit* should take place.[105] This is based on the pasuk "They will fear You with the sun."[106] *HaNeitz* is the time when the tip of the sun appears above the horizon.[107] The Gemara also seems to consider *HaNeitz* to be the time of the reddening of the sun.[108]

Using today's technology, it is possible to calculate the time of *HaNeitz* to the exact second. Some people and *minyanim* even use atomic clocks to start *Shemoneh Esrei shel Shacharit* at the exact moment of sunrise. A variety of factors affect the exact time of *HaNeitz*, however, so perhaps it is not possible to even calculate the precise moment of *HaNeitz*. The time of *HaNeitz* is impacted by location, altitude, obstructions on the horizon, and refraction of light.

The first factor that affects the time of *HaNeitz* is location. The sun rises in the east, so the further east one is, the earlier sunrise will occur. In New York, every change of 1,155 feet

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This is also what the Kaf HaChaim says in 18:18
Nivreshet (vol 1, pg 47 the footnote) holds *Misheyakir* occurs 8 minutes before what the Divrei Yosef holds. The Divrei Yosef also holds 60 minutes, so the Nivreshet holds it is 52 minutes before. https://hebrewbooks.org/pdfpager.aspx?req=6213&st=&pgnum=108

[102] https://www.myzmanim.com/read/sources.aspx, see bottom chart for time of tzitzit and *tefillin*

[103] Iggerot Moshe Orach Chayim Chelek 4, Siman 6

[104] Mishnah on Megillah 20a
It mentions that if one performs mitzvot before *HaNeitz* but after *Alot*, one has still fulfilled his or her obligation.

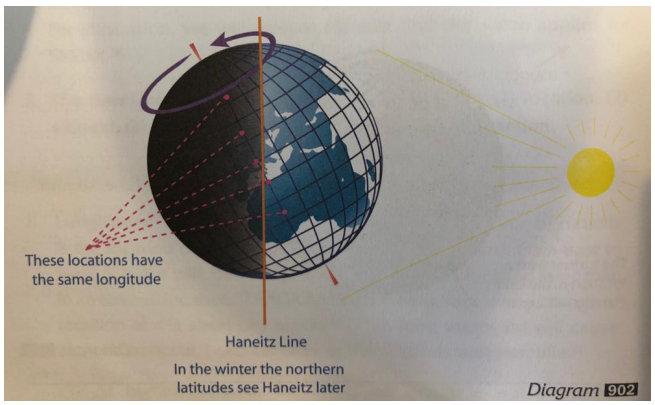
[105] Shulchan Aruch, Orach Chayim 89:1

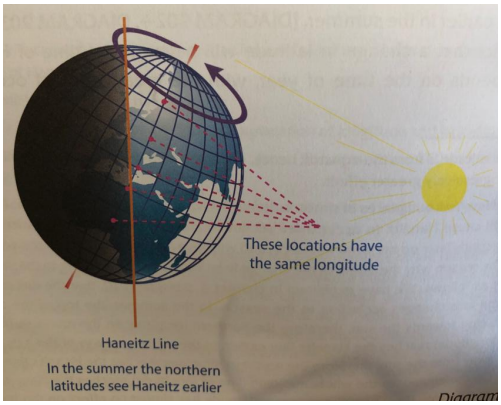
[106] Tehillim 72:5

[107] Maharal on Shabbat 35a - "Trei"

[108] Berachot 29b

(about .22 miles) westward will cause *HaNeitz* to occur 1 second later.[109] At higher latitudes, the change in longitude will have a greater effect since the circumference of the earth decreases. A change in latitude will also affect the arrival of *HaNeitz*, but not as drastically. Since the earth is tilted, the difference in latitude will either cause *HaNeitz* to be earlier or later, depending on the time of year. In the Northern Hemisphere, a more northern latitude will cause *HaNeitz* to be later in the winter and earlier in the summer.





[110]

Therefore, for one to calculate *HaNeitz* to the exact second, one must be calculating it for his or her exact location. A *zeman* given solely based on a zip code can be inaccurate for most parts of the area. With the technology we have today, luckily one is able to calculate *HaNeitz* to his or her precise location using his or her latitude and longitude coordinates. The MyZmanim app, a popular app many use to calculate *zemanim*, gives *zemanim* based on one's exact location.

The second factor that affects the accuracy of *HaNeitz* is altitude, or elevation. The ability for one to be able to see the sun rising is dependent on his or her altitude. A person at a higher altitude will see the sun earlier than a person at a lower altitude. Even if one is standing on sea-level, he or she would technically still see the sun earlier than what is measured at sea level since his or her eye level is higher than ground level.

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[109] This is because the sun moves 1.240 degrees of longitude every second. In New York, that is about 1,155 feet.
[110] Dvar Yom By Rabbi Braunfeld, page 188

The third factor affecting the time of *HaNeitz* is the height of the horizon. If there is something blocking the horizon, such as a mountain, the sun will appear to rise later than sunrise. It is important to determine whether mountains should be included when calculating *HaNeitz*. If mountains or trees are included, then *HaNeitz* will be determined when the sun rises over the mountains or trees. If obstructions are not included, then *HaNeitz* will be calculated as the time the sun rises over the horizon.

In the Gemara in *Yoma* it states that Helene HaMalka put a gold chandelier in the Beit Hamikdash.[111] When the sun rose it would shine and reflect on the chandelier so everyone would know it is time for *kriat shema shel Shacharit.* Har HaZeitim is to the east of the Beit Hamikdash; therefore, the sun would not shine on the chandelier until it rose over that mountain. One can imply from this Gemara that *HaNeitz* is determined by when it rises over the mountains. Therefore, mountains or anything blocking the sun would be included when calculating *HaNeitz*.

Additionally, in the Gemara Yerushalmi[112] it defines *HaNeitz* as the time the sun rises above the mountains (שתהא החמה מטפטפת על ראשי ההרים). This also makes it seem like *HaNeitz* is based on when the sun rises above the mountains.

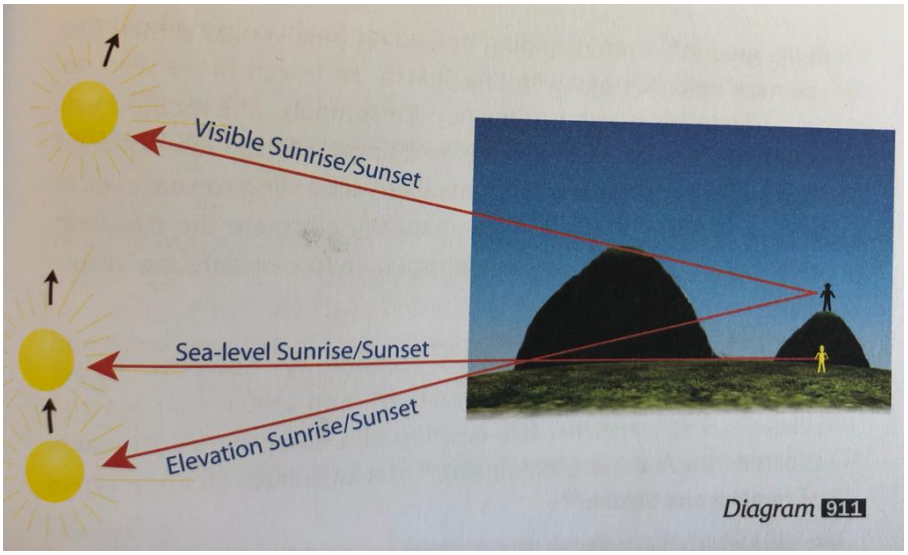
A question that results from discussing different altitudes and heights of the horizon is whether there is a specific time the whole city relies on. If one lives in a city with many mountains and varying altitudes, is every location using the same time for *HaNeitz*, or is it based on one's exact location? It is based on when the first location is able to see the sun rising, even if it may not have risen in other areas of the city?

Rav Moshe Nechemya Kohanov uses the Gemara in *Yoma* as a proof that *HaNeitz* for the whole city is determined by the first location seeing the sun rising.[113] Since everyone in the city

[111] Yoma 37b
[112] Talmud Yerushalmi Brachot 7b
[113] Netivot Hashalom Hilchot Kriat Shema (end of Chelek Aleph) 11

of Yerushalayim would rely on the reflection of the sun on the chandelier to start saying *kriat shema shel Shacharit* despite them being at a lower altitude, it is clear that *HaNeitz* is determined by the highest point within the city.[114] One may disprove this proof, however, since one is supposed to finish *kriat shema shel Shacharit* right before *HaNeitz*. Therefore, those at lower altitudes can say *kriat shema shel Shacharit* right before sunrise, and then start *Shemoneh Esrei shel Shacharit* afterwards when presumably it is *HaNeitz* for them.

There are therefore three ways to determine *HaNeitz* based on altitude and height from the horizon. The first approach is that *HaNeitz* is based on the height of the ground and excludes obstructions on the horizon.[115] This will be referred to as elevation sunrise. Another approach is that *HaNeitz* is based on the height of the ground and includes obstructions on the horizon. This is commonly referred to as visible sunrise. The last approach is that *HaNeitz* is measured as if the individual is at sea-level, looking at a sea-level horizon. We will refer to this as sea-level sunrise.



[116]

[114] Abaye says the reflection is for the people of Yerushalayim to say *kriat Shema*.
[115] This is referred to as astronomical sunrise by Rav Chaim Keller who created the Chai Tables which calculate *zemanim* for places all around the world.
http://www.chaitables.com/DblHallpaperpub.pdf
[116] Dvar Yom by Rabbi Braunfeld, page 201

Some calendars use sea-level sunrise to determine *HaNeitz*. This calculation is used since it is obtained from naval observatories, which measure sunrise according to sea-level. Rav Herschel Schachter says that sunrise is based on the naval observatory and adds that one should still take his or her elevation and surrounding mountains into consideration.[117] MyZmanim calculates *HaNeitz* based on level region. This means that the times are calculated assuming that one is at the same height as his or her horizon, whether or not this is the reality of the situation. It mentions, however, that if one is elevated above the eastern horizon, the time of sunrise is earlier. On its website one is able to put in his or her elevation above sea-level in respect to the western and eastern horizons above sea level to recalculate the times more accurately.[118]

The fourth factor that may affect the time of *HaNeitz* is refraction. Refraction is the phenomenon that when the sun appears to be on the horizon, it is actually not there. In fact, it is below the horizon. Since the sun's rays bend downwards as it travels, an observer can see the sun even though it is already beneath the horizon. Since *HaNeitz* is determined by when the sun appears on the horizon, it is necessary to determine how much the rays are bending. If the rays are bending more, the observer will still be able to see the sun when it is further below the horizon. The amount the rays bend depends on the density of the atmosphere which depends on the atmospheric pressure and temperature. The higher the density of the atmosphere, the more the rays bend. Since warm air is less dense than cool air, cooler air will cause the rays to bend more. Additionally, air with a lower atmospheric pressure is less dense than air with a higher pressure; thus, a higher atmospheric pressure will also cause the rays to bend more. When there is cooler air and a higher pressure, the rays will bend more which will cause *HaNeitz* to be earlier.

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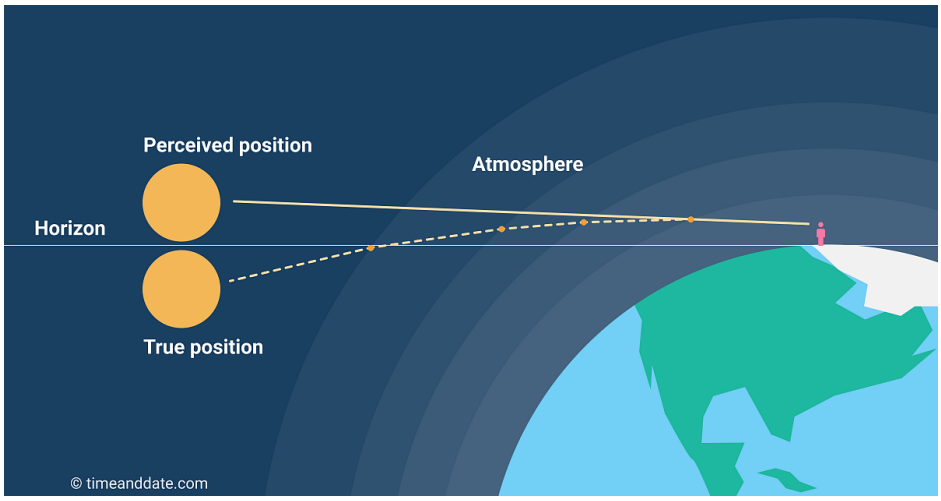
[117] YUTorah Online - Shiur on Zmanim in Halacha (Rabbi Hershel Schachter) minutes 69-77
[118] https://www.myzmanim.com/elevation.aspx?vars=US07666/4-19-2021/elab///////////////e389c1



Since temperature and atmospheric pressure are unpredictable, one cannot calculate the exact time of *HaNeitz*. It is good to assume that most times are not accurate to the exact second since the temperature and pressure were not considered. This is important when one is performing daytime mitzvot such as davening *Shemoneh Esrei shel Shacharit.* If one recites it before *HaNeitz*, he is only fulfilling his obligation *b'dieved.*

Chatzot

The time of *Chatzot* has *halachic* ramifications. It is the latest time one may daven *Shemoneh Esrei shel Shacharit,*[119] the earliest time from which one can no longer perform *melacha* on *Erev Pesach,*[120] and is the earliest time one no longer needs to sit on the ground on *Tisha B'av.*[121]

In the Gemara in *Pesachim* it states that in the 6th hour, which is *Chatzot,*[122] the sun is in the middle of the sky; it is between the eastern and western horizons.[123] It is therefore difficult at this time to tell which direction the sun is going in, and one could be confused between the 6th

[119] Rama, Orach Chayim, 89:1
[120] Shulchan Aruch, Orach Chayim 468:1
[121] Aruch HaShulchan, Orach Chayim 559:4
[122] Rashi on Brachot 3b - "שית דליליא"
[123] Pesachim 12b

and 7th hour. This time is called the solar noon; it is when the sun passes its location's meridian and reaches its highest position in the sky.[124] Every location on the same meridian experiences solar noon at the same time. Therefore, solar noon is based only on one's longitude,[125] not latitude.[126]

Seemingly, *Chatzot* should be at the same time every day since the length of a day is 24 hours. Since the sun orbits 24 hours every day, if the sun is at the midpoint position at 12 o'clock one day, it should be in that same position 24 hours later. In reality, however, a day is exactly 24 hours only four times throughout the year. Since a day is usually not 24 hours, from one *Chatzot* to the next it will be either slightly longer or shorter than 24 hours.

The Gemara states that the sun is in the middle of the sky in the 6th hour. This calculation presumably should be based on *shaot zemaniot* since all *zemanim* throughout the day are based on *shaot zemaniot.* We mentioned how there are two different opinions regarding how to calculate the *halachic* daytime hour. If the day starts at *HaNeitz* and ends at *Tzeit,* then at the 6th *halachic* hour, the sun will be in the middle of the sky. If, however, one calculates the daytime hours from *Alot* to *Tzeit,* assuming we are not holding like Rabbeinu Tam,[127] since there is more time between *Alot* and *HaNeitz* than between *Shkiah* and *Tzeit*, the sky will not be in the middle of the sky at the 6th hour.

Rav Moshe Feinstein's approach regarding *Chatzot* and *shaot zemaniot* solves this issue.[128] He says that the sun is in the middle of the sky every day at 12 o'clock noon.[129] Since the Gemara says the sun is in the middle of the sky at six *halachic* hours, it must be that the two

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[124] The meridian is an imaginary line running from the North pole to the South pole. https://www.timeanddate.com/astronomy/solar-noon.html
[125] The imaginary line running north to south that describes one's location.
[126] The imaginary line running west to east that describes one's location.
[127] That the time between *Alot* and *HaNeitz* is the same as the time between *Shkiah* and *Tzeit.*
[128] Iggerot Moshe Chelek Aleph, Siman 24
[129] In NY, solar noon is 11:56 am .

halves of the day are not the same. Rav Moshe Feinstein therefore maintains that the six morning *halachic* hours are calculated by dividing the time between *HaNeitz* and 12:00 into 6 parts, with each part being a *halachic* hour. The second part of the day, the six afternoon hours, are determined by dividing the time from 12:00 to *Shkiah* into 6 parts, with each part being a *halachic* hour. Therefore, the morning hours will usually be a different length than the afternoon hours.

Most calendars today calculate *Chatzot* using the *shaot zmaniot* based on a daytime from *HaNeitz* to *Shkiah.* This also solves the issue and ensures that the sun is in the middle of the sky at the 6th hour.

Shkiat HaChamah

Shkiat HaChamah, sunset, occurs when the sun completely sets and goes beneath the horizon.[130] At this time the day has technically ended, and one can no longer perform daytime mitzvot such as *tefillat Mincha.*[131] The calculation for this time is very similar to the calculation for *HaNeitz*. The same four factors that affect our ability to precisely measure the time of *HaNeitz* also hinders our ability to accurately calculate *Shkiah*.

Longitude and latitude affect the arrival of *Shkiah* similarly to *HaNeitz*. In terms of longitude, it affects *Shkiah* identically as it does *HaNeitz*. Every .22 miles westward in New York will cause *Shkiah* to occur 1 second later. Latitude affects *Shkiah* reversely to the way it affects *HaNeitz*. A more northern latitude that causes *HaNeitz* to be later in the winter and earlier in the summer, will cause *Shkiah* to be earlier in the winter and later in the summer.

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[130] Maharal on Shabbat 35a - "Trei"
Even though we discussed how according to Rabbeinu Tam there are two sunsets, he agrees that שקיעת החמה is when the sun sets and enters into the *rakiya*. He just believes that it is still *vadai yom* at this point so one can still perform daytime *mitzvot.*

[131] Iggerot Moshe Chelek Aleph, Siman 24

Altitude also affects one's ability to precisely identify *Shkiah*. It affects *Shkiah* similarly to the way it affects *HaNeitz*, but in reverse. If someone is at a higher altitude than sea level, he will see the sun set at a later time.

In the Gemara in *Shabbat*, Rabbi Yosi praises those who accept Shabbat in Tiveria, where it is a valley so it gets darker faster, and those who end Shabbat in Tzippori, which is on a mountain top so the sun is seen for longer and they end Shabbat later.[132] Since in these two places the residents either start Shabbat earlier than other places or end Shabbat later than everyone else, Rabbi Yosi is praising them. It appears based on this Gemara that the people in Tiveria and Tzippori were going above and beyond by extending Shabbat when they did not actually have to go above the letter of the law. Seemingly, *Shkiah* occurs at the time the sun sets at sea-level, regardless of where one is residing. Even though the people in Tiveria and Tzippori were at different elevation levels than sea-level, they were still allowed to start, or end Shabbat based on the sun setting at sea-level. Others, however, do not understand the Gemara this way. They assume that Rabbi Yosi is not referring to *Shkiah*, but rather *Tzeit*. This is implied by Rashi who says that at the time the sun was setting there appeared to be a lot of light.[133] He does not mention that they saw the sun, only that they saw a lot of light. Thus, if one's location is at a different elevation, that should be accounted for when calculating *Shkiah*.

The third factor affecting the *zeman* of *Shkiah* is obstructions on the horizon. The mountains or trees hindering one's ability to see the horizon line can also influence the time of *Shkiah*. In the Gemara in *Shabbat,* it mentions how Rava told his servant to light the Shabbat candles when the sun is on top of the trees.[134] When it is a cloudy day, if he is in the city, he should look at the roosters, since while it is still daylight they sit on roofs. If he is in the field, he

[132] Shabbat 118b
[133] Rashi Shabbat 118b- "Mimachnisei"
[134] Shabbat 35b

should look at the ravens, since they gather in the fields while it is still day. Alternatively, he can look at the leaves of the *adanei* (wild gourds). Their leaves bend to face the sun throughout the day, so one can tell if it is still day by looking at their leaves.[135] Rava is giving his servant different indicators to let him know when the day is almost ending and evening is soon approaching. Just like the roosters and ravens will fly away the second the day ends, so too this Gemara seems to imply that when the sun sinks below the trees, it is considered *Shkiah* and the end of the day. Thus, obstructions on the horizon will play a role in calculating the *zeman* of *Shkiah.*

One, however, can use the other Gemara in *Shabbat*[136] as proof that mountains are not included when determining *Shkiah*. Since Rabbi Yosi praises the residents of Tiveria, a location where the sun is blocked by mountains, for starting Shabbat early, clearly by the letter of the law they did not need to be starting Shabbat at that time. Therefore, trees or mountains blocking the sun can be excluded when determining the time for *Shkiah*. R' Moshe Feinstein cites this proof and holds that one need not include mountains when calculating *Shkiah*.[137] The Ben Ish Chai, however, says that *Shkiah* is based on when one can no longer see the sun.[138] He does not specifically mention the case where mountains or trees block the sun but it seems like he would consider that as part of determining *Shkiah* since one can no longer see the sun.

A similar question regarding varying heights within a certain city can be applied equally to the case of *Shkiah*. The Ben Ish Chai states that the highest place in the city determines when *Shkiah* is.[139] Since it sees *Shkiah* last, the entire city experiences *Shkiah* along with it.

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[135] Rashi on Shabbat 35b - "Adainei"
[136] Shabbat 118b
[137] Iggerot Moshe Chelek Aleph, Siman 97
[138] Ben Ish Chai, Shana Aleph, Parshat Vayakhel 9
[139] Ibid.

The three possible approaches to determine *Shkiah* are identical to the approaches for *HaNeitz*. The elevation sunset approach is that *Shkiah* is based on the height of the ground excluding any obstructions on the horizon. The second approach, visible sunset, is that *Shkiah* is determined based on the height of the ground including obstructions on the horizon. The last approach is that *Shkiah* is measured as though the observer is standing at sea-level and looking at a sea-level horizon.

Rav Herschel Schachter says similarly regarding *Shkiah* that it is based on the naval observatory.[140] MyZmanim calculates *Shkiah* based on one's level region just as it does *HaNeitz*.

The fourth factor affecting the time of *Shkiah* is refraction. As we mentioned, when an observer sees the sun on the horizon it is in fact below the horizon. Cooler temperatures and higher atmospheric pressures will cause the sun's rays to bend more causing *Shkiah* to be later. Since we are unable to take these into account because they are unpredictable, we cannot calculate the exact time for *Shkiah*. One should take all these factors into consideration when relying on the *zemanim* listed in calendars.

Conclusion

Zemanim play a critical role in the life of a *Torah* Jew. Many plan their whole days based on when it is the proper time to perform time-bound *mitzvot* such as *tefillah*. To fully understand the reasons and explanations for all the different *zemanim* used throughout the day allows one to see how important it is to be careful about these times and perform the *mitzvot* in the most appropriate way. It is a privilege to realize just how important every second truly is; it can be the difference between doing a completely permissible act, or violating an *issur deorayta.* I hope the

[140] YUTorah Online - Shiur on Zmanim in Halacha (Rabbi Hershel Schachter) minutes 69-72

reader now realizes how valuable his or her time is and tries to utilize every moment to properly serve Hashem and do His *mitzvot.*