The constellation Scorpio – מזלות ערב

Stars of Scorpio against the background of the Milky Way, which the Sages called the River of Fire.

Scorpio and Ursa Major – מזלות ערב: בורא עולמים: The map below presents the view of the night sky in July from the latitude of Jerusalem. Only the stars used by the Sages are displayed, because these are the ones utilized to determine the directions of the compass. The Ursa constellations, also known as the Great and Minor Bears, are always to the north. The North Star, at the edge of Ursa Major, marks the direction of due north, with only a very slight deviation. The situation is less straightforward with regard to the constellation Scorpio, since there are months it is not visible, and it does not always face exactly the same direction. In general, this constellation can be seen only in the summer months. Whenever it is visible it appears in the direction of south, but not due south. It is likely that these changes in the position of the Scorpio are among the factors that make it difficult to determine the directions of the compass according to the position of the stars. It should be noted that in the talmudic period the North Star was not due north; rather, due north was closer to the stars of Ursa Major.

If one does not know how to square the city – מזלות ערב: בורא עולמים When squaring a city in alignment with the directions of the world, the best method is to follow the stars, which provide an exact determination of the directions. Calculations based on the circuit of the sun are inexact (Ritva).

The sun and the directions – מזלות ערב: בורא עולמים. A slightly different and far simpler method to determine directions is offered in the Jerusalem Talmud. One notes the location of the sun at sunrise on the shortest day of the year, the winter solstice, and on the longest day of the year, the summer solstice. The midpoint between these locations is due east. The midpoint between the locations of the sun during sunset on these days is due west.

The Gemara asks: Isn’t it taught in a different baraita: If radish has been seen, an elixir of life has been seen? The Gemara answers: This is not difficult. Here, in the baraita that deprecates radish, it is referring to its leaves; there, in the baraita that praises radish, it is referring to the roots. Alternatively, here it is referring to the summer, when radish is beneficial; there, it is referring to the winter, when it is harmful.

On the topic of the attributes of different locations, Rav Yehuda also said that Rav said: In any city that has many ascents and descents, which can be taxing to the body, people and animals die at half their days, meaning half of their life expectancy. The Gemara expresses surprise: Can it enter your mind that Rav really meant to say that they die prematurely? Even in such cities they are known to have a regular life expectancy. Rather, say: They grow old at half their days, i.e., they age prematurely due to the strain of climbing up and down the inclines. Similarly, Rav Huna, son of Rav Yehoshua, said: The ascents and descents between Beit Biri and Beit Neresh, my place of residence, made me grow old prematurely.

With regard to the measurements of a city’s boundaries, the Sages taught the following baraita: If, in order to measure the Shabbat limit, one comes to square a city, i.e., to extend the city’s boundaries to include all of its protrusions within an imaginary square, he squares it so that the sides of the square align with the four directions of the world. He sets the northern side of the square to align with the north of the world, and its southern side to align with the south of the world. And your sign by which you can recognize the directions of the world is as follows: The constellation of Ursa Major is in the north and Scorpio in the south. The directions of the city are determined by these constellations.

Rabbi Yosei says: If one does not know how to square the city in alignment with the four directions of the world based upon the constellations, he should square it based upon the seasons, although this is less precise. How so? Where the sun rises and sets on the longest day of the year, the summer solstice, this route of the sun is the face of the north. The sun rises in the northeast and sets in the northwest, and thus travels from east to west across the north side of the world. Conversely, where the sun rises and sets on the shortest day of the year, the winter solstice, this route of the sun is the face of the south. Whereas at the vernal equinox and the autumnal equinox, when day and night are equal in length, the sun rises in the middle of the east and sets in the middle of the west.
The circuit of the sun – the north on the longest and shortest days. With regard to the extent of its tilt, the calculation of the seasons cited here is in accordance with Shmuel's opinion that the solar year consists of exactly 365 days and six hours. The intercalation of the year, however, follows the opinion of Rav Adda, who calculated the solar year as a few moments shorter than that. According to Rav Adda, the calculations of the seasons offered here are incorrect.

On the topic of the previous discussion with regard to calculating the directions of the world based upon the seasons, Shmuel said: The vernal equinox occurs only at the beginning of one of the four quarters of a day: Either precisely at the beginning of the day, or precisely at the beginning of the night, or at midnight, or at noontime.

Similarly, the summer solstice occurs only at certain times of the day: Either at the conclusion of one and a half hours or seven and a half hours of the day or night. And the autumnal equinox occurs only at certain times: Either at the conclusion of three hours or nine hours of the day or night. And the winter solstice occurs only at certain times: Either at the conclusion of four and a half hours or ten and a half hours of the day or night.

And all this is based on the principle that there are only ninety-one days and seven and a half hours between the beginning of one season and the next, as he assumed that a year is exactly 365¼ days. And similarly, each season begins precisely one-half planetary hour past the beginning of the previous season. There are seven heavenly bodies that are each ascendant for an hour at a time in a constant rotation: Mercury, Moon, Saturn, Jupiter, Mars, the Sun, and Venus. Each season begins half an hour later in this rotation than the previous season.

### Day

<table>
<thead>
<tr>
<th>Day</th>
<th>Sunrise</th>
<th>Sunset</th>
</tr>
</thead>
<tbody>
<tr>
<td>Autumnal equinox (September 23)</td>
<td>Easternmost point</td>
<td>Westernmost point</td>
</tr>
<tr>
<td>Shortest day (winter solstice; December 22)</td>
<td>27° 55 south of east</td>
<td>27° 55 south of west</td>
</tr>
<tr>
<td>Vernal equinox (March 21)</td>
<td>Easternmost point</td>
<td>Westernmost point</td>
</tr>
<tr>
<td>Longest day (summer solstice; June 22)</td>
<td>27° 55 north of east</td>
<td>27° 55 north of west</td>
</tr>
</tbody>
</table>

NOTES

The calculation of the seasons – The calculation of the seasons cited here is in accordance with Shmuel's opinion that the solar year consists of exactly 365 days and six hours. The intercalation of the year, however, follows the opinion of Rav Adda, who calculated the solar year as a few moments shorter than that. According to Rav Adda, the calculations of the seasons offered here are incorrect.

### BACKGROUND

The circuit of the sun – The center of the sun is not on the same plane as the equator; rather, the earth’s axis is tilted in relation to it (this is known by astronomers as the obliquity of the ecliptic). Therefore, the seasons differ from one another both in the lengths of their respective days and nights and in the location of the rising sun. The earth's tilt changes every day. On the days mentioned, the sun never rises from the exact northeastern corner or sets precisely in the northwestern corner of the sky, but rather does so near the exact corner. Therefore, according to this explanation, one should not rely upon these signs (Me’iri).

Rav Mesharshiya said: There is no validity to these rules established by Rabbi Yosei, as it was taught in a baraita: ‘The sun has never risen, even during the summer, at the northeastern corner of the sky and set in the northwestern corner, nor has the sun ever risen, even during the winter, at the southwestern corner and set in the southwestern corner. Therefore, one can establish the directions of the world according to the sun’s path only during the autumn and spring.

As it is stated: “One generation passes away and another generation comes; but the earth abides forever. The sun also rises and the sun goes down, and hastens to its place, where it rises again. It goes toward the south, and turns about to the north; round and round goes the wind, and on its circuits the wind returns” (Ecclesiastes 1:4–6). The verse is understood as describing the sun’s movements, as follows: “It goes toward the south” during the day; “and turns about to the north,” on the other side of the earth, at night. "Round and round goes the wind [*ruah*]:” the word *ruah* can also mean direction or side. Rabbi Yosei explains that these are the face of the east and the face of the west; sometimes the sun traverses them visibly, and sometimes it turns about them without being seen.

On the topic of the previous discussion with regard to calculating the directions of the world based upon the seasons, Shmuel said: The vernal equinox occurs only at the beginning of one of the four quarters of a day: Either precisely at the beginning of the day, or precisely at the beginning of the night, or at midnight, or at noontime.

Similarly, the summer solstice occurs only at certain times of the day: Either at the conclusion of one and a half hours or seven and a half hours of the day or night. And the autumnal equinox occurs only at certain times: Either at the conclusion of three hours or nine hours of the day or night. And the winter solstice occurs only at certain times: Either at the conclusion of four and a half hours or ten and a half hours of the day or night.

And all this is based on the principle that there are only ninety-one days and seven and a half hours between the beginning of one season and the next, as he assumed that a year is exactly 365¼ days. And similarly, each season begins precisely one-half planetary hour past the beginning of the previous season. There are seven heavenly bodies that are each ascendant for an hour at a time in a constant rotation: Mercury, Moon, Saturn, Jupiter, Mars, the Sun, and Venus. Each season begins half an hour later in this rotation than the previous season.
Talmud. One notes the location of the sun at sunrise on the shortest day of the year. The sun and the directions –

The constellation Scorpio –

מַזָל עַרְבּ

He squares it in alignment with the four directions of the world –

It goes toward the south –

If one does not know how to square the city –

בָּשׁוּם אָלֶף מֵחוֹזֶר אֶת מְרַבְּעָרְבּ

The calculation of the seasons –

לֵיתְרוּ לְרָיֵכְלַיִם

the year, however, follows the opinion of Rav Adda, who calculated the seasons cited here is in accordance with Shmuel's opinion that the calculation of its Shabbat limit, is squared in alignment with the directions.

Whenever it is visible it appears in the direction of south, but not due north. The sun never sets in the southeastern or southwestern corners (i.e., 45º from the north). The situation is less straightforward with respect to the rising of the sun during winter. The moon rises from the exact northeastern corner or sets precisely in the north at any hour of day or night. The sun indeed rises and sets toward the south and toward the north on the longest and shortest days. With regard to the extent of its tilt, the center of the sun is not on the north pole. Consequently, after squaring the city, he adds additional squares of two thousand cubits to each of its sides.

The Sages taught: One who squares a city in order to determine its Shabbat limit renders it like a square tablet, and then he also squares the Shabbat boundaries and renders them like a square tablet. Consequently, after squaring the city, he adds additional squares of two thousand cubits to each of its sides.

And when he measures the Shabbat limit, he should not measure the two thousand cubits diagonally from the middle of each corner of the city, because if he were to do so, he would lose the corners, i.e., the limit would extend only two thousand cubits on the diagonal from each of the corners. Rather, he measures the boundary as though he brought a square tablet that is two thousand cubits by two thousand cubits, and places it at each corner at its diagonal.

As a result, it will be found that the city gains four hundred cubits in this corner and another four hundred cubits in the opposite corner. Assuming that the city itself is round and has a diameter of two thousand cubits, as will be explained below, when the borders of the city are squared, approximately four thousand cubits are added to the city at each corner. When one then squares the Shabbat boundaries, it is found that the Shabbat boundaries gain eight hundred cubits in this corner and eight hundred cubits in the opposite corner. Consequently, by squaring both the city itself and its Shabbat boundaries, it is found that the city and the Shabbat boundaries together gain 1,200 cubits in this corner and 1,200 cubits in the opposite corner.

The circuit of the sun –

Sun, Venus, Mercury, Moon, Saturn, Jupiter, and Mars.

Saturn, Jupiter, and Mars. The table below lists the heavenly bodies for each day of the week:

<table>
<thead>
<tr>
<th>Day</th>
<th>Sunday</th>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
<th>Shabbat</th>
</tr>
</thead>
<tbody>
<tr>
<td>First</td>
<td>Mercury</td>
<td>Jupiter</td>
<td>Venus</td>
<td>Saturn</td>
<td>Mars</td>
<td>Moon</td>
<td>Mars</td>
</tr>
<tr>
<td>Sunrise</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Three</td>
<td>Saturn</td>
<td>Sun</td>
<td>Moon</td>
<td>Mars</td>
<td>Mercury</td>
<td>Jupiter</td>
<td>Venus</td>
</tr>
<tr>
<td>Hours</td>
<td>Venus</td>
<td>Mercury</td>
<td>Jupiter</td>
<td>Venus</td>
<td>Mars</td>
<td>Moon</td>
<td>Mars</td>
</tr>
<tr>
<td>Moonrise</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</tbody>
</table>

And Shmuel said: There is no instance when the vernal equinox occurs in the planetary hour of Jupiter and it does not break the trees with its strong winds; and there is no instance when the winter solstice occurs in the planetary hour of Jupiter and it does not dry up the seeds. And this applies only where the new moon appeared either at the hour of the Moon or at the hour of Jupiter.

The Sages taught: One who squares a city in order to determine its Shabbat limit renders it like a square tablet, and then he also squares the Shabbat boundaries and renders them like a square tablet. Consequently, after squaring the city, he adds additional squares of two thousand cubits to each of its sides.

And when he measures the Shabbat limit, he should not measure the two thousand cubits diagonally from the middle of each corner of the city, because if he were to do so, he would lose the corners, i.e., the limit would extend only two thousand cubits on the diagonal from each of the corners. Rather, he measures the boundary as though he brought a square tablet that is two thousand cubits by two thousand cubits, and places it at each corner at its diagonal.

As a result, it will be found that the city gains four hundred cubits in this corner and another four hundred cubits in the opposite corner. Assuming that the city itself is round and has a diameter of two thousand cubits, as will be explained below, when the borders of the city are squared, approximately four thousand cubits are added to the city at each corner. When one then squares the Shabbat boundaries, it is found that the Shabbat boundaries gain eight hundred cubits in this corner and eight hundred cubits in the opposite corner. Consequently, by squaring both the city itself and its Shabbat boundaries, it is found that the city and the Shabbat boundaries together gain 1,200 cubits in this corner and 1,200 cubits in the opposite corner.

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The Gemara asks: According to this calculation, how is the open space found to be one quarter of the area? It is more than one-third. The entire area of the extended boundary is thirty-two million square cubits, and the open space occupies twelve million square cubits, which is more than one-third of the total area of the extended boundary.

The Gemara answers: Do you think that this halakha was stated with regard to a square city? It was in fact stated with regard to a round city. The open space beyond the city is also round; however, the total extended boundary is square, so that the total area of a round city with a diameter of two thousand cubits and its extended boundary is thirty-six million square cubits.

The Gemara explains the calculation: How much larger is the area of a square than the area of the circle? One quarter. Subtract one quarter from the twelve million square cubits of open space, and nine million square cubits are left; and nine is precisely one quarter of thirty-six.
Abaye said: You will also find that the open space is one quarter of the total area in a city that is a thousand cubits by a thousand cubits. How many cubits is the extended boundary of the city without the corners? It is eight million square cubits. Additional areas are appended along each side of the city and extending two thousand cubits beyond the city itself. Each of these areas is two thousand cubits by one thousand cubits, for a total area of two million square cubits. Since there are four of these zones, their total area is eight million square cubits. How many cubits are the corners? They are sixteen million square cubits, as squares of two thousand cubits by two thousand cubits are added to each of the four corners.