

New Heavens and a New Earth

The Jewish Reception of Copernican Thought

JEREMY BROWN

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The Talmudic View of the Universe

A discussion of Jewish attitudes toward just about anything begins with the Bible and the Talmud. Biblical commentators, rabbinic leaders, and *halakhic* (Jewish legal) authorities all built upon a talmudic foundation, and even when the traditional Jewish world opened itself up to secular culture, it was the Talmud that was often the starting point for debates regarding the place of Judaism in the modern world. The Talmud, however, is not a monolithic text, but rather the record of hundreds of legal and ethical debates involving dozens of rabbis over at least five hundred years.¹ To speak then of *the* talmudic view of anything is to gloss over the fact that it is the views of individual rabbis that are being described. This is important to remember as we attempt to distill a talmudic cosmology, which will in the end be a reflection of the cosmologies of but a few rabbinic figures. This cosmology addressed all of the issues that were of concern to others who considered the natural world: What is the nature and shape of the Earth, and on what does it rest? What is the path of the Sun through both the day-night-day cycle and over the year, and how are the movements of the stars to be understood? Only when we have studied how these questions were answered in the Talmud can we compare them with the perspectives of other existing cosmologies.

The Shape of the Earth

To the naked eye, the terrain of the Earth varies quite distinctly; in some places it is fairly flat, while in others it is mountainous and irregular. Standing and looking out over the sea, the water appears perfectly smooth and continues as far as the eye could see. What is beyond that was often unknown in the ancient world, and what supported the Earth itself could only be ascertained from reading the Bible. Of the few sages whose cosmology is known to us, one of the most important was Rabbi Yose ben Halafta. Born in Lower Galilee some time in the middle of the second century, Rabbi Yose was a student of the famous

Rabbi Akiva, and he went on to establish a rabbinic court in his hometown of Zippori (Sepphoris). Although most of his teachings were legal in nature, he also addressed the geographic locations of both the Earth and God in the universe:

Alas for people that they see but know not what they see, that stand but know not on what they stand. What does the Earth rest on? On the pillars (for it is said: “Who shakes the Earth out of her place, and whose pillars tremble” [Job 9:6]). The pillars stand upon the waters (for it is said: “To Him that spreads the Earth above the waters” [Ps. 136:6]). The waters stand upon the mountains (for it is said: “The waters stood above the mountains” [Ps. 104:6]). The mountains stand on the wind (for it is said: “For, lo, He who forms the mountains, and creates the wind” [Amos 4:13]). The wind is upon the storm (for it is said: “The wind, the storm does its bidding” [Ps. 148:8]). The storm is suspended from the arm of the Holy One, blessed be He (for it is said: “And underneath are the everlasting arms” [Deut. 33:27]).²

It is of course entirely reasonable to suggest a metaphoric explanation for this cosmology and to suggest that this talmudic discussion not be taken literally.³ This approach would seem to be supported by an opposing cosmology suggested by those who take issue with Rabbi Yose’s picture:

But the Sages say: The world rests on twelve pillars (for it is said: “He set the borders to the peoples according to the number of the tribes of the children of Israel” [Deut. 32:8]). And some say seven pillars (for it is said: “She has hewn out her seven pillars” [Prov. 9:1]). R. Eleazar ben Shammua says: The world rests on one pillar, and its name is ‘Righteous’ (for it is said: “But ‘Righteousness’ is the foundation of the world.” [Prov. 10:25]).⁴

This single pillar suggested by Rabbi Eleazar certainly seems to be metaphoric rather than literal, given the context of the surrounding verses of the Book of Proverbs from which it is taken.⁵ A metaphorical understanding, however, does not fit in with the rest of the discussion. For, having established what lies beneath the Earth, the Talmud then addresses the nature of the skies above it and records the precise order and number of layers of the heavens. This technical discussion is generally not understood as being merely a metaphor. For example, it is this passage that is used by Maimonides to establish his own cosmology.⁶ In light of this, it is reasonable to assume that Rabbi Yose’s claim that the Earth rests on pillars that are supported by God is his description of reality.

Whether it stood on seven pillars or only one, the Earth was considered by the sages of the Talmud to be flat. As recorded in the Jerusalem Talmud, people lived on this flat Earth completely surrounded by water:

R. Yonah said: When Alexander the Macedonian wanted to go back he flew higher and higher until he saw the Earth as a ball and the sea as a plate.⁷

Another talmudic sage, Rabbi Natan, noted that the stars do not seem to change in their positions overhead when walking far distances. The assumption underlying his explanation for this observation was that the Earth is flat.⁸ Covering this flat Earth was an opaque cap referred to as the *rakia*, which is most commonly translated as the sky or firmament. Rava, a fourth-century Babylonian sage who lived on the banks of the river Tigris, determined this cap to be 1,000 *parsa* in width, while Rabbi Yehudah thought that he had overestimated this thickness.⁹ There were others who added to the picture of the sky; Resh Lakish announced that it actually was made up of seven distinct layers.¹⁰ Given this model, there would have to be a place where the opaque cap touched the Earth, and Rabba bar Bar Hanah in fact claimed to have touched this Earth-sky interface:

[A merchant said] come, I will show you where Earth and sky touch one another. I took up my [bread] basket and placed it in a window of heaven. When I finished my prayers I looked for the basket but did not find it. I said to the merchant: “Are there thieves here?” He replied to me: “It is the heavenly wheel revolving. Wait here until tomorrow and you will find it.”¹¹

Even allowing for a degree of talmudic fantasy, this fable was clearly built on the model that we outlined above.

The Path of the Sun

If the Earth was a flat disc covered by an opaque sky known as the *rakia*, the sages had to explain how the Sun moved into and out of view:

The wise men of Israel say that during the day the Sun travels under the *rakia*, and at night it travels above the *rakia*. And Gentile wise men say: during the day the Sun travels under the *rakia* and at night under

the Earth. Rabbi [Yehudah Hanasi] said: their view is more logical than ours for during the day springs are cold and at night they are warm.¹²

These two opposing views are shown in figure 2.1. Once again it is apparent that in the talmudic view, the sky must be completely opaque. As the Sun passes over the top of the sky at night, it is not in the slightest way visible.

The phenomena that Rabbi Yehudah Hanasi described, in which a body of water feels warmer at night (when compared with the surrounding cool night air) than it did during the day, is due to a property we now call specific heat or heat capacity.¹³ Because the heat capacity of water is about four times that of air, water takes longer to heat up but also longer to cool down than does the surrounding air; as a result, when compared to the cooler night air, the water feels comparatively warmer at night than it did during the day. This is also the reason that the weather in coastal areas is generally milder than areas more inland; the ocean traps the Sun's heat and slowly releases it, preventing large fluctuations in temperature. All this was not known to Rabbi Yehudah Hanasi, who came up with another explanation entirely.

This discussion about the path of the Sun at night had practical ramifications that eventually found their way into Jewish law. For example, when baking *matzot*—the unleavened cracker-like bread that is eaten at Passover—warm water must be avoided as it would speed up the process of leavening. The German Rabbi Jacob Moellin (1365–1427) ruled that water used to make *matzot* must be drawn immediately after sunset, because after this time the Sun warms the water as it passes beneath the Earth. This opinion was codified in the *Shulhan Arukh*, the Code of Jewish Law written by Joseph Caro in the sixteenth century.¹⁴

This talmudic passage demonstrates that the sages of the Talmud did not believe in what would later come to be called the Ptolemaic model of the solar system, in which the Earth was motionless at the center of the orbiting planets and stars. In their view, the Sun had an erratic orbit and one that was most

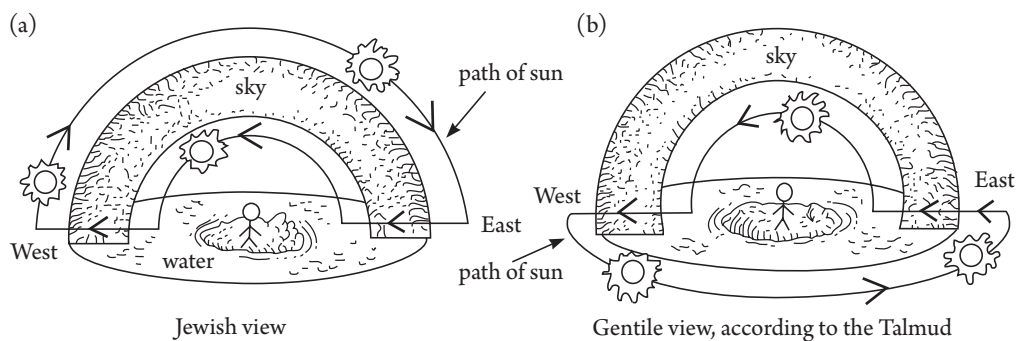


Figure 2.1 The daily movement of the sun. (a) The Jewish view (b) The Gentile view, reproduced with kind permission from Judah Landa, *Torah and Science*.

certainly not circular. Although to the naked eye, the stars and planets do seem to circle the Earth in an orbit that appears to be circular, exactly how the sages thought that they moved around the stationary Earth is not known. As a result, it would be an error to label the talmudic universe as Ptolemaic, for such a model is neither described by nor able to be reconstructed from talmudic texts.¹⁵

The Solar System

The solar system describes the group of planets (and asteroids) that orbit the star closest to the Earth called the Sun. With the exception of Saturn and Venus, the planets are not mentioned in the Hebrew Bible, although the stars—called *kohavim* in Hebrew—are mentioned almost forty times.¹⁶ Another term used to describe the heavens is *mazzalot*, but it appears only once in the Bible, and its meaning is unclear; some translate the word to mean the planets, while others translate it to mean the constellations or signs of the zodiac.¹⁷ It was not until the era of the *Mishnah* (c. 70–200 CE) that the planets are first definitively addressed in Jewish literature, but there is continued confusion about the meaning of the terms *kohavim* and *mazzalot*, which are used in phrases such as “the Sun, the Moon, the *kohavim* and the *mazzalot*” in multiple places in the Talmud.¹⁸ The earliest complete Jewish listing of the Sun, the Moon, and the five planets is found in *Bereshit Rabbah*, composed some time in the fourth or fifth century:¹⁹

There is a *mazzal* that finishes its orbit in twelve months like the Sun; there is a *mazzal* that finishes its orbit in twelve years like Jupiter (*Tsedek*), and there is a *mazzal* that finishes its way in thirty days, and this is the Moon, and there is a *mazzal* that finishes its way in thirty years, and this is Saturn (*Shabbetai*)—except for Mercury (*Kohav Hammah*), Venus (*Nogah*) and Mars (*Ma’adim*), which finish their orbits in four hundred and eighty years.²⁰

By the end of the talmudic period (c. 500 CE), the rabbis had a notion of the planets as distinct bodies, although some texts refer to them as *mazzalot*, and others use the term *kohavim*. The planets, together with the Sun, the Moon, and all the stars, were thought to exist in the *rakia*, the second of the seven layers that made up the heavens. For astrological purposes, it was important to get both the order and the orbits of the planets correct, because each planet was thought to rule over a particular hour of the day and a particular day of the week.

Perhaps the most well-known and coincidentally the most difficult to understand of the talmudic descriptions of the sky is the following statement:

“The Jewish sages say, the *galgal* is fixed and the *mazzalot* revolve, and the Gentile sages say the *galgal* revolves and the *mazzalot* are fixed.”²¹ Its meaning is unclear, and as the late Isadore Twersky pointed out, it “has a long history of interpretation, reflecting various moods: embarrassment, perplexity, satisfaction, with some attempts at harmonization or reinterpretation or restricting the significance of the report.”²² Many different interpretations have been offered. One is that the *galgal* refers to the Sun, and the *mazzalot* refer to the planets; in this understanding, the sages of the Talmud anticipated the Copernican heliocentric system. However, this explanation must be rejected because in the very next line of the discussion, the Talmud makes it clear that the *mazzalot* contain the constellations *Eglah* (Taurus) and *Akrav* (Scorpio).²³ It is therefore apparent that the *mazzalot* in this rabbinic passage are not to be identified with any of the planets. It is also clear that the system being described is not the Ptolemaic one in which the stars and planets revolve around the Earth, because the Earth is never referred to as *galgal*.²⁴ The most likely explanation of this passage is that the *galgal* refers to a sphere and that, according to the Gentile sages, the constellations are fixed within a revolving sphere. The Jewish sages believed the sky to be both solid and immovable; according to them, the constellations—which are clearly seen to revolve, do so independently of the fixed heavens beneath them.

The Length of the Solar Year and Its Religious Consequences

Although in the talmudic debate between the Jewish and Gentile sages, the *daily* orbit of the Sun was erratic, another talmudic sage, the astronomer Shmuel (Samuel), described an orbiting Sun whose *yearly* path was absolutely regular. In point of fact, according to Shmuel, the Sun orbits the Earth in exactly 365 days and six hours. This is the length of the year that was used in the Julian calendar, and it is likely that Shmuel, who lived at the end of the second century, had learned this from the Gentile scholars with whom he was in contact.²⁵ A year cannot, however, start six hours into the day, and the Julian calendar accounted for these six extra hours each year by adding them together once every four years into an extra day—a leap day. Shmuel’s length of the solar year (which is of course not the time for the Sun to orbit the Earth, but rather for the Earth to complete one revolution around the Sun) is actually longer than the correct period of orbit, which is 365 days, 5 hours, 48 minutes, and 45 seconds. However, Shmuel’s solar year was codified as the accepted length used by the Jewish calendar to calculate the date of some of its religious ceremonies. For example, once every twenty-eight years, Jews recite a blessing that commemorates the return of the Sun to the exact position that it occupied when